

Special Provision

Replace Section 660 with the following:

SECTION 660 SIGNALS AND LIGHTING

660-1.01 DESCRIPTION. Furnish and install, modify, remove, or salvage one or more traffic signal systems, flashing beacon systems, highway lighting systems, sign illumination systems, traffic count systems, electrical equipment on structures, falsework lighting, partial installations for future systems, or combinations thereof, as specified.

Where an existing system is to be modified, reuse the existing material in the revised system as shown on the Plans or specified in the Special Provisions, and salvage or dispose of all other materials.

When required by the Special Provisions, provide an on-site manufacturer's representative to:

1. Energize and adjust the electrical system.
2. Provide acceptable instruction for the operation and maintenance of the electrical system.

660-1.02 DEFINITIONS.

Use the definitions in NEMA TS 2-2003 V02.06, *Traffic Controller Assemblies with NTCIP Requirements*, Section 1, Definitions, along with the following:

1. Electrolier. The complete assembly of pole, mast arm, luminaire, ballast or driver, and light source.
2. Luminaire. The assembly which houses the light source and controls the light emitted from the light source. Luminaires consist of hood (including socket, lamp, and ballast or driver), reflector, and glass globe or refractor.
3. Lighting Standard. The pole and mast arm which supports the luminaire.
4. Vehicle. Any motor vehicle licensed for highway use by the State of Alaska.

660-2.01 MATERIALS. Use materials that conform to Section 740, the Materials Certification List, the Plans, Specifications, and the following:

Concrete	Section 501 (Class A)
Grout	Subsection 701-2.03
Reinforcing Steel	Section 503
Paint	Subsection 708-2.01
Steel Pipe Pile	Section 715
Anchor Plate	ASTM A709
Galvanizing	Subsection 716-2.07
Anchor Bolts	Section 740-2.02
Precast Concrete Products	Subsection 550-2.03

1. Equipment List(s) and Drawings. Within 30 days after the Contract award, submit an electronic portfolio of equipment and materials proposed for installation to the Department for review and approval. Include a table of contents in the portfolio(s) that includes each item's intended use(s) and the following:
 - a. Materials on the Qualified Products List: The Qualified Products List does not apply to the 660 items. Provide catalog cuts of materials to the Engineer for review and approval.

- b. Materials Not on the Qualified Products List: Catalog cuts that include the manufacturer's name, type of product, size, model number, conformance specifications, and other data as may be required, including manufacturer's maintenance and operations manuals, or sample articles.
 - c. Pole Package. A complete set of design, fabrication, and installation proposals for each signal and lighting pole. Include stamped engineering calculations, mill certifications, shop drawings, welding plans, equipment lists, and pole installation plans.
 - d. Materials Not Requiring Certification: Only submit those materials for review and approval if they are included on the Materials Certification List (MCL).
2. As-Built Plans. Prepare 3 complete sets of red lined as-built plans and keep them current with the construction. Detail in the as-built plans all construction changes made to the Plans. Include the following information on the appropriate sheets:
- a. Location and depth of conduit runs,
 - b. Station and offset of all junction boxes,
 - c. Heights of signal faces and overhead signs, and
 - d. A list of equipment, including manufacturer, brand, and model number installed in each controller cabinet.

Furnish copies of the as-built plans at least twice a month during construction so that they may be reviewed for accuracy and completeness. Furnish any additional information required to clarify the as-built plans and correct all discrepancies. The Department will not make progress payments for the signal and illumination work completed until reviewing accurate as-built plans reflecting the construction progress. Correct any deficiencies before payment.

Before final inspection of the work, submit 3 complete sets of as-built plans to the Engineer. You may substitute 2 colored copies of the as-built plans in lieu of keeping the 3 separate original copies. If you elect to do this, a sample of the method of copying must be approved before starting any work on the signal and lighting items.

When project has an SOA signal, use 1st paragraph below. When project has an MOA signal, use 2nd paragraph below. Delete unused paragraph.

Place 1 copy of the controller cabinet diagram, detector assignment sheet and the intersection and phase diagram as reviewed by the Engineer inside of each controller cabinet.

Place 1 copy of the controller cabinet diagram, detector assignment sheet and the intersection and phase diagram as reviewed by the Engineer in clear plastic envelopes and attach to the inside of each controller cabinet. In addition, submit two complete sets of all electrical related plan sheets. The engineer will deliver one copy of each to MOA Signal Electronics and MOA Street Light Maintenance.

3. Warranties, Guarantees, and Instruction Sheets. Deliver to the Engineer all manufacturers' warranties, guaranties, instruction sheets, and parts furnished with materials used in the work before the Department assumes maintenance responsibilities.

CONSTRUCTION REQUIREMENTS

660-3.01 GENERAL.

1. Scheduling of Work. Complete each new traffic signal system, highway lighting system, and sign illumination system and ensure it is ready for operation before opening to traffic the corresponding section of new alignment. Contact the regional DOT&PF Traffic Signal Technician 24 hours in advance of work on a signal or lighting system. Contact shall be made through the Engineer.

When project is in MOA service area, keep below paragraph sentence and delete the last two sentence above, if not delete below two sentence and keep the two above.

Contact the MOA Signal Electronics Shop and MOA Street Light Maintenance 48 hours in advance of work on a signal and/or lighting systems. During final inspection, contractor shall provide traffic control for MOA signals to perform inspection of signal equipment as many times as necessary until inspections are passed. Contact and scheduling shall be made through the Engineer.

After staking pole foundations, verify there will be no overhead or underground utility conflicts with foundations, poles, mast arms, or conduits. Locate and protect existing underground and overhead utilities. The location of cables, conduits, junction boxes, foundations and poles that are shown on the Plan sheets are approximate and it is the Contractor's responsibility to verify the actual location when working in the area. See Subsection 105-1.06.

Existing signing and traffic markings shall not be allowed to conflict with new signal modifications. New signing and traffic marking modifications shall not conflict with existing signals and shall be kept current with signal modifications.

Conduct work with the existing traffic signal systems remaining in operation unless authorized otherwise by the Engineer.

Incidental materials and other items that are not shown on the Plans, assembly drawings, or specified herein, that are necessary to complete the system, must be furnished and installed as though such materials and other items were shown on the Plans, assembly drawings, or specified herein.

Protect metallic materials against corrosion. Hot-dip galvanize ferrous metals such as bolts, braces, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion resistant steel, according to ASTM A 123 or A 153, except where other equivalent protection treatment is specifically approved in writing by the Engineer.

Asphalt patches placed in existing asphalt for loops and conduit crossings must be placed prior to the end of shift in which the loops and crossings are placed. Asphalt patches will match the thickness of the existing asphalt to a maximum of 3 inches thick. Where the existing asphalt is thicker than 3 inches, use compacted crushed aggregate base course to make up the difference.

Do not place traffic signal systems in operation until the street lighting is energized at controlled intersections.

Install detector loops and underground conduit before applying new pavement.

Do not pull conductors or cables into conduit until the junction boxes are set to grade, crushed rock sumps are installed, grout is placed around the conduit, and metallic conduit is bonded.

In vehicular undercrossings, place soffit lights in operation as soon as practicable after removing falsework from the structure. Place lighting for pedestrian structures in operation before opening the structure to pedestrian traffic.

2. Safety Precautions. Before starting work on existing street lighting circuits, de-energize the system by opening disconnect switches, and/or opening bypass switch plugs, and tagging each opened device as detailed in Part 4, Section 44, Article 440 of NESC. Where said circuits are under the control of an electric utility, obtain written assurance daily from the utility that the circuit being worked on has been de-energized.

Prior to beginning work, perform lockout/tagout procedures and establish an electrically-safe work condition per NFPA 70E Article 120. Post suitable signs at load centers when any of the circuits from that load center are being worked on.

Existing circuits listed on the wiring diagrams and Plan sheets were obtained from as-built information and must be verified before work involving those circuits.

3. Excavating and Backfilling. Complete excavation and backfill required to install the signal and lighting components embedded in the roadway as shown in the Plans, including foundations, conduits, junction boxes, and loop detectors before final lift paving. Provide traffic control to complete this work according

to the requirements of Section 643. Place excavated materials where it will not interfere with surface drainage.

Support and protect conduits and utilities scheduled to remain in service when encountering them during excavation.

Excavate trenches wide enough to install the number of conduits specified and to compact the bedding and backfill materials according to these specifications.

To install conduits, excavate trenches deep enough to allow for 6 inches of bedding material, the depth of the largest conduit, and the minimum burial depth specified between the top of the conduit and finished grade of the ground above the conduit. Keep the longitudinal profile of trench bottoms free of irregularities that would prevent the assembled conduit run from continuously contacting the top of the bedding material.

When conditions allow HDPE conduit to be installed by a plowed technique, restoring the area disturbed from the process shall be accomplished according to Subsection 204-3.01. Density testing may be waived and compactive effort substituted at the discretion of the Engineer. This work is subsidiary to conduit installation. Use Selected Material, Type A for backfill.

Dispose of, according to Subsection 203-3.01, excavated materials that remain after completing backfill work and excavated material not meeting the requirements of Selected Material, Type C, as defined in Subsection 703-2.07. Disposal of this material is subsidiary to the 660 Pay Items.

Dewater foundation and conduit excavations immediately before and during embedding and backfilling operations. Backfill excavations with materials that meet the following requirements:

- a. Backfill foundations with material that meets the requirements of Selected Material, Type A that passes through a 3 inch sieve.
- b. Within the limits of the typical section, embed conduits and backfill trenches using material that meets the requirements of the lift where it is located, reusing excavated materials if it meets the requirements of the applicable lift.
- c. In other locations, embed conduits and backfill trenches using material that meets the requirements of Selected Material, Type C, reusing excavated materials if it meets this requirement.
- d. Import, when ordered, embedment and backfill materials that satisfy the preceding materials requirements.

Embed conduit(s) between two 6 inch lifts of material cleaned free of rocks exceeding a 1 inch maximum dimension. Grade and compact the first lift to provide a surface that continuously contacts the assembled conduit run.

Within 6 feet of paved surfaces and around foundations, backfill in uniform layers no more than 6 inches deep and compact each layer according to Subsection 203-3.04. In other locations, compaction may be as approved by the Engineer.

4. Welding. Complete welding according to Subsection 504-3.01.7. Welding and approved shop drawings.

Submit shop drawings of the proposed work with the welding plans for approval. The shop drawings shall include material specifications, component dimensions, the types of welds that will be made, and the proposed type and extent of weld inspection.

Repair the holes that were used to mount equipment, in reused poles and mast arms by welding in disks flush with the adjoining surface. For the disk material, use steel that matches the ASTM designation, grade, and thickness of the steel used to fabricate each pole. Cut disks that match the dimensions of the hole being repaired from pieces of steel plate bent to match the pole's radius at the hole. Grind the welds smooth and flush with the adjoining pole and disk surfaces. Repair the damaged finish according to Subsection 660-3.01.8.

5. Removing and Replacing Improvements. The Contractor shall complete the following work at the Contractor's expense.

- a. Remove improvements that block completion of the work detailed in the Plans as specified herein.

- b. Reconstruct with new materials the non-reusable improvements the Contractor removed to complete the work.
- c. Replace with new materials the reusable items damaged by the Contractor, that are specified for reuse.
- d. Reconstruct with new materials improvements damaged or removed by the Contractor not conflicting with the work and not scheduled for removal.

Nonreusable improvements consist of cast in place items, including asphalt concrete pavement, sidewalks, curb and gutter, lawns, and traffic markings. Reusable improvements include the items that were made before installation. Crushed aggregate base material may not be used as backfill in the base course if excavation depth exceeds the thickness of the base course.

Complete reconstruction work, including materials, according to the applicable sections of the Alaska SSHC, and leave the work in a satisfactory and serviceable condition. In completing the reconstruction work, match the alignments, widths, thicknesses, shapes, sizes, cross sections, and finishes of the existing improvements.

If removing a portion of sidewalk or curb and gutter, remove an entire segment between the weakened plane contraction joints or between an expansion joint and a weakened plane contraction joint.

Before removing a segment of Portland or asphalt cement concrete material, cut completely through the material with a saw along the outline of the area to be removed. Make cuts neat and true and prevent shatter outside the area removed.

To replace lawns, leave the top of the backfilled excavation low enough to install 4 inches of compacted topsoil. Match the top of the topsoil with the bottom of the vegetative mat. Apply seed and keep the seeded areas watered according to Section 618.

Remove, keep alive, and replant trees, shrubs, and plants according to Section 621. Replace the trees, shrubs, and plants that do not survive with plants of like size and type.

6. Salvaging and Reusing Electrical Equipment. When the Plans include existing electrical equipment scheduled for removal or relocation, remove, and store the equipment listed in the following paragraph without damaging it. Deliver removed equipment not scheduled for reuse to the local District Maintenance Station or place specified in the Plans or Special Provisions. Notify the district superintendent or person specified by telephone one week before planned delivery date.

Salvage the controller assemblies, signal heads, mounting brackets, luminaires, lighting standards, signal posts and poles, mast arms, optical detectors, load centers, light emitting diode optical units, and the lids of junction boxes scheduled for removal and other materials scheduled for relocation. The Contractor shall replace at the Contractor's expense salvaged equipment damaged or destroyed before or during delivery or reinstallation.

Controller assemblies and load centers include the cabinet and equipment contained in the cabinet before Contract award.

Remove from the highway right-of-way materials associated with the equipment removed or relocated and not scheduled for reuse, including conduits, junction boxes, conductors, and foundations. Raze the tops of foundations abandoned in place according to Subsection 660-3.02. Fill the holes left by removing junction boxes and foundations with Selected Material, Type A and compact as directed.

With approval, after removing conductors, buried conduits that do not interfere with other construction may be abandoned in place. The Department may require a credit for this waiver. Remove the ends of abandoned conduits from the junction boxes that will remain in service.

Within 15 days of the Notice to Proceed, complete an inventory of the materials that will be salvaged in the presence of the Engineer. Note the location and condition of the materials. When material specified for reuse is found in an unserviceable condition, the Engineer will determine whether to repair it or replace it with new material that will be paid for as extra work under Subsection 109-1.05. Retain a copy of the inventory and give the original documents to the Engineer.

When the Plans specify reinstalling existing equipment at new locations and installing State furnished equipment, complete the following work at the Contractor's expense.

- a. For poles, install new foundations, furnishing the new nuts, bolts, washers, and conduits needed to complete the installations.
- b. For lighting poles, install new illumination tap wires and fused disconnect kits.
- c. For luminaires, clean the luminaires inside and out and install new lamps of the same wattage.
- d. For signal heads, furnish and install the mounting brackets needed to complete the relocation, and clean the signal heads inside and out.
- e. For poles and undisturbed poles from which the Plans specify removing equipment, repair the holes that were made to mount equipment according to Subsection 660-3.01.4 Welding and repair the finishes according to Subsection 660-3.01.8 Repairing Damaged Finishes.

Repair holes left in the shafts of existing metal poles, due to removal of equipment or mast arms, by welding in a suitable disk, grinding smooth, and painting as provided for repair of damaged coatings in AASHTO M 36 or using a knockout seal.

When ordered, the Engineer will pay for repairing existing damaged finishes on existing equipment according to Subsection 660-3.01.8 as extra work.

If deciding to use new equipment rather than reusing the equipment specified, notify the Engineer of the change and include a submittal according to Subsection 660-2.01.1.

Deliver the salvaged materials undamaged to the local DOT & PF Maintenance and Operations Yard.

Contact the local state Electrician one week before planned delivery.

When project is in MOA service area keep below paragraph and delete the two sentences above, if not delete below paragraph and keep those above.

Salvaged traffic signal system items shall be delivered to the MOA Traffic Signal warehouse at 5923 Rowan Street. Signal poles, mast arms and electroliers shall be delivered to the MOA Traffic Signal Pole yard at 3rd & Orca Street. Contact Municipality of Anchorage Signal Electronics Shop Foreman (telephone 907-343-8355) to arrange delivery of signal poles and mast arms. Contact Street Light Administrator for more information on salvage and delivery of electroliers. Allow MOA maintenance personnel to select equipment and pole items they would like to salvage. The remaining items become the property of the Contractor.

7. Field Tests. Electrical circuits must pass the following tests before the Engineer will accept the work for payment. Perform these tests in the presence of the Engineer and document the results of each test on a per circuit basis. Retain a copy of test results and give the original documents to the Engineer. Furnish equipment needed to perform these tests.

Replace or repair at the Contractor's expense, and in an approved manner, faulty materials and work revealed by these tests. After making repairs, repeat tests on the repaired circuit and continue this process until circuits have passed required tests. The Department reserves the right to have the Contractor retest circuits, and to use the retest results to accept or reject individual circuits.

- a. Grounds. Before completing the circuitry and functional tests, physically examine conduits ends, junction box lids, load centers, and the foundations for signal posts and poles, lighting poles, and controller cabinets to ensure the grounding system required by Subsections 660-3.06 and 661-3.01 has been installed and splices and connections are mechanically firm.
- b. Continuity. When loop detector work is included, test each loop detector circuit for continuity at the roadside junction box before splicing the loop detector to the lead-in cable. Each loop detector must have a resistance less than 0.5 ohms.

After splicing the loop detectors to the lead-in cables, test each pair at the controller or detector

AK DOT&PF Hwy CR 1901422 cabinet. Each pair must have a value less than 5 ohms for single pair lead-in cables and 10 ohms for dual pair lead-in cables. 6 of 29

1NAME Replace "1NAME" w/ Project Name

PROJECT NO.: Insert Project Number

VI

ALASKA 2020

for multipair lead-in cables. The continuity test ohm reading at the cabinet must be greater than the ohm reading measured for the loop detector at the junction box.

- c. Insulation Resistance (megohm) Test. Complete this test to verify the integrity of each conductor's insulation after pulling the conductors and cables into position and before terminating the conductors. At 500 VDC, each conductor's insulation shall measure a minimum resistance of 100 megohms or the minimum specified by the manufacturer. With single conductors, complete the test between each conductor and ground. In each multiconductor cable, complete the test between conductors and between each conductor and ground.

When loop detector work is included, after splicing the loops to the shielded pairs in the lead-in cables, measure each pair in the lead-in cables at the controller or detector cabinet between one conductor and the cabinet ground rod.

- d. Inductance Test. When loop detector work is included, measure each detector loop and lead-in cable system at the controller or detector cabinet. The inductance must be in the range of 50 to 500 microhenries.
- e. Circuit. Energize every signal indication circuit with lamps installed before installing the load switches.
- f. Functional. Perform the following tests on each signal and lighting system after the component circuits have satisfactorily passed the tests for continuity, grounding, insulation integrity, and circuitry.

- (1) For each new traffic signal system, complete at least 24 hours of flashing operation, followed by not less than 5 days of continuous, satisfactory operation. The Engineer may decide to omit the flashing portion of the test for modified signal systems and for new signals that replaced existing signals that remained in operation during the construction phase.

If the Engineer omits flashing operation and the system performs unsatisfactorily, correct the condition and repeat the test until the system runs for five days with continuous, satisfactory operation.

Begin the signal functional tests between 9:00 a.m. and 2:00 p.m. on any day, except a Saturday, Sunday, a legal holiday, or the day before the legal holiday.

Before each system activation, aim signal faces according to Subsection 660-3.08 and ensure equipment specified in the Plans is installed and operable, including: pedestrian signals and push buttons; signal backplates and visors; vehicle detectors; highway lighting; and regulatory, warning, and guide signs.

- (2) Perform the functional test for each highway lighting system and sign illumination system until the systems burn continuously 5 days without the photocell, followed by a 5 day operational test using the photocell.
- (3) Perform the functional test for each flashing beacon system for not less than 5 days of continuous, satisfactory operation.
- (4) Perform a continuous 5 day burning test on each pedestrian overpass and underpass lighting system before final acceptance.

A shut down of the electrical system due to a power interruption does not constitute discontinuity of the functional test if the system functions normally when power is returned.

8. Repairing Damaged Finishes. Examine new, reused, and State furnished equipment for damage to its finish before putting the equipment into service. Repair the damaged finishes found according to the following:

- a. Galvanized. Repair damaged areas more than 12 inches away from welds and slip fit areas, by applying minimum 7.8 mils of zinc-based alloy applied according to ASTM A780.

If the damaged areas are within 12 inches of welds and slip fit areas, make the repair by applying a minimum 7.8 mils of zinc rich paint applied according to ASTM A780.

b. Painted. Repair damage to painted finishes according to the following:

- (1) Wash the equipment with a stiff bristle brush using a solution containing two tablespoons of heavy-duty detergent powder per gallon of water. After rinsing, wire brush surfaces to remove poorly bonded paint, rust, scale, corrosion, grease, or dirt. Remove dust or residue remaining after wire brushing before priming.
- (2) Factory or shop cleaning methods may be used for metals if equal to the methods specified herein.
- (3) Immediately after cleaning, coat bare metal with pretreatment, vinyl wash primer, followed by 2 prime coats of zinc chromate primer for metal.
- (4) Give signal equipment, excluding standards, a spot finishing coat on newly primed areas, followed by 1 finishing coat over the entire surface.
- (5) Give nongalvanized standards 2 spot finish coats on newly primed areas.

Paint coats may be applied either by hand brushing or by approved spraying machines. Perform the work in a neat and workmanlike manner. The Engineer reserves the right to require the use of brushes for the application of paint, should the work done by the paint spraying machine prove unacceptable.

9. Regulation and Code. Complete work according to the standards of the NEC, the NESC, and local safety codes as adopted and amended by the Authority Having Jurisdiction.
10. Failed Equipment and Workmanship. For the term of the Contract, from initial equipment installation through final acceptance, Subsection 105-1.16, when directed, promptly replace failed equipment, equipment components and repair failed workmanship.

660-3.02 FOUNDATIONS. Use foundation type shown in Plans.

1. Cast-in-Place Foundations. Cast-in-place foundations for posts and poles in drilled holes. Use either precast or cast-in-place foundations for cabinets. Locate the tops of traffic signal post and pole foundations flush with the adjacent finished walkway, shoulder, or surrounding ground.
 - a. Form the entire controller foundation and the top 12 inches of pole or post foundations and give the top a smooth steel trowel finish.
 - b. Place conduits in the center of the pole-post foundations with clearance allowed for bushings. If subsurface conditions prevent completing a drilled hole, and when approved, use a corrugated metal pipe (CMP) form as a substitute for the drilled hole. Consider the savings in concrete to offset the cost of supplying and installing the CMP form. No additional payment will be made for the CMP formed foundation.
 - c. When a CMP is used, over-excavate the area around the form enough to allow for proper compaction around the form. Backfill and compact according to Section 205, and Subsections 203-3.04 and 660-3.01. Do not use water for drilling operations or for any other purpose where it may enter the hole.
 - d. Use controller cabinet anchor bolts as recommended by cabinet manufacturer and set with a template.
 - e. Place Class A concrete meeting Section 501. Place reinforcing steel meeting Section 503. If required, use corrugated steel pipe that is at least 14 gauge, meeting Subsection 707-2.01.

- f. Drill holes or use forms that are vertical and true to the locations shown in the Plans. Before placing the form or reinforcing steel cage, remove loose material to ensure the foundation rests on firm, undisturbed ground.
- g. If a reinforcing steel cage is required, place and secure it symmetrically about the vertical axis and securely block it to clear the sides of the foundation. Use a template to securely support all anchor bolt assemblies and conduit ends so they do not move during concrete placement.
- h. Do not permit surface water to enter the hole. Before placing concrete, remove all water that may have infiltrated in the hole. Thoroughly moisten both the forms and the ground before placing concrete. Pour each foundation in one continuous pour.
- i. Do not erect or place posts, poles, and pedestals on the foundation until 7 days after placing the concrete. Plumb the assembly by adjusting the nuts on the anchor bolts before attaching the skirt.
- j. Replace, with no additional compensation, all finished foundations with anchor bolts that do not match the base plate of the pole or are out of plumb. Do not modify the anchor bolts or base plate to get the base plate set on the leveling nuts. Protect foundation anchor rods from damage before installing controller cabinets. The Engineer must approve the method used for protection. This work does not relieve the Contractor of responsibility specified under Subsection 107-1.15.
- k. Furnish anchor rods that conform to ASTM F1554, the grade and supplementary Charpy V-Notch requirements listed in the Plans. Furnish each anchor bolt with three nuts and two washers.

Install the bottoms of the bottom leveling nuts in a level plane within 1 inch of the top of foundations. Adjust nuts until their tops form a level plane. Install one washer on top of leveling nuts and, after setting the pole on these washers, install one washer under top nuts.

Bring leveling nuts (bottom nuts) to full bearing on the bottom of the base plate.

Generously lubricate the bearing surface and internal threads of top nuts with beeswax. Tighten top nuts to a "snug" condition. Use a click type torque wrench to apply 600 foot-pounds of torque to the "snug" top nuts.
- l. Attach a bare, copper wire as a grounding electrode conductor to the spiral bar in the reinforcing steel cage. Use an irreversible compression type connector to make the attachment. Protect the attachment during concrete placement. In foundations that lack reinforcing steel cages, install 21 feet of coiled #4 AWG, bare, copper wire as the grounding electrode. Route the conductor to protrude near the top, center of the foundations. Slide a minimum 6 inch long, Schedule 80 polyvinyl chloride (PVC) or high-density polyethylene (HDPE), protective sleeve over the conductor. Allow 1 inch of the sleeve and 24 inches of conductor to protrude from the foundations.

2. Pile Foundations.

- a. Install pipe piles according to Section 505.
- b. Install pipe piles open-ended and to a minimum depth of 15 feet (less top projection).
- c. Use CJP groove welds for all circumferential welds.
- d. Inspect 100% of CJP welds using UT or RT.
- e. Backfill and compact the work hole around upper portion of each pile in 8-inch lifts with a soil-cement mixture.
- f. Certify steel pipe piles by matching the stencils on the pipe piles (by 300 foot lots) to the physical and chemical tests for the applicable lot.
- g. Use no more than one splice per foundation. Locate the splice at least 10 feet from the top of the pile.

3. All Foundations.

- a. Install frangible couplings according to the manufacturers written installation instructions. Use shims furnished by the coupling manufacturer.
- b. Provide new foundations and anchor bolts of the proper type and size for standards that are to be relocated. Install the anchor bolts on a bolt circle that matches the base plate.
- c. Install a raised Type III junction box on the door side of the controller cabinet and butt it against the cabinet's foundation unless installing a one-piece cabinet/junction box foundation. Extend the top of the controller cabinet foundation 18 inches above the junction box and provide it with a 1-inch diameter drain. The drain connected to the cabinet interior must empty to the rear and above the ground. Place all conduits in the door side half of the foundation to provide adequate terminal block clearance.
- d. Existing foundations may be abandoned-in-place unless otherwise stated in the Plans. However, remove the tops of the foundations, reinforcing steel, anchor bolts, and conduits to at least 12 inches below the roadway subgrade, sidewalk, or unimproved ground. Backfill the resulting hole with Selected Material, Type A and compact material as directed by the Engineer.

660-3.03 CONDUIT. Electrical conductors shall be installed in conduit, except for overhead wiring, wiring inside poles, and when otherwise specified. Use rigid metal conduits (RMC) and fittings for raceways, including bored casings, except when the Plans specify using polyethylene conduits. Install conduits of the sizes specified along the routes detailed on the Plans. When routing is not shown, route conduits as directed by the Engineer.

1. Install conduits at least 30 inches below the finished grade of the ground above the conduit, except conduits that will be sealed under a minimum 4 inch thick Portland cement concrete sidewalk may be installed a minimum of 18 inches below the top back of curb or surface above the conduit, whichever is lower.
2. Install conduits that cross unpaved areas and paved roadways that will be overlaid in excavated trenches. Excavate, bed conduits, and backfill trenches according to Subsection 660-3.01.3, Excavating and Backfilling.
3. Install conduit(s) under paved roadways and approaches that will not be overlaid by boring or drilling methods. Jacking conduits into position is allowed. However, if subsurface conditions prevent the successful completion of the work, install the conduit(s) by boring or drilling methods without additional compensation.
4. If encountering obstructions during jacking or drilling operations obtain approval and cut small holes in the pavement to clear the obstruction. Locate the bottom inside face of the bore pit no closer than the catch point of a 1 1/4 to 1 slope (a horizontal to vertical ratio) from the edge of pavement. Do not leave these pits unattended until installing an approved means of protection.
5. Sweep both rigid metal and polyethylene conduits through the open bottom of junction boxes by installing 90 degree rigid metal elbows on the ends of conduit runs. To each elbow, install a nipple that terminates 5 to 12 inches above the bottom edge of each junction box. At junction boxes where polyethylene conduits runs are to enter the junction box, install a 5 foot section of RMC on the horizontal end of the RMC sweeps.
6. When loop detector work is included, install the tails of loop detectors without elbows through the walls of junction boxes at elevations that ensure the loops drain into the box. Extend the ends a minimum of 2 inches beyond the inside wall of the box.
7. Drill a 3/8 inch drain hole in the bottom of the lower straight section of elbows and in the bottom of conduits at the low points of conduit runs. Smooth the edges of the drilled holes on the inside of elbows to prevent scraping the conductors. Cover the holes with a wrap of approved filter cloth secured with 2 self-clinching nylon cable ties.

8. Keep conduits clean. Install grounding bushings and approved plastic insert type plugs on the ends of conduit runs before backfilling around the conduit ends. Tapered or universal fit plugs are acceptable for temporary usage. Any permanent plug or cap shall be an approved watertight cap.
9. At the low points of conduit runs, install sumps containing a minimum 2 cubic feet of coarse concrete aggregate material that conforms to Subsection 703-2.02. Compact the aggregate sumps as directed to prevent settlement of the trench backfill.
10. Install conduits that must cross existing facilities such as storm drainpipes, duct systems, and other underground utilities at the minimum depths specified, going under the facilities if necessary. Install additional drains and aggregate sumps at the low spots, if any.
11. Position conduits in trenches, junction boxes, and foundations to provide clearances of at least 21/2 inches around 2 inch conduits and at least 2 inches around conduits larger than 2 inches.
12. Fabricate rigid metal conduits less than 10 feet long from standard lengths of conduit. Cut conduits squarely to ensure the threading die starts squarely on the conduit. Cut the same number of threads as found on the factory threaded ends. Ream the inside of conduit ends cut in the shop or field to remove burrs and sharp edges. Do not use slip joints or pieces of running thread pipe.
13. Coat drilled holes, shop and field cut threads, and the areas with damaged zinc coating with zinc rich paint.
14. When standard couplings cannot be used to join conduit components, use approved threaded unions.
15. Bury a continuous strip of 4 mils thick, 6 inch wide polyethylene marker tape above underground conduit runs. Install the tape 9 inches (\pm 3 inches) below finished grade, using two strips side by side to mark road crossings. Furnish tapes with a black legend on a red background.
16. When the Plans specify using polyethylene conduit, install RMC in structures and foundations, between type 2 and 3 load centers and the nearest junction box, and on the surfaces of poles and other structures.
17. In foundations, install 90 degree elbows and conduits of the size and quantity shown on the Plans. Extend the conduits a maximum of 2 inches above the top of the foundations for posts and poles with breakaway bases and 4 inches above the top of foundations for fixed base structures.
18. Seal conduits leading to electrical equipment mounted on soffits, walls, and other locations below the grade of the serving junction box with an approved duct sealing compound.
19. Install expansion fittings in conduits that cross expansion joints.
20. Install a polypropylene pull rope with a minimum 200 pound tensile strength in future use or spare conduits and reinstall the plugs. Double back pull rope, at least two feet, into both ends of each conduit. Tapered or universal fit plugs are acceptable for temporary usage. Any permanent plug or cap shall be an approved watertight cap.
21. Install a pull tape with a minimum 200 pound tensile strength in all traffic signal conduits entering signal poles, signal junction boxes, and signal controller cabinet foundations. Double back pull tape, at least two feet, into both ends of each conduit.
22. The Contractor may install conduits larger than the sizes specified. If used, it must be for the entire length of the run. Reducing couplings or bushings are not allowed. Complete work associated with installing conduits larger than specified without extra compensation.
23. Clean existing conduits that will remain in service using a heavy-duty air compressor that delivers at least 125 cubic feet of air per minute at a pressure of 110 pounds per square inch. Clean the conduits before pulling in new cables and after removing cables to be removed or replaced as follows:
 - a. When the conduits contain cables that will remain in service, leave the cables in place during the cleaning, and
 - b. Ream empty conduits with a mandrel or cylindrical wire brush before blowing them out with compressed air.

24. When modifying existing conduit runs, complete the work as required for new installations using the same sizes and types of conduit. When extending existing conduits, add no more than a 90 degree horizontal bend to the extension.
25. When installing a junction box in a continuous run of existing conduit, remove a length of conduit in each conduit run and complete the work of installing the conduits, elbows, and nipples as required for a new installation.
26. When adjusting existing junction boxes to a new grade, remove cables and replace the nipples as required to provide the clearances specified for new installations.
27. Remove the ends of abandoned conduits from junction boxes that will remain in service.
28. When Plans call for connecting polyethylene conduit to RMC use a UL listed DuraLine Shur Lock type coupler or approved equivalent rated for direct bury application. The coupler must be rated for same wall thickness as the adjoining conduits. Thread the ends of the RMC with the same number of threads as found on the factory threaded ends of RMC. Ream the inside of conduit ends cut in the shop or field to remove burrs and sharp edges.

660-3.04 JUNCTION BOXES. Install precast reinforced concrete junction boxes of the types specified. For junction boxes that contain traffic signal conductors, furnish cast iron lids with the word TRAFFIC inscribed into them. For junction boxes that contain lighting conductors exclusively, furnish cast iron lids with the word LIGHTING inscribed into them.

Junction Box Location

When shown, install junction boxes at the station and offset locations specified. When lateral locations are not specified, install junction boxes 8 feet from the face of curb or edge of pavement. If the 8 feet offset falls:

1. In a pedestrian facility separated less than 7 feet from the roadway face of curb or edge of pavement, increase the offset and install the junction boxes on the backside of the facility. When lacking the right of way to install junction boxes outside the pathway, install at locations as directed, avoiding curb ramps, curb ramp landings, and the middle of walkways.
2. In a pedestrian facility separated at least 7 feet from the roadway face of curb or edge of pavement, reduce the offset and install the junction box next to the facility.
3. Outside the right of way, install the boxes just inside the right of way line.
4. In a raised median, install junction boxes near the center of the median.
5. In a ditch bottom or area that collects drainage, install the junction boxes at locations as directed.
6. Behind guardrails that shield slopes steeper than 3:1 (a horizontal to vertical ratio), install junction boxes between posts and at least 5 feet back from the face of rail.
7. On top of underground utilities or storm drains, install the junction boxes at locations as directed.

Longitudinally, install junction boxes adjacent to the loop detectors or pole they serve, except avoid installing Type 1A junction boxes in driveways and in locations subject to use by heavy trucks. When shown near the ends of medians, install junction boxes at least 10 feet from the median end. When the offsets for electroliers and flashing beacon posts place them near the junction boxes that serve them, install the junction boxes on the side of the electroliers and posts downstream of traffic flow. When installing copper signal interconnect cable use minimum size Type II junction boxes.

Four (4) Limitations

Limit the distance between adjacent junction boxes to the following dimensions:

1. 300 feet for conduits that exclusively contain two loop lead-in cables.
2. 300 feet for conduits that contain a single cable other than signal interconnect.

3. 190 feet for conduits that contain more than one cable.

If the preceding limitations require installing additional junction boxes not shown on the Plans, the Engineer will pay for them as extra work; otherwise, installing additional junction boxes will be at the Contractor's expense.

After grading the roadside, vertically adjust those junction boxes that do not conform to the following criteria. In unpaved areas that will not be seeded, in areas adjacent to pedestrian facilities, and in paved medians, install the tops of junction boxes 1 inch below finished grade. In seeded areas, adjust tops of junction boxes to be flush with final grade.

Bond junction box lids to an equipment grounding conductor according to Subsection 660-3.06. Attach the jumpers to the lids with brass or stainless-steel hardware.

Install a porous backfill material under each junction box. Porous backfill material shall conform to Subsection 703-2.10, Gradation B. Dimensions for porous backfill material include an 18" depth and a length and width equal to those of the junction box it drains. Compact the porous backfill material as directed to prevent junction box settlement.

In every new and reused junction box, install an electronic marker. Conform markers to the American Public Works Association Standards including but not limited to:

1. Color - red
2. Material - high-density polyethylene
3. Shape - round (ball like)
4. Size - 4 to 5 inches in diameter
5. Configuration - encapsulating an antenna tuned to the appropriate frequency for locating power
6. Responsive range - up to 5 feet away from the locator device
7. Environmental conditions - including extremes in temperature at the installation site
8. Contain no internal power source

Acceptable marker manufacturers include:

1. 3M, Dynatel EMS ball marker model no. 1402-XR
2. Tempo (a Tectron Company), Omni Marker
3. Substituted, equivalent approved equal device

660-3.05 WIRING. Install power conductors serving the cabinet sized such that their ampacity rating is greater than the cabinet total connected load after applicable diversity factors have been applied. Make wiring neat in cabinets by cabling wires together with self-clinching nylon ties. Terminate all spare conductors on terminal blocks. Attach all conductors, including spares, to terminal blocks with "spade" type terminal lugs. Furnish additional terminal blocks if enough locations are unavailable in existing terminal blocks. Install signal cabling continuously without splices from the controller cabinet to the termination lugs in the signal housing.

1. Do not pull conductors into conduits until the following conditions are met:
 - a. The prescribed clearances around conduit ends are provided,
 - b. Crushed rock sumps are installed under junction boxes,
 - c. Conduit ends protrude above the bottom of junction boxes within the prescribed range,
 - d. New conduits are free of material that became lodged in them during the completion of the work,
 - e. Reused conduits are cleaned according to Subsection 660-3.03,
 - f. Junction boxes are set to grade, and
 - g. Grounding bushings are installed on the ends of metallic conduits.

2. Pull conductors by hand or by approved commercially built cable-pulling equipment that is specially designed for that purpose. Do not pull cable by any other means. Equip the cable pulling device with a force limiting circuit and force gauge.
3. Use wire-pulling lubricant when placing the cables and conductors in conduit. Do not allow the tension of the wire or cable to exceed the manufacturer's recommend allowable tension for the conductor or cable.
4. When adding new conductors to a conduit with existing conductors, remove all conductors and clean the conduit with a mandrel or brush. Pull both old and new conductors through as a unit. In a new installation, pull all conductors through the conduit as a unit.
5. Leave at least 1 foot of slack in the bottom of each signal or combination signal and lighting pole of each signal conductor or cable. Neatly leave at least 3 feet of slack illumination and signal conductor or cable curled up in the bottom of each junction box or splice location.
6. Separate the neutral for pedestrian push button circuits from the signal light circuit neutral.
7. Run all signal and feeder conductors continuously without splices from a terminal block located in a cabinet, compartment, or signal head, to a similarly located terminal block. When modifying an existing signal system when specifically shown in plans, splice existing conductors (cables) to new conductors (cables) as required to complete the signal system. Make these splices when indicated in the plans.
8. Route highway illumination cable through each lighting pole designated for connection to that cable's circuit. Do not splice illumination cable between a load center and a pole or between poles. Join the individual conductors by using non-insulated, overlap type pressure connectors. Insulate with mastic-lined heat shrink tubing or 2 layers of one-half lapped UL listed electrical tape. Do not use wire binding screws, studs, or nuts. Stagger splices to minimize the overall diameter.
9. Install all loops in 1-inch rigid schedule 80 PVC conduit in the roadway and to the nearest junction box. Run loop lead-in cable continuously without splices from the controller cabinet to the curbside detection junction box nearest the loop being spliced to the lead-in cable. Splice the loop(s) to the lead-in cable by soldering at the junction box and encapsulating in a waterproof splice kit.

Multiple loop configurations must have the individual lead-ins, multiple pair, or single pair brought to the controller cabinet for termination. Make series connection of loop lead-ins in the controller cabinet only. Wind all loops in the same direction with the starting lead marked with an "S." Connect the black conductor of the pair shown in Table 660-1 to the "S" designated conductor of the loop. Connect multiple loop detectors in the same lane so that the adjacent loops are in alternating directions clockwise (CW), counter clockwise (CCW), etc.

10. When splicing loop detectors to multi-pair loop lead-in cables, complete the work according to the following.
 - a. See the Plans for the identifying number assigned to each loop detector and the loops assigned to each loop lead-in cable. Using this information, splice the loop detector tails to the paired conductors found in each lead-in cable, using the color code in Table 660-1.
 - b. Remove a short section of cable jacket and only cut the shielded pairs dedicated to loop detectors being spliced. Run these pairs, without splices, to the controller cabinet.
 - c. Join loop and lead-in conductors with crimp and self-solder adhesive-lined heat shrink sealed butt splice connectors.

TABLE 660-1

AK DOT&PF Hwy CR, POST: 02147	MULTIPLE PAIR LOOP LEAD-IN COLOR CONNECTION SCHEDULE	660 - SIGNALS AND LIGHTING	14 of 29
-------------------------------	---	----------------------------	----------

1NAME	Replace "1NAME" w/ Project Name
-------	---------------------------------

PROJECT NO.:	Insert Project Number
--------------	-----------------------

XIV

ALASKA 2020

Loop Detector Number	Colored Pair
The lowest numbered loop detector	Red and Black
The second lowest numbered loop detector	Blue and Black
The third lowest numbered loop detector	White and Black
The fourth lowest numbered loop detector	Green and Black
The fifth lowest numbered loop detector	Brown and Black
The sixth lowest number loop detector	Yellow and Black
Spare pair	Orange and Black

- d. Crimp spade terminals to the ends of the shielded pairs in the controller cabinet.
11. Maintain the electrical isolation between shields and do not allow the drain wires to come in contact at any point other than the ground bus in the cabinet. Tie all drain wires to the ground bus at the controller cabinet.
12. Encapsulate illumination/power cable splices in four-piece molds that are held together with stainless steel hose clamps. Two pieces form a cylinder and two flexible end caps. Seal the ends and allow the conductor entry. Use molds with dimensions suitable for the splice made, encase the cable jackets, and fill with an insulating and sealing epoxy resin. Furnish molds rated for 600 VAC operation, feature fill, and vent funnels for epoxy resin. Fill the splice mold bodies with epoxy resin that is resistant to weather, aromatic and straight chain solvents, and that will not sustain combustion.

When approved by the Engineer, one splice may be used in the following cases:

- An in-line splice may be used when a planned cable run exceeds the length available from the manufacturer on a single spool of cable.
- In a run of 1,000 linear feet or more.

When a cable is spliced, it shall occur within an appropriately sized junction box or in the base of an electrolier designed for said splice.

Insert a loose woven polyester web that allows a full 1/4 inch of insulating compound to flow between the splice and the inside of the mold. Fill the PVC molds with epoxy resin that cures transparent, is nontoxic, is non-corrosive to copper, and does not support fungi or mold growth.

13. Encapsulate all loop lead-in cable splices in rigid, transparent, PVC or PE approved tubing filled with re-enterable polyurethane electrical insulating and sealing compound. Furnish splice kits rated for 1000 volts AC operation and direct burial. When filling the mold bodies of loop lead-in cable splices, use a compound that provides re-entry capabilities.

When project is in MOA service area use "13" below and delete "13" paragraph above, if not delete below paragraphs and keep those above.

13. Encapsulate all loop lead-in splices in HDPE flexible corrugated approved conduit filled with re-enterable non-urethane encapsulating compound.

Use 2" HDPE flexible corrugated conduit, encase all conductor and cable jackets and completely fill the conduit section.

14. Permanently identify all cables and single wire conductors by labeling all pole bases and cabinets, at each detector loop tail/lead-in cable and illumination cable splices, and in junction boxes adjacent to lighting and signal poles. When modifying an existing system, label all new and existing lighting cables/conductors with circuit numbers at locations noted above. If the existing circuits are not identified, the Engineer will provide the required circuit numbers.

15. Label the cables used in the signal and illumination systems with the following legends:

- a. Use the legends included in Table 740-2, for the cables listed.
 - b. Use the loop number shown on the Plans to label each tail of all loop detectors and the paired loop lead-in conductors in the controller cabinet.
 - c. For interconnect cables, use the first letter of the direction the cable follows to the adjacent intersection on each cable. Add a number suffix if more than one cable is routed to the adjacent intersection.
 - d. Furnish the two types of identification tags listed below that feature handwritten legends. Write the legends specified neatly and legibly, using a black marking pen recommended by the tag manufacturer. Replace at no expense to the State all identification tags the Engineer deems illegible.
 - (1) Type 1 Tag: Use identification cable ties for labeling loop detector tails and the paired conductors included in each loop lead-in cable in the controller cabinet. Furnish identification cable ties made of nylon that feature a nonmagnetic stainless steel locking device embedded in the head and a tag attached "flag style" to the head. Use cable ties consisting of a single strap with a minimum size tag of 3/4 inch by 3/8 inch.
 - (2) Type 2 Tag: To label all other cables, use cable tags made of nylon reinforced vinyl impervious to the elements and which will not tear. Provide tags with a 4 inch by 1-3/4 inch minimum size that attach flag style at one corner to a single strap. Furnish yellow tags for labeling all signal and interconnect cables and red tags for labeling lighting and feeder cables.
 - e. Label all cables in the controller cabinet with Type 1 Tags only. All controller cabinet tags shall be within six inches of the termination of the cable.
 - f. Label all loop detector tails and paired loop conductors with Type 1 Tags only. All other cables shall be labeled with Type 2 Tags outside of the controller cabinet.
16. Terminate the control and power cables as shown in Table 740-2.
17. Telemetry cable termination shall be coordinated with a signal technician. Provide type No. 66B3-50 terminal blocks as required.
18. Wire luminaires using No. 10 AWG illumination tap conductors that run from the fused disconnect kit in the pole base.
- Install a fused splice connector between the line and luminaire ballast tap conductors in the base of every pole equipped with a luminaire.
- Attach the conductors to the connector halves with setscrew type pressure connectors. Provide the plug and socket assembly so that the fuse remains in the load side plug without exposing live metal parts when the connector separates and the coil springs are not included in the current carrying circuit.
- Make the fused connectors readily accessible from the handhole. Install tap conductors to prevent slack when their ends touch the top of the foundation.
19. Retrofit reused poles with new tap wires, fused disconnect kits, and fuses.
20. Whenever conductors cannot be terminated as specified in the Plans in circuit breakers due to size, splice a piece of #8 AWG copper power conductor onto the end of each conductor using an overlap type, irreversible compression connector. Insulate the splice with heat shrink tubing. Complete the splice in the space between the top of the load center foundation and the bottom of the cabinet. Limit the length of the #8 AWG conductors to 5 feet. Note: this splice is acceptable only if the overcurrent protective device protecting the #8 AWG conductors is rated 40A or less.

21. Spare lighting conductors shall be capped in the pole bases and load centers by cutting the wire flush with the end of the insulation and bending the conductor back against itself and securing with three layers of electrical tape to prevent any possibility of making contact with ground or current carrying conductors.

660-3.06 BONDING AND GROUNDING. All installations must comply with the grounding and bonding requirements of NEC Article 250 and the following requirements: Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, including metallic cable sheaths, metal conduits, non-metallic conduit grounding wire, junction box lids and frames, cabinets, transformer cases, and metal posts and poles, must be electrically connected to earth ground, and must be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path. Make fixtures mounted on metal poles, including signal components and luminaires, mechanically and electrically secure to the pole. An equipment grounding conductor must be installed between the grounding lug near the base of the pole and the lighting fixture.

Install grounding bushings with insulated throats on the ends of metallic conduits.

Install an insulated or bare stranded copper wire for the equipment grounding conductor in conduits, except those conduits installed for future use. Install size #8 AWG grounding conductors, except in those conduits that contain circuit conductors larger than #8 AWG. In this case, install a wire equal in size to the largest circuit conductor. Attach the grounding conductors to the grounding bushings, leaving 12 inches of slack between each bushing. Connect grounding conductors together using irreversible compression type connectors to form a fully interconnected and continuous grounding system.

Retrofit existing spare conduits that will contain new cables exclusively with new grounding bushings. When the Plans require installation or removal of conductors from existing conduits, retrofit with new equipment grounding conductors sized according to the preceding paragraph.

Bond junction box lids to the equipment grounding conductor using copper braid with a cross sectional area equal to a #8 AWG and eyelet spaced at 6 inch intervals. Connect bonding jumpers to the grounding conductors using irreversible compression type connectors.

Replace missing or damaged conduit and junction box lid bonding jumpers.

Join the equipment grounding conductors from the conduits to the #4 AWG grounding electrode conductor using irreversible compression type connectors at Portland cement concrete foundations. For pile foundations, attach the equipment grounding conductor from the conduit to the pile cap adapter with a listed mechanical grounding connector.

When installing signal poles, signal posts, and lighting standards with frangible coupling bases, run a 5 feet long grounding conductor from the grounding bushing on the conduit to the grounding lug located in the handhole of each pole.

Bond slip base type standards and pedestals by using 2 conductors from the conduit, one attached with a ground rod clamp to an anchor bolt and the other connected to the grounding lug located in the handhole of each pole.

Solidly ground one side of the secondary circuit of a transformer.

Install a 3/4 inch by 10 feet copper clad ground rod inside each controller cabinet foundation and a #6 AWG bare stranded copper wire for the grounding electrode conductor. Furnish one piece bronze clamps with a hex head setscrew that are suitable for direct burial and for use with copper clad ground rods.

When routing a new conduit into an existing junction box or replacing an existing junction box, new and existing conduits shall have the grounding improved to current specifications.

660-3.07 TRAFFIC CONTROLLER ASSEMBLIES. Prepare each solid-state, traffic controller assembly to operate various traffic signal devices as shown on the Plans. The controller must provide right-of-way, clearance, and other indications using duration and sequence as determined by preset programming.

Details of operation for the complete controller assembly must be according to the traffic phases; preferential phase sequence and concurrence; signal indications; signal indication sequence; detection requirements; and other details shown on the Plans or as specified herein.

1. Shop Tests. The Controller Assembly manufacturer shall conduct a pretest of the cabinet and controller assembly. The pretest includes but is not limited to:
 - a. Ensure the cabinet is free of paint scratches, dents, sharp edges, and other physical defects.
 - b. Ensure cabinet hinges, heater, ventilation system, lighting, and door locking mechanism function properly.
 - c. Ensure that there are no short circuits between AC+, AC-, and GND anywhere in the cabinet.
 - d. Check that there is no continuity between AC+ and DC+.
 - e. Check for continuity between any green wire connection point and GND.
 - f. Ensure devices within the cabinet are labeled properly.

The Controller Assembly manufacturer shall conduct a final test of the cabinet and controller assembly. Qualified Cabinet Test Technicians shall conduct the final test. The final test includes but is not limited to ensuring proper operation of flash colors & combination, standard controller phasing, pedestrian pushbutton isolation, MMU, circuit breaker/fuse operation, telemetry operation, loop panel/detector rack operation, EVP operation, and proper police & auxiliary panel operation.

Upon completing the final test, the cabinet shall be run, "burned in," under full loads for a period of not less than 48 hours with a test timing plan in effect which utilizes full cabinet phases and functionality.

In the course of testing, a component found to function incorrectly or exhibit physical damage must be replaced with an equivalent new component before delivery. Should the cabinet fail during burn in, the cause of the failure must be remedied and the test restarted with another 48 hours of burn in. The intent of this specification is to meet or exceed the requirements of Econolite test procedure MWI-10-28 Rev. C. With prior approval of the Engineer, other equivalent test procedures may be substituted.

Upon completion of the pretest, final test, and burn in, the Controller Assembly manufacturer shall issue a letter of certification stating that the required tests have been completed, note defects found and the remedial action taken. Further, the certification shall state the assembly conforms to the NEMA TS 2-2003 v02.06, Traffic Controller Assemblies with NTCIP Requirements, Section 2 Environmental Requirements. Submit the certification letter and copies of the test results to the Engineer.

The work required in this subsection is subsidiary to the associated traffic signal system under Pay Item 660.0001.____Traffic Signal System Complete.

2. Controller Cabinet Installation.

- a. Where the cabinet is mounted on a concrete pedestal foundation, place a 1-inch drain hole or pipe with screen in the foundation, connecting to the cabinet and emptying above the ground line.
- b. Place a 3/8-inch fillet of silicone caulking between each controller cabinet and the concrete slab foundation to prevent dust and dirt from entering the cabinet.
- c. When called for in the Plans or Special Provisions, add 2 inches of approved foam insulation within the bottom of the cabinet between the control equipment and the concrete base. Design all wiring, terminals, and other items to allow sufficient room for the insulation.
- d. On Precast Controller Foundations. When called for in the Plans or Special Provisions, place a 3/8-inch thick, 2-piece exterior grade plywood board on the bottom of the cabinet and under the foam insulation. Place the plywood within the controller cabinet, and do not extend under it. Make holes to allow for the conduits entering the cabinet. Place a pliable sealant composed of a silicon caulking

compound between the plywood board and the cabinet and between the plywood board and all the conduits.

- e. Place a ground rod in the Type III junction box next to the cabinet or in the foundation of the cabinet if it is precast foundation.
- f. See Subsection 660-3.05 and Section 740 for wiring requirements.

3. Controller Operation. Provide the following operations.

- a. Wire the controller cabinet to flash the yellow signals on the main street or highway, and the red signals on the cross streets and left turn lanes.
- b. Make the flashing circuit independent of the controller unit. They must remain in operation upon shutdown of the controller or removal of the controller from the cabinet.
- c. Wire the controller cabinet so that removal of the conflict monitor causes the intersection to go into flashing operation.
- d. Accomplish transfer to flashing operation by relays between the normal load switching device and the field terminals.
- e. Do not operate pedestrian pushbuttons at more than 24 volts.
- f. Controller Priorities. Prioritize the drives, controls, and equipment so that each device, control, or item of equipment overrides the operation of those items listed below it:
 - (1) Power failure
 - (2) Power restart
 - (3) Flashing
 - (4) Railroad preemptor
 - (5) Emergency vehicle preemptor
 - (6) Phase selector
 - (7) Interconnect
 - (8) Time switch
 - (9) Normal controller unit operation

Provide the following preemption operations when called for on the Plans or as specified in the Special Provisions.

- a. General. Preemption units must use the controller unit functional inputs and timings to the largest extent possible. Signal load switching control must remain with the controller unit.
- b. Railroad Preemption. The Railroad Preemption Routine must consist of 4 functional intervals in the order listed below:
 - (1) Enter Preemption Interval.
 - (a) Energize a 120 VAC alarm circuit which may be used for a sign, bell, or beacon.

- (b) Immediately advance to the pedestrian clearance interval of any walk that is being displayed. On any phase other than the track clearance phase(s), abbreviate the pedestrian clearance interval by a timer with a minimum range of 0-30 seconds.
 - (c) Following the pedestrian clearance period, the controller must advance into and time normally the vehicle clearance intervals.
 - (d) If the preemption is received while in the track clearance phase(s), skip step (b) and (c) above.
- (2) Track Clearance Interval.
- (a) Provide a timing period to allow sufficient green clearance time for any vehicles that may be stopped on or immediately behind the railroad tracks. The timing must be adjustable over a range of 0 to 30 seconds.
 - (b) Following the track clearance period, the controller must advance into and time normally the vehicle clearance interval(s).
- (3) During Preemption Interval. Allow the controller to operate normally except for phases that conflict with the railroad crossing. Keep this interval in effect until the preemption call is removed.
- (4) Leaving Preemption Interval.
- (a) De-energize alarm circuit.
 - (b) Immediately advance to the active phase normal pedestrian and/or vehicle clearance interval(s).
 - (c) The controller must advance to those phases that were omitted under preemption control when complete control is returned to the controller unit.
- c. Emergency Equipment Preemption. The Emergency Equipment Preemption Routine must consist of 3 functional intervals in the order listed below:
- (1) Enter Preemption Interval.
- (a) Energize a 120 VAC alarm circuit which may be used for a sign, bell, or beacon.
 - (b) Immediately advance to the pedestrian clearance interval of any walk that is being displayed. On any phase other than the track clearance phase(s), abbreviate the pedestrian clearance interval by a timer with a minimum range of 0-30 seconds.
 - (c) Following the pedestrian clearance period, the controller must advance into and time normally the vehicle clearance intervals.
 - (d) If the preemption call is received while in the preempt phase(s), skip step (b) and (c) above.
- (2) Preempt Phase Interval. Hold the controller in the preempt phase(s) until the call is removed.
- (3) Leaving Preemption Interval. When the preemption call is removed, the controller unit must immediately revert to normal operation.

660-3.08 SIGNAL AND LIGHTING INSTALLATION REQUIREMENTS. Install signal and lighting equipment according to the details shown on the Plans and the following:

Apply anti-seizing compound to the following fasteners: frangible couplings, mechanical grounding connectors, bolts that secure handhole covers and signal mounting hardware to poles and mast arms.

Remove the fasteners from luminaire mounting brackets, fused disconnect kits, grounding bushings, and signal faces that secure the visors, and apply anti-seizing compound to these fasteners before completing the installation.

Before passing conductors through the holes made in posts, poles, and mast arms for wireways, remove the burrs and sharp edges from the inside and outside of these holes.

Until each traffic signal and/or flashing beacon goes into operation, keep the vehicular and pedestrian signal faces covered with beige colored canvas shirts sized to fit the signal faces shown in the Plans. Each signal shirt shall feature elasticized openings that fit over the visors and at least two straps to secure it to the signal. Provide shirts with a legend that reads "out of service" and a center section that allows an operator to see the indications during system tests.

When not shown in the Plans, determine the shaft lengths of lighting and signal poles and signal mast arm connector plate locations to provide the plan mounting heights of luminaires and traffic signal heads.

Furnish work to install foundations for relocated poles, including conduit, excavation, reinforcing steel, class A concrete, anchor bolts, nuts, and washers.

1. Electrolier Installation. Before installing electroliers, check the socket position of each luminaire to verify it matches the position indicated in the instructions for the light distribution type shown on the Plans.

Install electroliers with mast arms with a slight rake by plumbing the side of the pole opposite the mast arm. After the pole has been plumbed, level the luminaire as recommended by the manufacturer.

Install electroliers without mast arms with the centerline of the pole plumb.

2. Signal Pole Installation. Install signal poles with a slight rake by plumbing the side of the pole opposite the mast arm just above the base plate. Tighten the nuts on the anchor bolts/rods as described in Subsection 660-3.02.

Cover the gap between the foundation and base plate by installing a metal skirt around the base plate, secured with stainless steel sheet metal screws.

3. Vehicular Signal Head Installation. With two-piece mast arms, do not install signal heads within 12 inches on either side of the overlapped splice section.

Attach each side mounted terminal compartment with two 1/2" x 13 bolts, with washers, threaded into holes tapped into the side of the pole at the location shown on Alaska Standard Plan T-30. Install the vertical pipe members plumb.

When installing 4 or 5 sections vertically stacked signal heads on the sides of poles, secure the vertical pipe to the pole using a steel conduit hanger mounted 6 inches below the top horizontal pipe.

Aim through phase vehicular signal faces at a point located a distance from the face as shown in Table 660-2. If two through signal faces are not visible from this point at a height of 42 inches above finished grade, consult the Engineer for corrective measures.

TABLE 660-2

THROUGH PHASE SIGNAL FACE AIMING POINTS

85th Percentile Speed (mph)	Minimum Visibility Distance (feet)
20	175
25	215
30	270

35	325
40	390
45	460
50	540
55	625
60	715

4. Pedestrian Signal and Push Button Installation. Orient pedestrian signal faces at the center of the crosswalk on the opposite side of the street. Attach each clamshell bracket with two 1/2" x 13 bolts threaded into holes tapped into the side of the pole. Install a spacer, furnished by the bracket manufacturer, on each bolt.

Install the push button on the crosswalk side of the pole. Install push button signs above each push button. Furnish signs with the arrow pointing in the direction of the appropriate crosswalk. When channel is used for mounting push button signs, tap the top and bottom sign bolts into the pole.

5. Underpass Lighting System Installation. Mount the luminaires as detailed on the drawings to orient the axis of the lamp perpendicular to the axis of the underpass.
6. Flashing Beacon Installation. When the Plans specify using the flasher in a signal controller cabinet to energize beacons, furnish a two pole, fused block with built in fuse pullers and two fuses to protect the flasher. Furnish and leave 5 feet of cable in the cabinet. Others will install the fused block and terminate the beacon cables.
7. Wood Pole Installation. Place the poles in the ground to at least 6 feet deep.

After setting each pole in the ground, backfill the space around the pole with selected earth or sand, free of rocks 4 inches and larger, or deleterious material. Place the material in layers approximately 4 inches thick and thoroughly compact them with mechanical tampers.

Furnish poles that provide a minimum vertical clearance of 21 feet between the pavement and low point of overhead conductor.

660-3.09 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS. This work consists of protecting and maintaining the existing and temporary electrical systems during the life of the Contract. The work includes locating, repairing, replacing, adjusting, realigning, cleaning, and relocating components of traffic signals, lighting systems, interconnect, and flashing beacons to keep them wholly operational and positioned according to the following specifications.

Furnish the Engineer with the name and phone number of the person who will maintain the existing and temporary electrical facilities at the Preconstruction Conference. Make this person available at times until the date of Acceptance for Traffic and Maintenance and provide labor, materials, and equipment this person may need to complete repairs ordered by the Engineer.

When beginning work, the Engineer will notify the Contractor and the local maintenance agencies in writing of the transfer of maintenance responsibilities, providing an effective date and time. Maintenance does not include replacing defective equipment or repairing equipment damaged before the transfer of maintenance responsibility. Therefore, before starting work on the project, inventory the condition of the existing equipment with the Engineer and document the damaged and defective equipment. If beginning work before providing the Engineer with an inventory, the Contractor waives the right to claim extra compensation when the Engineer later finds damaged or defective equipment.

Keep components of the existing and temporary electrical systems operational during the progress of the work, except when the Engineer allows shutdowns to alter or remove the systems. The Engineer will consider these systems operational when no damaged or defective equipment is found in service,

components are clean, located, and aligned as specified herein, and photoelectric controls operate the lighting systems. The State will pay for electricity used to operate the systems if the public benefits from their operation. Furnish replacement equipment compatible with equipment used in the Central Region.

Begin work to repair, replace, adjust, realign, clean, and/or relocate components of an affected system within one hour when ordered by the Engineer. If work is not complete, the Engineer may have outside forces complete the repairs and deduct the amount billed from monies due the Contractor.

1. Records. When working on a traffic signal system, print a record of work performed in the diary found in each controller cabinet. Make sure each entry includes:
 - a. The dates and times beginning and completing work, and the names of the Crewmembers completing the work.
 - b. The characteristics of the equipment failure or faulty operation evident before repair.
 - c. The changes made or corrective actions taken.
 - d. The printed name and signature of the person responsible for making the repairs or changes.

The Engineer will limit signal system shutdowns to the hours traffic restrictions are allowed in Subsection 643-3.08, Construction Sequencing. During shutdowns, use flag persons to control traffic. Provide local traffic enforcement and maintenance agencies 24 hour notice before shutting down a traffic signal system.

Locate existing conduit runs, buried cables, junction boxes, and underground utilities before starting work that may damage these facilities or interfere with these systems.

Where roadways remain open to traffic and the work includes modifying the existing lighting systems, energize the modified circuit by sunset on the same day the Contractor retires the original circuit.

Relocate or replace signal poles, lighting standards, sign poles, flashing beacon poles, load centers, and controller cabinets whenever reducing clearance from the traveled way to less than 15 feet.

2. Alignment. During the various phases of construction, shift the signal heads to keep them aligned horizontally and vertically with the approaches according to the following:
 - a. For overhead signals located 53 feet and more from the stop line, maintain 18 feet to 20 feet of clearance between the traveled way and the bottom of each signal. For closer signals refer to the MUTCD for maximum clearances.
 - b. For side mounted signals, maintain 9 feet to 11 feet of clearance between the traveled way and the bottom of the signal.
 - c. Align overhead signals controlling a single lane with the center of the lane.
 - d. Align overhead signals controlling two lanes with the lane lines separating the lanes.
 - e. When the horizontal angle to the side mounted far right signal exceeds 20 degrees, relocate this signal to an overhead location. Measure the angle 10 feet back from the stop line on the lane line between the two farthest left through lanes.
 - (1) With two or more through lanes, center one signal head over each lane.
 - (2) With one through lane and protected permitted signal phasing, leave the five-section signal over the lane line and center the signal to be relocated over the through lane.
 - (3) Otherwise, install the relocated signal 8 feet to the right of the signal centered over the through lane.
 - f. For pedestrian signals, maintain 7 to 9 feet between the traveled way and the bottom of each pedestrian signal.

- g. Aim signal heads according to Table 660-2 found in Subsection 660-3.08. When no longer required, salvage original and Department provided equipment according to the Plans and No. 6. Salvaging or Reusing Electrical Equipment, found in Subsection 660-3.01. Remove other materials used in the temporary systems from the project.

660-3.10 FALSEWORK LIGHTING. When required by the Special Provisions, install falsework lighting where vehicular traffic with or without pedestrian traffic crosses through or under structure falsework.

Provide illumination of the portal faces of falsework during the hours from dusk to dawn. Provide illumination of the pavement and pedestrian openings through or under falsework 24 hours a day.

Submit a plan for the proposed lighting installations and do not commence falsework construction until the Engineer has reviewed such plans. The Engineer will make a subsequent review after you place falsework lights in operation.

Falsework lighting equipment remains your property and must be removed from the site of the work upon completion of the project or when directed.

660-3.11 TRAFFIC SIGNAL MODIFICATIONS. Required work is detailed in the Plan sheets and notes and the following. Work related to the Traffic Signal Communications System will be paid for separately.

The Contractor will have 10 hours to "changeover" the new controller assembly. Changeover includes but is not limited to removing the existing controller assembly, replacing with new controller assembly, landing new and existing wires, programming the new controller unit, and bringing the signal back to full functionality. The 10 hour window will only occur on the days assigned under an approved traffic control plan. The Contractor will be assessed a Traffic Price Adjustment for an unauthorized lane closure according to Subsection 643-3.06. Refer to section 643 for further restrictions.

Traffic control during the changeover will be paid for under section 643 Pay Items. At a minimum, traffic control will include the following:

1. A portable changeable message board in advance of each approach with the message "Traffic Signal Work, New Traffic Pattern Ahead, from 00:00 AM/PM mm/dd/yy to 00:00 AM/PM mm/dd/yy
2. A flagger for each approach

Traffic signal modifications are subject to the full Standard Specification for Highway Construction, the Special Provisions, and the following:

1. Traffic Controller Cabinet: When a new traffic controller cabinet is called for, ensure legible labeling of all cabinet cables including but not limited to; control, detector, EVP, UPS, interconnect, and telephone. Label detectors and signal heads individually.
2. Traffic Signal Heads: When new traffic signal heads are required, provide with new LED units and new mounting hardware. If new heads are not called for, replace any missing visors or backplates subsidiary to the Traffic Signal Modification Pay Item.

When replacing traffic signal or pedestrian indications conform to Subsections 740-2.14 and 2.15 and maintain brand consistency throughout intersection. When new heads are provided aim heads according to Table 660-2.

3. Loops: When shown in the plans, replace inductive loops including homerun cable and required splice. Loop tests are required per Section 660-3.01.7.
4. Conduits: Unless new conduits are called for reuse existing conduits. When new conductors are being added to existing conduits, conform to sections 660-3.03, 3.05, and 3.06.
5. EVP Components: When called for in the plans provide EVP components including all cables and mounting hardware. Ensure proper operation of EVP system.

6. UPS: When called for in the plans provide fully functioning UPS system. If no separate UPS item exist, the UPS will be paid for subsidiary to the Traffic Signal Modifications Pay Item.
7. Load Center: When called for in the plans provide fully functioning Load Center. If no separate load center item exists, the load center will be paid for subsidiary to the Traffic Signal Modifications Pay Item.
8. Conductors: Reuse existing conductors except where the plans call for new conductors.

Salvage decommissioned reusable traffic signal equipment, components/materials and deliver to the local Maintenance & Operations station within 72 hours of removal. Refer to section 660-3.01 for delivery locations. Decommissioned components damaged as part of the salvage effort must be replaced with new components at no additional cost.

When Project is in MOA include subsections 660-3.12 and 660-3.13 below. If outside MOA delete both subsections.

660-3.12 SIGNAL SYSTEM TIMING AND ADJUSTMENTS. The Engineer will use Municipality of Anchorage (MOA) signal maintenance personnel for certain work inside controller cabinets. Before MOA personnel arrive to test loop detector conductors, ensure terminal connectors are attached to paired loop detector conductor ends and paired loop detector conductors and cables are labeled as specified in subsection 660-3.05, Wiring.

1. Loop Detector Wiring. Municipality of Anchorage Traffic Signal Maintenance (MOA Signal Maintenance) will test and connect paired loop detector conductors to the terminal blocks.
2. Control Cable Wiring. When modifying an operational signal system or controller assembly, MOA Signal Maintenance will connect control cables within the controller cabinet to the terminal blocks.
3. Timing Adjustments. During construction, MOA Signal Maintenance/Operations may adjust the system and intersection operational timing to accommodate project conditions.
4. Interconnect Wiring. MOA Signal Maintenance will test and connect copper interconnect wiring to the terminal blocks and will perform copper interconnect splices.

660-3.13 CONTROLLER CABINET PREPARATION. Ship new traffic controller cabinet(s) and equipment to the Municipality of Anchorage Traffic Signal Electronics Shop at 3601 Dr. Martin Luther King Jr. Avenue. MOA will inspect cabinet wiring, burn in signal equipment, customize cabinets for desired operation and test the equipment according to subsection 660-3.07, Shop Tests. Allow 6 weeks for cabinet testing.

When Project is outside MOA include subsection 660-3.13 below. If inside MOA delete subsection 660-3.13 below.

660-3.13 CONTROLLER CABINET PREPARATION. Ship new traffic controller cabinet(s) and equipment to the Matsu District Office maintenance shop at 500 Seward Meridian Parkway, Wasilla, AK 99654. Maintenance and operations staff will inspect cabinet wiring, burn in signal equipment, customize cabinets for desired operation and test the equipment according to subsection 660-3.07, Shop Tests. Allow 6 weeks for cabinet testing.

660-3.14 ARC FLASH HAZARD WARNING. Label traffic controller cabinets, and other electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized, to warn qualified persons of potential electrical arc flash hazards per NEC 110.16. The labels must meet the requirements in NEC 110.21(B) and must contain the information required in NFPA 70E 130.5(H).

660-4.01 METHOD OF MEASUREMENT. Section 109 and the following:

Bored Casing. By the linear foot along the slope of the bored or jacked casing for the actual length bored or jacked, in place.

Traffic Loop. By each loop unit, complete and in place, including all conduit, conductors, and other equipment to the nearest junction box.

Traffic Loop Replacement. By each loop unit damaged during the milling operation, complete and in place, including all conduit, conductors, and other items necessary per this section to replace fully functioning loops. Work to include splicing of loops to existing lead-in cable.

Relocate Electroliner. By each complete unit, removed, relocated, reinstalled, and functional.

Temporary Electroliner. By each electroliner and foundation furnished, installed, and maintained as directed by the Engineer.

Signals and Lighting (Miscellaneous). Measured in accordance with the directive authorizing the work.

660-5.01 BASIS OF PAYMENT.

Payment Includes labor, equipment, and materials required to provide fully functional traffic signals and lighting systems, permanent and temporary, using new equipment. Remanufactured or rebuilt equipment will not be permitted.

Subsidiary to each Pay Item including but not limited to (Except when included as a separate Pay Item):

1. General construction requirements,
2. Bonding and grounding,
3. Bored Casings,
4. Completing tests,
5. Conductors,
6. Conduit,
7. Dewatering excavations,
8. Excavation, trenches in rock or soil, bedding, backfill for foundations, conduits, components,
9. Foundations including concrete to complete foundations,
10. Junction boxes including adjustment to final grade,
11. Labeling conductors,
12. Maintaining temporary and existing electrical systems,
13. Minor routing changes directed by the Engineer,
14. Preparing as-builts,
15. Removal and disposal of existing/new unused foundations, conduit, conductors, and junction boxes,
16. Removing, repairing, and replacing improvements,
17. Removal of signs and reinstallations required to install foundations, conduits, and junction boxes,
18. Repairing damage to finishes on new equipment,
19. Salvaging reusable equipment and materials and delivering to the local Maintenance and Operations station including but not limited to existing signal structure (refer to section 660-3.01 for delivery locations),
20. Wiring, and
21. Replacing failed equipment, equipment components and repairing failed workmanship.

660 Pay Items do not include: roadway planing, roadway paving, drainage structures, erosion, sediment, and pollution control, signing, striping and pavement markings, traffic control, and components of the traffic signal communication system when included as separate pay items.

Pay Item 660.0001.____ Traffic Signal System Complete, ().

1. Signal structures
2. Traffic controller assemblies including assembly testing and preparation, vehicle and pedestrian indications, detection systems, emergency vehicle preemption systems, PTZ cameras, auxiliary and test equipment, on-site manufacturer assisted start up, and training when called for in the Plans.
3. Work associated with installing loop detectors and conduit crossings, and any other items except when included in a separate Pay Items such as saw cutting, asphalt removal, aggregate base course, tack coating, and installing new hot mix asphalt.
4. Includes salvage of existing signal system components not specified in plans to be reused, when not included as a separate item.

Pay Item 660.0003.____ Highway Lighting System Complete, ().

1. Lighting structures.
2. Includes salvage of existing lighting components not specified in plans to be reused, when not included as a separate item.

Pay Item 660.2000.____ Temporary Electrolier.

1. Work to have plans and materials approved.
2. Temporary electrolier including the structures, foundations, and load centers (as needed) and their removal. Moving the electroliers, assembly and operational installation, removing and replacing, and installing conductors (in conduit or direct bury only). Furnishing and installing temporary electrical load centers when existing load centers are not available for use.
3. Temporary electrolier will be paid on a contingent sum basis at the unit price of \$3300/each. The Engineer does not require a change order/directive for this Pay Item.

Pay Item 660.2008.____ Traffic Loop Replacement.

1. Replace loops within the specified depth of planning that are damaged during the planning operation at a rate of \$1250 each. Loops outside the specified depth of planning that are damaged during the planning operation are replaced at no expense to the Department per 202-5.01.

Payment will be made under:

PAY ITEM

Item Number	Item Description	Unit
660.0001.____	Traffic Signal System Complete, _____	LS
660.0002.____	Flashing Beacon System Complete, _____	LS
660.0003.____	Highway Lighting System Complete, _____	LS
660.0004.____	Sign Illumination System Complete, _____	LS
660.0005.____	Structure Illumination System Complete, _____	LS

PAY ITEM

Item Number	Item Description	Unit
660.0007.____	Temporary Signal System Complete, _____	LS
660.0008.____	Temporary Illumination System Complete	LS
660.0009.____	Bored Casing, ____-Inch Minimum Diameter	LF
660.0011.____	Traffic Loop	Each
660.0012.____	Underpass Lighting System Complete	LS
660.0013.____	Relocate Electrolier	Each
660.2000.____	Temporary Electrolier, _____	CS
660.2001.____	Signal and Lighting Salvage, _____	LS
660.2002.____	Pedestrian Lighting, _____	LS
660.2003.____	Traffic Signal System Modifications _____	LS
660.2004.____	Adjust Junction Box	Each
660.2005.____	Junction Box, Type ____	Each
660.2008.____	Traffic Loop Replacement	CS
660.2031.____	Signal System Timing and Adjustments _____	CS

Project Number

Pay Items. SSHC Section 109 the 2nd paragraph says: "When more than one type of material or work is specified for a pay item, the proposed line number and item description are used to differentiate the material or work."

Example:

One type of material or work:

PAY ITEM

Item Number	Item Description	Unit
660.0001.____	Traffic Signal System Complete, "That Road and This Road Intersection"	LS
660.0001.____	Traffic Signal System Complete, "No Name Rd and Any Name Road Intersection"	LS

660.2032. _____ Illumination Price Adjustment CS, is a deduct. When a large bank of new lighting replaces existing lighting, the Contractor is required to maintain the existing lighting until the Engineer accepts the new lighting as installed complete, functional. Use this Pay Item to enforce this requirement. When the Contractor does not maintain the existing lighting a price adjustment in the form of a deduct or similar will be assessed. **This Pay Item is not intended to be used for typical, smaller light installations and has been removed from the typical provisions. Where a project with a large amount of lighting is required and an existing bank of lights must be maintained - contact the CR specification engineer for a copy of the Illumination Price Adjustment provisions.**