SECTION 622 - ROADWAY AND SIGN LIGHTING SYSTEM

622.01 Description. This section describes the following:

(A) Furnishing and installing roadway lighting system, including materials necessary for operating and controlling roadway lighting system.

(B) Furnishing and installing sign lighting system, including materials necessary for operating and controlling sign lighting system.

(C) Relocating existing roadway lights, including materials necessary to reconnect relocated lights to existing light circuits.

622.02 Materials.

Structural Concrete (Class B) 601
Reinforcing Steel 602
Dark Green Enamel Paint 708.03
Welded Wire Fabric Reinforcement 709.01(C)
Concrete Pull Box 712.06(B)
Conduits 712.27
Light Poles 760.01
Luminaire Mast Arms 760.02
Luminaires for Roadway, Underpass, Sign and Pedestrian Stairways Lighting 760.03
Cables and Wires for Roadway Lighting System 760.04
Disconnect and Protective Devices 760.05
Waterproof Connectors for Roadway Lighting 760.06
Photoelectric Control 760.07

Structural steel anchor bolts and steel plates shall conform to AASHTO M 164 and ASTM A 36, respectively. Exposed anchor bolts, nuts, and washers shall be zinc-coated, in accordance with AASHTO M 232. Anchor bolts and nuts shall be galvanized after threads are cut. After galvanizing, ensure that all nuts will turn on bolts to full thread depth. Coat threads with paraffin wax.
Crossarms, hardware, and anchoring materials shall match materials normally stocked and used for similar purpose by local public utility companies.

Electrical equipment shall conform to standards of the following, wherever applicable:

(A) NEMA.

(B) UL, Inc.

(C) Electrical Testing Laboratories (ETL).

(D) National Electrical Testing Association, Inc. (NETA)

Materials shall conform to requirements of the contract documents and the following:

(A) NEC.

(B) General Order Nos. 6 and 10, of the Hawaii Public Utilities Commission.

(C) ASTM.

(D) ANSI.

(E) Local utility company rules.

(F) Local ordinances that may apply.

622.03 Construction. Perform work in accordance with requirements of the contract documents and the following: NEC; General Order Nos. 6 and 10 of the Hawaii Public Utilities Commission; ASTM; ANSI; local utility company rules; and local ordinances that may apply.

(A) Equipment List and Drawings. Submit within seven days following contract award, 10 copies of materials and equipment list. Include name of manufacturer, size and identifying number of each item, detailed scale drawings, wiring diagrams of special equipment, and proposed deviations from the contract. If required, submit samples of materials.

Prepare diagrams and drawings using graphic symbols indicated in IEEE publication Graphic Symbols for Electrical and Electronic Diagrams.
Submit ten copies of materials and equipment list for temporary lighting system. When existing lights are removed, damaged, or non-functional, install and operate temporary lighting system during hours of darkness. Provide same amount of illumination as existing lighting system.

Upon completion and acceptance of work, submit construction as-built drawings showing detailed construction changes.

(B) Excavation and Backfill. Excavate and backfill in accordance with Section 204 - Excavation and Backfill for Miscellaneous Facilities.

(C) Installation.

(1) Foundations. Construct foundations as indicated in the contract documents. Foundations within clear zone, as defined by AASHTO Roadside Design Guide, including anchor bolts, shall not extend more than 4 inches above surrounding ground.

Set forms true to correct line and grade. Use rigid forms, securely braced in place. Place conduit ends and anchor bolts in proper position and height and hold in place with rigid top template. In addition to rigid top template, hold anchor bolts in place by means of rigid bottom template made of steel. Bottom template shall provide proper spacing and alignment of anchor bolts near their bottom embedded end. Install bottom template before placing footing concrete. Anchor bolts installed more than 1:40 from vertical will be rejected. Hold conduit ends and anchor bolts in place by template until concrete sets. Cure concrete for not less than 72 hours.

Mix, place, and cure concrete for foundations in accordance with Section 601 - Structural Concrete and Section 503 - Concrete Structures.

(2) Metal Lamp Standards. Install metal lamp standard with shaft plumb on anchor bolts and concrete foundation. Set bracket arm perpendicular to roadway centerline.

Set standards at required locations or as ordered by the Engineer. Install transformer base such that access cover is located on trailing face perpendicular to oncoming traffic.

Place leveling grout with weep holes under entire metal lamp standard base plates. Form exposed portions to present neat appearance.

(3) Mast Arms. Set mast arms perpendicular to roadway centerline.
(4) **Luminaires.** Assemble luminaires and install on metal lamp standards and mast arms. Set luminaire’s vertical axis perpendicular to roadway and longitudinal axis parallel to roadway.

Install luminaires at pedestrian stairways, underpasses, and sign luminaire brackets, as indicated in the contract documents.

(5) **Pull Boxes.** Furnish and install pull boxes as indicated in the contract documents. Carefully excavate for pull boxes.

Install pull boxes so that covers are level with curb or sidewalk grade or 1 inch above existing ground.

(6) **Conduits.** Lay polyvinyl chloride (PVC) conduits carefully in trenches prepared to receive conduits. Concrete encase PVC Schedule 40 conduits under roadway areas. Use PVC Schedule 80 conduits, direct buried, in areas not exposed to traffic.

Set conduits to be placed in concrete structure or encased in concrete to required lines and grades. Support conduit rigidly in place by masonry material, manufactured conduit spacers, or other accepted means, so that conduit will not dislodge during concrete placing and tamping. Place concrete encasement using hand shovels only. Cure concrete for at least 12 hours before backfilling and compacting.

Whether shop or field cut, ream end of conduits to remove burrs and rough edges. Make cuts square and true. Slip joints or running threads will not be allowed for coupling conduit. When standard coupling cannot be used for coupling metal-type conduit, use of UL or ETL listed threaded union will be allowed.

Install rigid steel conduit in accordance with NEC requirements for rigid metal conduit. Use white and tinted ready-mixed paint on threads of joints. Repair zinc-coated surfaces in accordance with Subsection 501.03(G)(2) - Repairing Damaged Zinc-Coated Surfaces.

Apply two coats of asphaltic base paint to exterior portions of direct burial steel conduits not encased in concrete immediately after installation.

Install and repair surfaces of PVC-coated rigid steel conduit in accordance with manufacturer’s recommendations.

 Install PVC conduit in accordance with NEC requirements. Use solvent weld connections. Make solvent weld joints in accordance with conduit manufacturer’s recommendations.
Make directional changes in non-metallic conduit with curved segments using accepted deflection couplings, or with short lengths of straight conduits and couplings. Deflection angle between two adjacent lengths of conduit shall not exceed 6 degrees. Do not use radius of less than 12 times nominal size of conduit, unless using factory-made ells.

Thread connection for PVC conduits to rigid metal conduits on metal conduit side.

Provide each conduit run with No. 10 gage flexible, zinc-coated pull wire or 1/8-inch polyolefin line extending through entire length. Double additional 2 feet of wire or polyolefin line back into conduit at both ends of run. End metal conduits entering pull boxes with insulating grounding bushings. End non-metallic conduits with end bells. Cap or plug ends temporarily.

Cap or plug and mark ends of conduit stubouts. Ends of conduit runs shall extend at least 24 inches past face of curb or edge of pavement, unless entering pull boxes. Install markers or markings on curbs for conduit runs. Show locations on as-built plans, as specified under Subsection 622.03(A) - Equipment List and Drawings.

Pass bullet-shaped test mandrel, 14 inches long with diameter 1/2 inch less than inside diameter of each conduit run. Scores found on mandrel deeper than 1/32 inch shall be indication of burrs or obstruction in conduit run. Remove burrs and obstructions. Redo mandrel test until no scoring on mandrel deeper than 1/32 inch is evident.

Keep interior of conduits clean during construction by temporarily plugging ends of conduits. Plug conduit ends at end of each workday, whenever work is stopped, and whenever conduits are subject to submergence in water. Install conduits to drain toward pull boxes or handholes.

(7) Cables and Wires. Provide cables and wires conforming to the NEC. Arrange cables and wires within enclosures, cabinets, luminaires, standards, and pull boxes neatly; and cable together using self-clinching nylon cable ties or other method accepted by the Engineer.

Encase cables and wires installed underground or in concrete rigid barrier type guardrail in conduits.

Immediately before installing cables and wires in conduits, pull wire brush through each conduit to remove extraneous matter, obstructions, and debris.
Furnish cables and wires on reels.

Pull cables and wires directly from their cores or reels into conduits with cable grip designed to provide firm hold on exterior covering of conductor and cable. Do not pull off and lay cables and wires on the ground before installation. Make pulls in one direction only. Use UL or ETL listed inert lubricant. Do not leave cables and wires under tension or tight against bushings or fittings.

Remove damaged ends resulting from use of pulling grips immediately after pulling cable and wire. Maintain cable and wire end seals. Do not pull open-ended cables and wires through conduits. Install cables and wires continuous from pulling point to pulling point. Splices between pulling points will not be allowed. Splices shall only occur inside pull boxes, handholes, or transformer bases.

After cables and wires are installed, seal conduits ends with duct sealing compound conforming to Subsection 712.27(E) - Duct Sealing Compound. Seal vacant conduits with duct sealing compound or plug designed for that purpose and accepted by the Engineer.

When splicing is required, join cables and wires with no-solder pressure connectors. Use no-solder pressure connectors for splicing cables and wires, No. 8 AWG or larger. Leave no sharp points that can pierce taping. Splice and terminate cable and wire in accordance with cable and wire manufacturer’s recommendations. Submit cable and wire manufacturer’s splicing instruction sheets.

Trim cable and wire insulation to conical shape. Roughen cable and wire insulation before applying splice insulation. Splice insulation includes layers of thermoplastic electrical insulating tape not over 0.007 inch thick conforming to Military Specification MIL-I-24391C. Apply splice insulation well lapped over and with same thickness as original insulation. For high voltage and multiple lighting cable and wire splices, apply two layers of synthetic oil-resistant rubber tape conforming to ASTM D 4388 over each cable and wire before placing thermoplastic tape. Then cover splice with at least two layers of asphaltic-impregnated, open-mesh, fabric tape and coating of high-grade insulating paint or similar material.

Coil neatly, at least 5 feet of slack cable or wire near each lamppost foundation, pull box, or transformer base.

String overhead line cables and wires in accordance with Chart No. 1, General Order 6, Rules for Overhead Electric Line Construction as amended, by the Hawaii Public Utilities Commission.
Encase cables and wires on surface of wood poles in rigid steel or PVC-coated rigid steel conduits from 6 inches above ground level to 10 feet above ground and in PVC Schedule 80 conduits above 10 feet.

(8) **Bonding and Grounding.**

(a) Provide grounding for entire electric installation in accordance with the NEC and as specified herein. Ground the following:

1. Electrical service including equipment and enclosures.
2. Conduits, other conductor enclosures, and panelboards.
3. Equipment with non-current carrying metal parts, such as controller cabinets, and lighting fixtures.

(b) **Grounding Electrode.** Furnish copper clad ground rod with 25 ohm maximum resistance to ground. Size of ground rod shall be 3/4 inch by 10 feet minimum. Where resistance exceeds 25 ohm maximum, provide one additional ground rod.

(c) **Manner of Grounding.** Sizes and types of ground conductors, ground clamps, bonding jumpers, conduit, fittings, methods of securing same to obtain electric continuity and effective grounding, when not indicated, shall be in accordance with NEC requirements.

(d) Install ground wire in non-metallic conduits. Furnish ground wire size in accordance with the NEC. Bond street lights and equipment enclosures together by using ground conductor running in conduit system.

(9) **Pull boxes.** Install pull boxes so that covers are level with curb or sidewalk grade or 1 inch above existing ground.

Give frames and covers two coats of asphaltic base paint after installation.

(10) **Continuity of Service.** During relocation, reconstruction or other improvements of existing roadway and sign lighting system, keep existing system operational until reconstructed or new system is in service. Arrange work accordingly and provide temporary lighting system as necessary.
(11) **Secondary Connections.** Make connections from secondary power supply line to fuse boxes with copper cable and wire matching existing secondary cable and wire material.

(D) **Painting.** Furnish metal poles and mast arms with natural zinc-coated finish. Do not paint metal poles and mast arms.

Paint expressway sign luminaire brackets in accordance with Subsection 750.06 - Expressway Sign Luminaire Brackets.

(E) **Electric Service.** Arrange for electric power service with such promptness as to cause no delay in work or work of any other Contractor, and comply with power company’s requirements. Provide secondary circuit extensions to power company’s service. Power company shall provide unmetered service connections, in accordance with Schedule F for multiple service.

On multiple circuits, install laminated black and white plastic identification tag at each source, wood pole, or metal lamppost supporting luminaire.

(F) **Field Test.** Perform the following tests in presence of the Engineer and submit test results as follows:

(1) Test for continuity of each circuit.

(2) Test for grounding of each circuit.

(3) Megger test each circuit between circuit and ground. Insulation resistance shall not be less than values specified in Table 622.03-1 - Insulation Resistance when measured with instrument having voltage rating of 500 volts.
TABLE 622.03-1 - INSULATION RESISTANCE

<table>
<thead>
<tr>
<th>Cable or Circuit</th>
<th>Minimum Resistance (ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.14 - No.12 wire</td>
<td>1,000,000</td>
</tr>
<tr>
<td>25 to 50 amperes</td>
<td>250,000</td>
</tr>
<tr>
<td>51 to 100 amperes</td>
<td>100,000</td>
</tr>
<tr>
<td>101 to 200 amperes</td>
<td>50,000</td>
</tr>
<tr>
<td>201 to 400 amperes</td>
<td>25,000</td>
</tr>
<tr>
<td>401 to 800 amperes</td>
<td>12,000</td>
</tr>
<tr>
<td>over 800 amperes</td>
<td>5,000</td>
</tr>
</tbody>
</table>

(4) Functional test to show that system functions as specified. Replace or repair faults in material or installation revealed by these tests. Repeat same tests until no fault appears.

(G) Salvaging Electrical Equipment. Carefully remove, clean, store, reinstall, and reconnect relocated lighting fixtures.

Remove and dispose of existing electrical equipment not reused in the contract and remove top of abandoned foundation, including anchor bolts and conduits, in accordance with Section 202 - Removal of Structures and Obstructions. Backfill resulting hole with material acceptable to the Engineer.

(H) Restoring Pavements and Other Improvements. Restore to their original condition, existing pavements and other improvements, such as driveways, sidewalks, curbs, and gutters, disturbed by excavation. Use replacement material equal to or better in quality than existing materials. Match existing grades, thickness, texture, and color whenever applicable.

(I) Warranty. Provide new material and equipment for permanent construction.

Furnish copies of manufacturer’s warranty or warranties guaranteeing equipment free from defects in materials, design, and manufacturing, for not less than 12 months from date of acceptance.

Adjust or repair material and equipment under warranty within 24
622.03

hours from time of notification.

Temporarily replace under-warranty material and equipment requiring factory corrections, within 24 hours from time of notification. Install factory-corrected or new material and equipment no later than 30 days from time of notification.

622.04 Measurement. Roadway and sign lighting system will be paid on a lump sum basis. Measurement for payment will not apply.

622.05 Payment. The Engineer will pay for the accepted roadway and sign lighting system on a contract lump sum basis. Payment will be full compensation for the work prescribed in this section and the contract documents.

The Engineer will pay for the following pay item when included in the proposal schedule:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

The Engineer will pay for the accepted hauling and stockpiling of salvaged materials and equipment off the right-of-way, as ordered by the Engineer in accordance with Subsection 104.02 - Changes.

END OF SECTION 622