

1                   **SECTION 622 - ROADWAY AND SIGN LIGHTING SYSTEM**  
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4   **622.01    Description.** This section describes the following:  
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6           **(A)**    Furnishing and installing roadway lighting system, including materials  
 7           necessary for operating and controlling roadway lighting system.  
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9           **(B)**    Furnishing and installing sign lighting system, including materials  
 10          necessary for operating and controlling sign lighting system.  
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12          **(C)**    Relocating existing roadway lights, including materials necessary to  
 13          reconnect relocated lights to existing light circuits.  
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15   **622.02    Materials.**

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17	Structural Concrete (Class B)	601
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19	Reinforcing Steel	602
20		
21	Dark Green Enamel Paint	708.03
22		
23	Welded Wire Fabric Reinforcement	709.01(C)
24		
25	Concrete Pull Box	712.06(B)
26		
27	Conduits	712.27
28		
29	Light Poles	760.01
30		
31	Luminaire Mast Arms	760.02
32		
33	Luminaires for Roadway, Underpass, Sign and Pedestrian	
34	Stairways Lighting	760.03
35		
36	Cables and Wires for Roadway Lighting System	760.04
37		
38	Disconnect and Protective Devices	760.05
39		
40	Waterproof Connectors for Roadway Lighting	760.06
41		
42	Photoelectric Control	760.07
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44           Structural steel anchor bolts and steel plates shall conform to  
 45           AASHTO M 164 and ASTM A 36, respectively. Exposed anchor bolts, nuts, and  
 46           washers shall be zinc-coated, in accordance with AASHTO M 232. Anchor bolts  
 47           and nuts shall be galvanized after threads are cut. After galvanizing, ensure that all  
 48           nuts will turn on bolts to full thread depth. Coat threads with paraffin wax.

## 622.02

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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*.

94 Submit ten copies of materials and equipment list for temporary  
95 lighting system. When existing lights are removed, damaged, or non-  
96 functional, install and operate temporary lighting system during hours of  
97 darkness. Provide same amount of illumination as existing lighting system.  
98

99 Upon completion and acceptance of work, submit construction as-built  
100 drawings showing detailed construction changes.  
101

102 **(B) Excavation and Backfill.** Excavate and backfill in accordance with  
103 Section 204 - Excavation and Backfill for Miscellaneous Facilities.  
104

105 **(C) Installation.**  
106

107 **(1) Foundations.** Construct foundations as indicated in the  
108 contract documents. Foundations within clear zone, as defined by  
109 *AASHTO Roadside Design Guide*, including anchor bolts, shall not  
110 extend more than 4 inches above surrounding ground.  
111

112 Set forms true to correct line and grade. Use rigid forms,  
113 securely braced in place. Place conduit ends and anchor bolts in  
114 proper position and height and hold in place with rigid top template. In  
115 addition to rigid top template, hold anchor bolts in place by means of  
116 rigid bottom template made of steel. Bottom template shall provide  
117 proper spacing and alignment of anchor bolts near their bottom  
118 embedded end. Install bottom template before placing footing  
119 concrete. Anchor bolts installed more than 1:40 from vertical will be  
120 rejected. Hold conduit ends and anchor bolts in place by template  
121 until concrete sets. Cure concrete for not less than 72 hours.  
122

123 Mix, place, and cure concrete for foundations in accordance  
124 with Section 601 - Structural Concrete and Section 503 - Concrete  
125 Structures.  
126

127 **(2) Metal Lamp Standards.** Install metal lamp standard with shaft  
128 plumb on anchor bolts and concrete foundation. Set bracket arm  
129 perpendicular to roadway centerline.  
130

131 Set standards at required locations or as ordered by the  
132 Engineer. Install transformer base such that access cover is located  
133 on trailing face perpendicular to oncoming traffic.  
134

135 Place leveling grout with weep holes under entire metal lamp  
136 standard base plates. Form exposed portions to present neat  
137 appearance.  
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139 **(3) Mast Arms.** Set mast arms perpendicular to roadway  
140 centerline.  
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**(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.

190 Make directional changes in non-metallic conduit with curved  
191 segments using accepted deflection couplings, or with short lengths of  
192 straight conduits and couplings. Deflection angle between two  
193 adjacent lengths of conduit shall not exceed 6 degrees. Do not use  
194 radius of less than 12 times nominal size of conduit, unless using  
195 factory-made ells.

196  
197 Thread connection for PVC conduits to rigid metal conduits on  
198 metal conduit side.

199  
200 Provide each conduit run with No. 10 gage flexible, zinc-coated  
201 pull wire or 1/8-inch polyolefin line extending through entire length.  
202 Double additional 2 feet of wire or polyolefin line back into conduit at  
203 both ends of run. End metal conduits entering pull boxes with  
204 insulating grounding bushings. End non-metallic conduits with end  
205 bells. Cap or plug ends temporarily.

206  
207 Cap or plug and mark ends of conduit stubouts. Ends of  
208 conduit runs shall extend at least 24 inches past face of curb or edge  
209 of pavement, unless entering pull boxes. Install markers or markings  
210 on curbs for conduit runs. Show locations on as-built plans, as  
211 specified under Subsection 622.03(A) - Equipment List and Drawings.

212  
213 Pass bullet-shaped test mandrel, 14 inches long with diameter  
214 1/2 inch less than inside diameter of each conduit run. Scores found  
215 on mandrel deeper than 1/32 inch shall be indication of burrs or  
216 obstruction in conduit run. Remove burrs and obstructions. Redo  
217 mandrel test until no scoring on mandrel deeper than 1/32 inch is  
218 evident.

219  
220 Keep interior of conduits clean during construction by  
221 temporarily plugging ends of conduits. Plug conduit ends at end of  
222 each workday, whenever work is stopped, and whenever conduits are  
223 subject to submergence in water. Install conduits to drain toward pull  
224 boxes or handholes.

225  
226 **(7) Cables and Wires.** Provide cables and wires conforming to  
227 the NEC. Arrange cables and wires within enclosures, cabinets,  
228 luminaires, standards, and pull boxes neatly; and cable together using  
229 self-clinching nylon cable ties or other method accepted by the  
230 Engineer.

231  
232 Encase cables and wires installed underground or in concrete  
233 rigid barrier type guardrail in conduits.

234  
235 Immediately before installing cables and wires in conduits, pull  
236 wire brush through each conduit to remove extraneous matter,  
237 obstructions, and debris.

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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.

286 Encase cables and wires on surface of wood poles in rigid steel  
 287 or PVC-coated rigid steel conduits from 6 inches above ground level  
 288 to 10 feet above ground and in PVC Schedule 80 conduits above 10  
 289 feet.

290  
 291 **(8) Bonding and Grounding.**

292  
 293 **(a)** Provide grounding for entire electric installation in  
 294 accordance with the NEC and as specified herein. Ground the  
 295 following:

- 296  
297 1. Electrical service including equipment and  
298 enclosures.
- 299  
300 2. Conduits, other conductor enclosures, and  
301 panelboards.
- 302  
303 3. Equipment with non-current carrying metal parts,  
304 such as controller cabinets, and lighting fixtures.

305  
 306 **(b) Grounding Electrode.** Furnish copper clad ground rod  
 307 with 25 ohm maximum resistance to ground. Size of ground  
 308 rod shall be 3/4 inch by 10 feet minimum. Where resistance  
 309 exceeds 25 ohm maximum, provide one additional ground rod.

310  
 311 **(c) Manner of Grounding.** Sizes and types of ground  
 312 conductors, ground clamps, bonding jumpers, conduit, fittings,  
 313 methods of securing same to obtain electric continuity and  
 314 effective grounding, when not indicated, shall be in accordance  
 315 with NEC requirements.

316  
 317 **(d)** Install ground wire in non-metallic conduits. Furnish  
 318 ground wire size in accordance with the NEC. Bond street  
 319 lights and equipment enclosures together by using ground  
 320 conductor running in conduit system.

321  
 322 **(9) Pull boxes.** Install pull boxes so that covers are level with curb  
 323 or sidewalk grade or 1 inch above existing ground.

324  
 325 Give frames and covers two coats of asphaltic base paint after  
 326 installation.

327  
 328 **(10) Continuity of Service.** During relocation, reconstruction or  
 329 other improvements of existing roadway and sign lighting system,  
 330 keep existing system operational until reconstructed or new system is  
 331 in service. Arrange work accordingly and provide temporary lighting  
 332 system as necessary.

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## 622.03

334                   **(11) Secondary Connections.** Make connections from secondary  
335 power supply line to fuse boxes with copper cable and wire matching  
336 existing secondary cable and wire material.  
337

338                   **(D) Painting.** Furnish metal poles and mast arms with natural zinc-coated  
339 finish. Do not paint metal poles and mast arms.  
340

341                   Paint expressway sign luminaire brackets in accordance with  
342 Subsection 750.06 - Expressway Sign Luminaire Brackets.  
343

344                   **(E) Electric Service.** Arrange for electric power service with such  
345 promptness as to cause no delay in work or work of any other Contractor,  
346 and comply with power company's requirements. Provide secondary circuit  
347 extensions to power company's service. Power company shall provide  
348 unmetered service connections, in accordance with Schedule F for multiple  
349 service.  
350

351                   On multiple circuits, install laminated black and white plastic  
352 identification tag at each source, wood pole, or metal lamppost supporting  
353 luminaire.  
354

355                   **(F) Field Test.** Perform the following tests in presence of the Engineer  
356 and submit test results as follows:  
357

358                   **(1)** Test for continuity of each circuit.  
359

360                   **(2)** Test for grounding of each circuit.  
361

362                   **(3)** Megger test each circuit between circuit and ground. Insulation  
363 resistance shall not be less than values specified in Table 622.03-1 -  
364 Insulation Resistance when measured with instrument having voltage  
365 rating of 500 volts.  
366

366

TABLE 622.03-1 - INSULATION RESISTANCE	
Cable or Circuit	Minimum Resistance (ohms)
No.14 - No.12 wire	1,000,000
25 to 50 amperes	250,000
51 to 100 amperes	100,000
101 to 200 amperes	50,000
201 to 400 amperes	25,000
401 to 800 amperes	12,000
over 800 amperes	5,000

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**(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**

395 hours from time of notification.

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402 **622.04 Measurement.** Roadway and sign lighting system will be paid on a lump  
403 sum basis. Measurement for payment will not apply.

404

405 **622.05 Payment.** The Engineer will pay for the accepted roadway and sign  
406 lighting system on a contract lump sum basis. Payment will be full compensation for  
407 the work prescribed in this section and the contract documents.

408

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

411

<b>Pay Item</b>	<b>Pay Unit</b>
_____ System	Lump Sum

412

413

414

415

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

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**END OF SECTION 622**