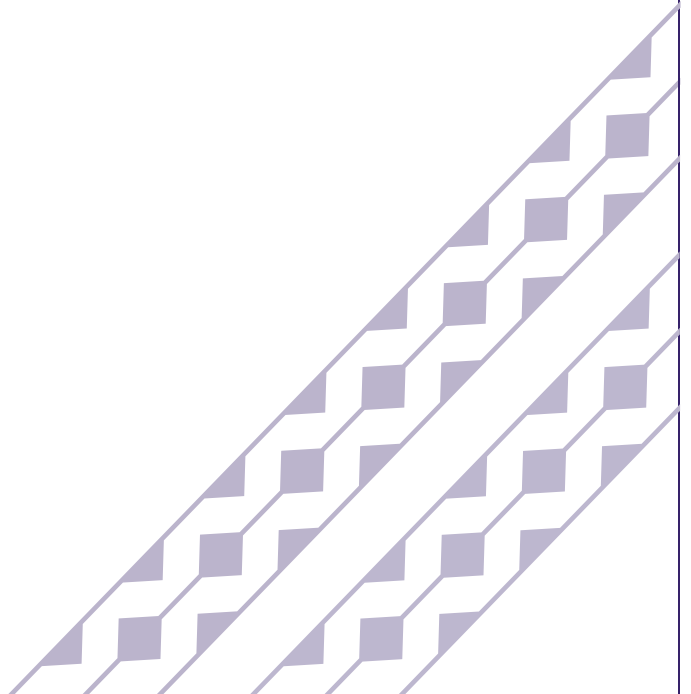




**Hawaiian
Electric**

The information found in this document are general guidelines that may be used to aid in the preparation of your service request proposal. Please be advised that depending on the specific needs and actual conditions of your project, Hawaiian Electric may require your design to comply with different specifications including specifications that include more stringent requirements than those included in these design specification guidelines. For further guidance and clarification on the actual specifications that will apply to your particular project, please refer to instructions issued by Hawaiian Electric's Planner or Engineer who is assigned to your particular (Project/Review Request/...). Additionally, please be advised that Hawaiian Electric reserves the right to require additional modifications to any approved design if it is determined during actual construction that additional modifications must be made to address certain field conditions that were not detected or Hawaiian Electric was unaware of during the design review process.



HAWAIIAN ELECTRIC CO., INC.

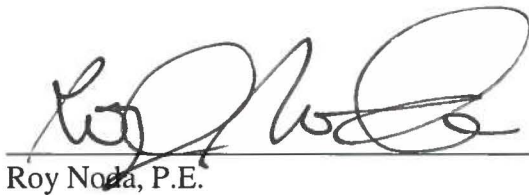
SPECIFICATION NO. CS9401-5

FOR

DESIGN AND CONSTRUCTION OF

PRECAST CONCRETE MANHOLES, HANDHOLES AND VAULTS

Prepared by **Asset Management** Department



Roy Noda, P.E.
Principal Structural Engineer
Structural Division



Warren Hayakawa, P.E.
Principal Technical Services Engineer
Technical Services Division

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HECO SPECIFICATION NO. CS9401-5

DESIGN AND CONSTRUCTION OF PRECAST CONCRETE MANHOLES, HANDHOLES AND VAULTS

PART 1 GENERAL

1.01 GENERAL SUMMARY

- A. This Specification includes the requirements for the design and construction of traffic and non-traffic rated electrical precast concrete manholes, handholes, and vaults.
- B. For certain project site conditions the use of precast concrete structures may not be suitable. For some project locations the Hawaiian Electric Company (the Company, or HECO) will make this decision in advance of bidding. If the Company does not make this decision and the project site conditions make the use of precast structures impracticable, the project general contractor shall be responsible for the additional costs of **providing** cast-in-place concrete structures.
- C. Related Specifications:
 - 1. HECO Specification No. CS7001 Construction of Underground Facilities (latest edition)
 - 2. HECO Specification No. CS9301 Cast-in-place Concrete Work (latest edition)

1.02 SYSTEM DESCRIPTION AND DESIGN REQUIREMENTS

- A. Precast concrete manholes, handholes and vaults shall conform to standard (or project) drawings prepared by the Company or to Company-approved Contractor or manufacturer designs. Contractor or manufacturer designs of precast concrete products shall conform to the requirements and loadings described in this specification and shall be designed, stamped and signed by an engineer with a current structural engineer's license from the State of Hawaii prior to submission to the Company for review. Precast concrete products shall include all components and accessories required by the Company.
- B. Precast **manholes** and vaults shall be designed so that when the bottoms are set near level, the tops match the grade of the ground or sidewalk surfaces at each location. Design features or transitions shall be provided with the structure such that the tops match the finish grades. The details and use of these features and transitions shall be illustrated on the Contractor or manufacturer's design drawings.

C. Design Requirements. Design of precast concrete manholes, handholes and vaults shall conform to the following except as modified herein:

1. **ACI 318** Building Code Requirements for Structural Concrete
2. **ASTM C 857** Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures; **shall apply to manholes, handholes, and vaults not located within areas under the jurisdiction of the State of Hawaii DOT.**
3. National Electrical Safety Code (NESC), 2002 edition.
4. State of Hawaii Public Utilities Commission General Order No. 10, Rules for Construction of Underground Electric and Communications Systems, Section 32 – Manholes and Handholes.
5. Standard Specifications for Highway Bridges, 17th Edition, and latest Interims, American Association of State Highway and Transportation Officials (AASHTO) shall apply to traffic manholes, handholes and vaults not located within areas under the jurisdiction of State of Hawaii Department of Transportation (DOT).
6. AASHTO LRFD Bridge Design Specifications, **7th** Edition, and latest Interims, shall apply to all manholes, handholes and vaults located within areas under the jurisdiction of the State of Hawaii DOT unless alternate design requirements are approved by the State of Hawaii DOT.

Precast concrete products shall be designed to sustain all expected loads that may be imposed upon the structure. In case of conflicts among design requirements, the more stringent requirements shall apply. **Cross referenced standards and codes shall correspond to the applicable code version noted above. Where no version is specified/applicable, the latest standard/code shall apply.**

D. Design loads shall consist of dead load, live load, impact loading, loads due to the ground water and lateral soil pressure, and any other loads which may be imposed upon the structure. The governing design loading shall be the combination of loads which produces the maximum shears and bending moments in the structure. However, precast products shall be designed to withstand any combination of loadings at all points.

1. Unless the established flood elevations at the project site or the project drawings call for a different amount, the design criteria for ground water table shall be assumed to be 3 feet below finish grade.
2. HECO design vertical live loads for manholes, handholes, vaults and underground structures are summarized in Table 1. Traffic live loads shall be increased for impact.

TABLE 1 – Vehicle and Pedestrian Loads

Load Designations (a)(b):	Gross Vehicle Weight (GVW) in Pounds	Max. Wheel Loads in Pounds (0.4 of GVW on one rear wheel) or as noted	Uses / Locations
1. Areas not located within the jurisdiction of the State of Hawaii Department of Transportation:			
a. Traffic: ASTM A-16; AASHTO Standard Spec. HS20-44	40,000	16,000	traffic areas; design per AASHTO Standard Specifications for Highway Bridges.
b. Light Traffic: ASTM A-5 (HECO TR Loading)	12,500	5,000	very light traffic
c. Pedestrian Loading: A 0.3		300 pounds /sq. ft.	walkways, sidewalks
2. Areas located within the jurisdiction of the State of Hawaii Department of Transportation:			
a. Traffic and non-traffic: AASHTO HL-93	as allowed by State law	16,000	traffic areas, walkways, sidewalks, shoulders including entire State right of way; design per AASHTO LRFD Bridge Design Specification

- (a) In the **ASTM C857** designation (A-) the number after A is the maximum wheel load in thousands of pounds. In the AASHTO designation the number after the HS is the total loaded vehicle (comparable to GVW) in tons. The H stands for highway, and the S stands for semi-trailer.
- (b) Design loads other than those listed may be specified.
- (c) **Typical**, unless an alternate loading is approved by the State of Hawaii DOT for areas where there is no way a vehicle can have access to **or impart loads on** the manhole, handhole or vault. **Uniform lane load (psf) shall not apply.**

3. **Except for handholes 3'x5' and smaller**, all pulling eyes or irons and the precast concrete wall and structure to which it is attached shall be capable of holding a **service** load of 10,000 pounds pure tension (with a factor of safety of 2.0 **where ASD methodology is used or with a load factor of 1.6 if LRFD methodology is used**). For 3'x5' **and smaller** handholes the **service** load shall be 2,000 pounds

pure tension with **the same factors of safety or load factor**. This loading shall be in conjunction with other design loads.

The locations of pulling eyes shall be as specified by the appropriate drawing in APPENDIX A of this specification **or Company drawing(s), unless otherwise noted**, and shall be shown on the design and shop drawings. Pulling eyes shall be aligned as close as possible to the duct banks they serve on the opposite walls. Each duct cluster shall have one pulling eye in line with the top of the cluster and another in line with the bottom of the cluster. Locations are subject to Company approval. Pulling eyes shall be located at **18"** from the floors and the ceilings and on the vertical centerlines of the duct banks, unless the proximity of the ducts to the ceilings and walls makes this **location** impractical. In this situation, the **locations are subject to Company approval**.

4. The buoyancy effect of structures subjected to high or fluctuating water table shall be considered in the design of the structure. The factor of safety against buoyancy of the structure shall be at least 1.3. Appropriate design or installation recommendations shall be provided to counteract the effects of buoyancy.
5. The duct entrance locations and sizes (including corner entrance conditions where applicable) shall be considered and incorporated into the structural design calculations. The initial and future locations and sizes of ducts and pulling eyes will be shown for each project structure. The Company drawing(s) in Appendix A show the typical duct entrance and pulling eye arrangements **for projects not within a State right of way (ROW). Refer to other Company drawing(s) for work within State ROW.**

E. Design Method.

1. Except for projects on State highways, roadways and right of ways, the structural design method used for the precast concrete structures shall be either the "elastic" method (**allowable stress design**) or the "ultimate strength" method of reinforced concrete design as outlined in **ACI 318**.
 - a. Minimum concrete cover:
 - 1) Typical minimum reinforcing concrete cover (except concrete handhole covers): 1 1/2 inch for the exterior and 3/4 inch for the interior of the structure. For waterproofing requirements, **Section 2.08E.3** shall apply. The 3/4" cover for the interior bars is based on appropriate waterproofing.
 - 2) Minimum reinforcing concrete cover for concrete handhole covers: 1 inch for the top of the cover and 3/4 inch for the interior and sides of the cover.
2. For projects in State highways, roadways and right of ways, the "LRFD" design method per AASHTO LRFD Bridge Specifications shall be followed. Design and

construction details shall conform to the AASHTO LRFD Bridge Design Specifications, unless alternate requirements are approved by the State of Hawaii DOT.

- a. **Unless shown otherwise, typical minimum reinforcing concrete cover (except concrete handhole covers): 1 1/2 inch for the exterior and 1 inch for the interior of the structure. For waterproofing requirements (integral waterproofing admixture), see Company drawings.**

1.03 SUBMITTALS

A. Manufacturer's Qualification Data

B. Product data and certificates of compliance for the following:

1. Joint sealants
2. Water sealing gaskets
3. Duct connectors **and terminators**
4. **Pulling irons**
5. **Sump pans**
6. **Manhole frame and cover**

C. Precast Product Design Drawings and Calculations.

1. The design drawings shall have all the information necessary to conduct a complete structural analysis of the precast items and accessories.
2. Design drawings shall include details and location of structural and incidental features as specified herein:
 - a. Reinforcement size, configuration, location and placement details.
 - b. Dimensional details of the pulling iron, so the Company can verify that its cable pulling equipment will fit. Show locations and design capacities of pulling irons.
 - c. Details and dimensions of covers and frames. Where applicable, reference HECO drawing numbers for standard frames and covers.
 - d. Details, locations and design capacities of structure lifting devices.
 - e. Details and locations of sumps, water sealing gaskets and waterstops. Submit product data for water sealing gaskets and waterstops.

- f. Joint details, joint sealing material and method of application.
 - g. Weight of each precast concrete sections and covers.
 - h. Design criteria and loadings for precast concrete product.
3. For **alternate** designs, the manufacturer may be asked to furnish, at no cost to the Company, certified evidence of physical proof tests which verify that specific components, such as the pulling irons, meet the specified design loads.

The proof test shall be representative, in the opinion of HECO, of the proposed design. For pulling irons, the minimum proof load (load at failure) shall be 3 times the design working load. The test shall note the load at which initial concrete cracking occurs. Crack initiation shall not occur at less than 1.5 times the design service load.

- 4. Precast concrete product design drawings and calculations shall be stamped and signed by an engineer with a current structural engineer's license from the State of Hawaii.
- 5. Three (3) sets of detailed design drawings and calculations shall be submitted for approval by the Company prior to submission of shop drawings.
- 6. A design drawing of a precast product may cover many projects that use the same basic design.
- 7. **Submit design calculations for the analysis of precast units for lifting stresses and the sizing and location of lifting devices.**
- 8. **For any deviations from the standard drawings, submit structural design calculations based on the design criteria in these specifications prior to the start of fabrication.**

D. Concrete Mix Design and Verification Reports:

- 1. For each mix include date of report, precast product, name of precast manufacturer, name of testing service, and concrete supplier. Concrete mix design shall include a tabulation of the proposed materials, aggregates, source location of aggregates, additives, water-cement ratio, strength, applicable reference specifications for each class of concrete. Include verification test results and reports for each class of concrete showing that the mix design has been tested to produce concrete with the properties specified and will be appropriate for the job conditions. If allowed by the mix design, indicate the amount of water and conditions whereby water may be added to ready-mix concrete at the manufacturer's plant.

2. Test results for each proposed mix shall include:
 - a. Gross weight and yield per cu. yard of trial mixtures.
 - b. Water to cement ratio.
 - c. Measures slump and air content.
 - d. Compressive strength developed at 7 days and 28 days, from not less than 3 test cylinders cast for each 7 and 28-day test, and for each design mix.

E. Project Shop Drawings

1. In addition to the product design drawings mentioned above, the Contractor shall submit three (3) sets of Project Shop Drawings to HECO for approval. These drawings shall show the location of the pulling eyes, duct entrances, sumps, and shall show other pertinent information, such as the dimensional layouts and reinforcing plans for the duct entrance sleeve clusters. The Company will return two (2) sets marked appropriately to the Contractor.
2. These Project Shop Drawings shall identify the project on which the precast product will be used. These drawings shall also reference the manufacturer's model number and the design drawing on which it is based, and the manufacturer shall certify that the basic design is the same as design drawings approved by the licensed structural engineer mentioned above in Section 1.03C.4. The manufacturer shall have a licensed structural engineer make this certification.
3. The intent of calling for these Project Shop Drawings is to have design documentation for the inspection of the precast operations and inspection of the installation operations. For projects with identical models and minor variations of them, the drawings will be the same except for the project titles. In addition, Project Shop Drawings will help to ensure that the structures are installed in the correct locations. The approval of the shop drawings by the Company is for general intent only and the Contractor is still responsible for the correctness of the product.
4. Approval of project shop drawings shall allow the manufacturer to proceed with construction of underground structures, manholes, handholes and covers.

1.04 QUALITY ASSURANCE

- A. Unless approved otherwise by HECO, all precast concrete manholes, handholes and vaults, or sections thereof, shall be manufactured in a plant specifically designed for fabricating precast reinforced concrete products in accordance with **ASTM C 858**, Standard Specification for Underground Precast Concrete Utility Structures. Precast concrete products shall be subject to inspection by the Company or its agent in

accordance with **ASTM C 1037**, Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

B. Precast Concrete Manufacturer Qualifications:

1. Precast concrete manufacturer shall have a minimum of 5 years experience in constructing precast concrete utility structures.
2. Prior to submitting proposals to furnish precast items that will accommodate HECO facilities, the manufacturer shall be subject to a prequalification review which includes the following:
 - a. HECO Support Services and/or Engineering & Project Management Departments will determine if the manufacturer has the financial capacity to do the work and cover its warranties. The manufacturer shall be able to qualify for surety bonds.
 - b. The Company Engineering & Project Management Department or a Company-approved independent firm will check the manufacturer's facilities and methods to verify that they conform with the Company's technical requirements and industry standards and that the facilities are capable of producing the specified products.

C. Precast concrete products shall be inspected and tested per paragraph 2.09.

1.05 STORAGE AND DELIVERY

- A. The concrete strength of the precast unit leaving the plant shall be sufficient to withstand all handling, pickup and impact stresses during its delivery. As a minimum, the concrete strength at the time of shipment shall be at least 75% of its 28-day strength.
- B. Unless specifically instructed otherwise, the completed products must be held by the manufacturer for a minimum of 7 days after the pouring operation before shipment of the products, or unless the manufacturer proves that the precast unit meets the strength requirement described above prior to shipment.
- C. All spalls and cracks shall be repaired prior to shipment and/or installation. No product shall be delivered with cracks that affect the serviceability and structural integrity of the product. Refer to Section 2.08E.3. and Section 2.09A.5.

PART 2 PRODUCTS

2.01 FORM MATERIALS

Form materials shall conform to HECO Specification CS9301, Cast-in-place Concrete Work, latest edition.

2.02 REINFORCING STEEL MATERIALS:

- A. Reinforcing steel bars shall be deformed, free from loose rust, scale, and other coatings and shall conform to the following:
 - 1. **ASTM A 615**, Grade 60 for normal use (not to be welded).
 - 2. **ASTM A 706** for rebars which will be welded.
- B. Steel Wire: **ASTM A 82**, cold-drawn metal, hot dipped galvanized.
- C. Welded Wire Fabric: **ASTM A 185**, galvanized, welded steel wire fabric, or sizes and types indicated in drawings.
- D. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place shall be precast concrete or all plastic bar supports complying with CRSI Manual of Standard Practice.

2.03 CONCRETE MATERIALS

- A. Concrete: Precast concrete products shall be normal-weight concrete except where lightweight concrete is specifically indicated on the drawings.
- B. Portland Cement: **ASTM C 150**, Type I. Use one brand of cement throughout project, unless otherwise acceptable to the Engineer.
- C. Aggregates: Aggregates shall be tested for reactivity in accordance with **ASTM C 289** and **ASTM C 295**, or **ASTM C 227** and shall be classified as non-reactive as verified by the test results. If a change of aggregate source or admixture is proposed, the engineer shall be notified and separate laboratory trials shall be required.
 - 1. Normal Weight Aggregates: Aggregates shall conform to **ASTM C 33**. Provide aggregates from a single source for exposed concrete.
 - a. Fine aggregate shall be clean, hard, dense, free of foreign matter and shall consist of **natural** sand, manufactured fines, or a combination thereof.
 - b. Coarse aggregate shall consist of crushed stone or gravel manufactured from clean, hard, tough, dense, basalt, free from deleterious substances.

- D. Mixing Water: Concrete mixing water shall be taken from a potable supply used for domestic purposes and shall be free from rust and silt.
- E. Admixtures:
1. With prior approval of HECO, admixtures conforming to HECO Specification CS9301, Cast-in-place Concrete Work, latest edition may be used if the strength and durability of the concrete is not impaired.
 2. Admixtures shall be compatible with other admixtures, cementitious materials and components in the mix design. Do not use admixtures containing calcium chloride.
 3. Admixtures containing thiocyanates at dosage levels which promote corrosion of steel will not be permitted in the concrete mix. For admixtures containing thiocyanates, submit test data regarding corrosion of steel in concrete including corrosion results associated with dosage range.

2.04 PROPORTIONING AND DESIGN OF CONCRETE MIXES

- A. Precast concrete products shall be normal-weight concrete except where lightweight concrete is specifically indicated on the drawings.
- B. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in **ACI 301** and **ACI 318**. If trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing. Proportion design mixes by weight for each class of concrete required, complying with **ACI 211.1**, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete" for normal weight concrete and with **ACI 211.2**, "Standard Practice for Selecting Proportions for Structural Lightweight Concrete" for structural lightweight concrete.
- C. Design mixes shall provide concrete compressive strengths and properties shown in Table 2, unless otherwise indicated on the drawings or special conditions.

TABLE 2 – CONCRETE CLASSES AND LOCATIONS					
Class of Concrete (Normal weight concrete unless otherwise indicated)	Min. 28 day compressive strength, psi	Max Water- Cement Ratio, W/C	Max. Size Aggregate, in.	Slump at Point of Discharge, in.	Typical Locations (unless otherwise shown on the drawings)
HECO 5000	5,000	0.4	3/4	6-7** typical (4" at ramps)	Handholes, manholes, vaults, and underground structures.
** Initial design slump shall be 2-4 inches. Add appropriate water-reducing and/or high range water-reducing admixtures as required to obtain specified slump at point of discharge.					

- D. Submit written concrete mix designs to the Engineer for each design mix at least 15 calendar days prior to the start of the work.
- E. Provide test results from the concrete supplier for each of his proposed design mixes, to establish the following:
 - 1. Gross weight and yield per cu. yd. of trial mixtures.
 - 2. Measured slump.
 - 3. Measured air content.
 - 4. Compressive strength developed at 7 days and 28 days, from not less than 3 test cylinders cast for each compressive strength.

2.05 METALS

- A. Steel plates, bars, angles, anchor rods: Conform to **ASTM A 36**, hot dipped galvanized.
- B. Steel shapes and channels: Conform to **ASTM A 992**, Grade 50 or **ASTM A 36**, hot dipped galvanized.
- C. Stainless steel: Conform to **ASTM A 276, Type 316**.

2.06 ACCESSORIES

- A. Pulling irons: Pulling irons and components, including the internal and external nuts, the u-bolts and plates of the u-bolt type of pulling eyes, shall be made of non-magnetic stainless steel conforming to **ASTM A 276, Type 316**, or of other non-corrosive material approved by HECO. Welding of stainless steel items shall be performed per

American Welding Society standards using an E316 electrode. When installed the u-bolt assemblies shall be water tight.

- B. Sumps shall be centrally located under the manhole openings. Sumps shall be provided with removable, non-slip, non-corroding covers that will safely cover the sump (3/8 inch thick pultruded vinyl ester floor plate with 2 each 1/2 diameter center holes, gray, fire-retardant, self extinguishing, McNichols or approved by HECO).
- C. Structure lifting anchors and devices shall be placed to maximize the ease of precast manhole, handhole or vault placement and shall have a minimum factor of safety of 4.0 times the section weight. Except for covers, lifting anchors and devices shall be hot dipped galvanized. Anchors and devices for covers shall be stainless steel, **ASTM A 276, Type 316**.
- D. Water sealing gaskets shall be adequate to withstand environmental conditions (i.e., saltwater, petroleum, acidic and alkaline liquids, etc.).
- E. Threaded concrete anchors 1/2" diameter x 3-3/4" length shall be provided at a maximum of 24" center to center horizontal and vertical spacing on each wall of the manhole, handhole, or vault, for cable racking purposes. Ultimate shear capacity = 4000 pounds and ultimate tensile capacity = 4000 pounds with 2.25 inch embedment. The project designer shall specify in advance whether these inserts shall be made of plastic, galvanized steel or stainless steel.
- F. Ground Rods: Two opposite corners of the precast manhole, handhole or vault floor shall be provided with sealed holes through which 5/8" diameter ground rods can be driven as needed and made water tight after the driving is completed.
- G. Duct Connectors: Preformed plastic adapters which will be cast in the concrete walls and will provide a smooth tight connection with the incoming ducts. Bowco Industries Duct Terminators or approved by HECO.
- H. Joint Sealant: Preformed flexible plastic gasket conforming to Federal Specification SS-S-210A, Type 1, rope form, Ram-Nek or approved by HECO.
- I. Identification tag: A permanently embedded brass identification tag shall be provided on the interior of all precast units. The name of the manufacturer, product and/or model number, location of the precasting facilities, the date of precasting and the capacity of the pulling eyes shall be clearly and permanently marked on the tag. The tag shall be located on the side of the manhole, **vault**, or handhole opening.

- J. Identification imprint: The manhole covers, the tops of visible end walls of handholes, or the handhole covers, if the end walls are too narrow or are not visible, shall be imprinted with the letters below to identify the ownership of the structures:

Owning Company	Identifying Letters
Hawaiian Electric Co., Inc.	HECO
Hawaii Electric Light Co., Ltd.	HELCO
Maui Electric Co., Ltd.	MECO

2.07 FRAMES AND COVERS

Frames and covers shall conform to the following:

- A. Manholes: **HECO 31" Manhole Grate shown in Standard Material Drawing 011335**, HECO 31" Manhole Cover shown in Standard Material Drawing 011327 and HECO 31" Manhole Frame shown in Standard Material Drawing 011328.
- B. Handholes not subject to vehicular traffic: HECO Handhole Concrete Cover SW (Sidewalk), 1' - 6 3/4" x 3' - 3 3/4" x 2 1/2" and HECO Handhole Concrete Cover SW1 (Sidewalk), 1' - 2 13/16" x 3' - 3 3/4" x 2 1/2", detailed on HECO Drawing 101028, "Concrete Covers for Handholes, Plans, Elevations, Sections & Details, Underground Typical Construction." This cover shall be designed for the 300 lbf/sq. ft. shown in TABLE 1.
- C. Handholes subject to very light vehicular traffic: HECO Handhole Concrete Cover TR (Traffic) 1' - 3" x 3' - 4 3/4" x 3 3/8", detailed on HECO Drawing 101028, "Concrete Covers for Handholes, Plans, Elevations, Sections & Details, Underground Typical Construction." This cover shall be designed for the A-5 loading (5000-pound wheel load) in TABLE 1.
- D. Handholes subject to heavy vehicular traffic (not in State of Hawaii highways and rights of way): HECO Handhole Concrete Cover Type TR Modified (Traffic) 1' - 3" x 3' - 4 3/4" x 3 3/8", detailed on HECO Drawing 101029, "Type 'TR' Modified Traffic Cover for AASHTO H20 Wheel Load & Typ. Details, Plans, Elevations, Sections & Details, Underground Typical Construction." This cover shall be designed for the A-16 loading (16,000-pound wheel load) in TABLE 1.
- E. Handholes subject to heavy vehicular traffic (within State of Hawaii highways and rights of way): HECO Drawing **103765 "HECO HL-93 rated Manholes, Vaults, and Handholes-Cover Plate Details"**.
- F. At the discretion of the project designer or engineer, light-weight, galvanized steel, non-slip covers can be substituted for one or more of the SW-type concrete covers in a handhole. These steel covers, the handhole structure and shelves that support the covers shall be designed for the A-0.3 loading in TABLE 1. The steel covers shall be like light-weight, non-slip, galvanized steel covers, manufactured for HECO by

INWESCO, or approved equals. The lifting nuts welded to the bottom of the cover shall be made of non-magnetic stainless steel. These light weight covers shall be designed to minimize the pressure build-up in the handhole in the event of a cable or gas explosion in the duct system served by the handhole or in the handhole. This objective can be accomplished by making sure the lifting holes are open at all times and by having holes made in the edge supporting angles or by providing spaces between angles through the proper cutting and positioning of the supporting angle segments. When necessary to prevent the entry of a spears or similar sharp device into the handhole, a strong metal clip shall be welded next to the lifting holes and nuts and bent over the nut to form a barrier to entry. To prevent unauthorized entry, this SW-type steel cover shall weigh at least 100 pounds but shall not weigh more than 110 pounds. To prevent injury to the general public and to workers, sharp corners and edges shall be eliminated prior to galvanizing.

- G. Similarly, at the discretion of the project designer or engineer, light-weight, galvanized steel, non-slip covers can be substituted for one or more of the TR-type concrete covers in a handhole. These steel covers, the handhole structure and shelves that support the covers shall be designed for the A-5 loading in TABLE 1. The steel covers shall be light-weight, non-slip, galvanized steel covers, manufactured for HECO by INWESCO, or approved equals. The lifting nuts welded to the bottom of the cover shall be made of non-magnetic stainless steel. These light weight covers shall be designed to minimize the pressure build-up in the handhole in the event of a cable or gas explosion in the duct system served by the handhole or in the handhole. This objective can be accomplished by making sure the lifting holes are open at all times and by having holes made in the edge supporting angles or by providing spaces between angles through the proper cutting and positioning of the supporting angle segments. When necessary to prevent the entry of a spears or similar sharp device into the handhole, a strong metal clip shall be welded next to the lifting holes and nuts and bent over the nut to form a barrier to entry. To minimize the possibility of back injuries, these covers shall weigh no more than 150 pounds. To prevent injury to the general public and to workers, sharp corners and edges shall be eliminated prior to galvanizing.
- H. To make them non-slip, the tops of the galvanized metal covers described above shall be made of Algrip galvanized steel plate produced by Safe-Walk Inc. Algrip plate consists of super-hard granules of aluminum oxide embedded into the top surface of the plate. An acceptable alternate for the tops of the covers is a Slip-Not steel plate made by W. S. Molnar Co. This product is made by the plasma deposition of file-hard steel on the top surface of the plate.

2.08 PRECAST CONCRETE FABRICATION

- A. Forms shall be sufficiently designed and braced to maintain their alignment during placement of wet concrete. The form shall allow the placement of pulling eyes or irons directly opposite of duct entrances. The forms shall permit the use of a centrally located 31" diameter round opening frame and cover in the top section for access by personnel (See Section 2.07 above) and an adequately sized sump centered in the

bottom section of the precast manhole, handhole or vault. Forms shall provide a surface finish that is smooth and free from honeycomb pockets.

- B. Reinforcing Steel: All reinforcing steel shall be of the size and in the location as shown on the stamped structural plans and shall be sufficiently tied to withstand any displacement during the concrete pouring operation. All steel shall be free of loose rust, dirt, oil or other deleterious material and shall maintain a minimum concrete cover in strict accordance with **ACI 318** unless otherwise specified herein.
- C. Duct connectors: The manufacturer shall cast into the manhole, handhole and vault a strong, plastic adapter that will provide for a smooth, tight connection with the incoming ducts. If the duct connections are to be made at some future time, these plastic adapters shall prevent any moisture or dirt from entering the manhole, handhole or vault. The external portion of the adapters shall be covered with a removable cover that will keep the dirt out of the adapter until the connections are made in the future. These sleeves shall snugly fit over and connect to Schedule 40 PVC ducts. The concrete around these sleeves shall be reinforced. The number, size, and location of these sleeves and sleeve-banks shall be shown on the shop drawings submitted for final approval prior to fabrication. The sleeve configuration shall conform to the maximum size and number shown on the previously approved design drawing.
- D. Placement of Concrete: All concrete shall be handled from the batch plant (per **ASTM C 94**) to the form work in a continuous manner without segregation or loss of ingredients. Concrete shall be placed in layers not over two (2) feet deep. Each layer shall be thoroughly compacted by mechanical internal or external-vibrating equipment. The duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation, as measured by the appearance of the free surfaces before initial set of the concrete. Refer to Section 2.08E.3.
- E. Curing and Finishing:
 - 1. Curing shall comply with HECO Specification CS9301 and as modified herein. The concrete may be steam cured after an initial set has taken place. The steam temperature shall not exceed 160 degrees F, and the temperature shall be raised from normal ambient temperatures at a rate not to exceed 40 degrees F per hour.
 - 2. The steam cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any structural loads that it may be subjected to during the form stripping operation. After the stripping of forms, further curing shall be continued by means of water spraying or by means of a continuous coating of an approved membrane curing compound. The curing compound shall be clear or white in color, conforming to **ASTM C309** and shall be compatible with any finish material.
 - 3. Interior walls and ceilings shall be smooth and free of irregularities and all surfaces shall be sound. Sections having cracks and other defects that may impair structural strength or that may allow water migration are not acceptable. At

HECO's option, interior walls shall be coated with a white cement based, heavy duty, waterproof coating, unless noted otherwise in the project documents. Also at the option of HECO the exterior surfaces subject to ground water exposure shall be treated with a cement based heavy duty waterproof coating so as to form a liquid tight seal, unless noted otherwise in the project documents.

When the structure is assembled, joints **shall** be evenly aligned and completely filled with the sealant per Section 2.06H. Manhole necks in ceilings shall have beveled edges (no sharp corners).

4. Finishing work shall comply with HECO Specification CS9301 and as modified herein.
- F. The weights of each precast concrete section shall be stenciled on the products prior to shipment.

2.09 SOURCE QUALITY CONTROL

A. HECO Inspections:

1. Precast concrete products, components and accessories shall be inspected by HECO prior to placement of the concrete. Concrete shall not be poured without inspection by HECO.
2. The inspection of the fabrication of all precast products at locations not on Oahu shall be performed by Company or subsidiary personnel, or by independent persons or firms approved in advance by the Company. The Company shall pay for this independent inspection. The manufacturer shall give ample notice to independent inspection agencies so the inspections will spot deficiencies in time for corrective action. In no case shall the advance notice be less than three working days.
3. For precast products fabricated on Oahu, the precaster shall provide an advance listing of units to be built to the HECO inspector, on a monthly basis. The listing shall include the scheduled concrete pour dates and the projects on which the units are to be used.
4. The contractor responsible for the installation of the precast item shall notify the appropriate Company Inspector three working days in advance of the installation of the precast product.
5. The Company or its agent shall have the sole right to determine if an item is damaged or defective and is to be repaired or replaced. All repairs and replacements are to be at the manufacturer's or contractor's expense.

B. Special Inspection

1. Special inspections per Building Code requirements are required for the following types of concrete work:
 - a. Reinforcing steel.
 - b. Bolts installed in concrete.
 - c. Concrete placement and testing.
 - d. Other designated concrete related work requiring special inspections as indicated on the drawings.
2. Special Inspector shall be provided by HECO. Contractor shall arrange for special inspections and shall notify Engineer and Special Inspector at least 3 working days prior to performing work requiring special inspections.
3. Special Inspector shall observe the construction work and notify HECO and the Contractor of discrepancies in the work. Contractor shall correct deficiencies in a timely manner.
4. Special Inspector shall submit inspection reports to HECO and the engineer or architect of record. A final report per Building Code requirements shall also be submitted to HECO and the building official.

C. Testing: The following concrete tests shall be performed by a qualified testing laboratory for the initial pour of each type of precast concrete product and at an interval of every year thereafter. Costs of tests shall be borne by the precast concrete manufacturer.

1. Slump. One each standard slump test per **ASTM C143**.
2. Air Content: **ASTM C 173**, volumetric method for lightweight or normal weight concrete; **ASTM C 231** pressure method for normal weight concrete; one for each day's pour of each type of air- entrained concrete and for each set of compressive strength test cylinders made.
3. Concrete Temperature: Test hourly when air temperature is 80°F (27°C) and above; and each time a set of compression test specimens made.
4. Compressive strength tests: One set of four (4) standard 6"x12" cylinders molded and cured per **ASTM C 31** and tested per **ASTM C39**. One cylinder shall be tested at 7 days, two cylinders tested at 28 days and one cylinder retained reserved for later testing if required.

5. Test reports shall be submitted in writing to HECO. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
6. Costs of additional testing, engineering evaluation and investigation for work with test results than do not meet the requirements of the specifications shall be borne by the precast concrete manufacturer.

PART 3 EXECUTION

3.01 EXCAVATION AND EARTHWORK

The latest revision of Hawaiian Electric Company, Inc. Specification No. CS7001, Standard Specifications for Construction of Underground Facilities, shall govern the excavation and earthwork for precast manholes, handholes and vaults unless otherwise specified herein or by the Project Engineer.

3.02 PREPARATION AND INSTALLATION

- A. A **hydrophilic** joint sealing compound (**MC-2010MN by Adeka Corporation or approved equal**) shall be used between precast manhole, handhole and vault sections as a sealant to ensure a leak free structure.
- B. Precast structures shall be installed in accordance with the provisions of the **ASTM C891**, Standard Practice for Installation of Underground Precast Concrete Structures and the latest revision of HECO Specification CS7001.

3.03 FIELD QUALITY CONTROL

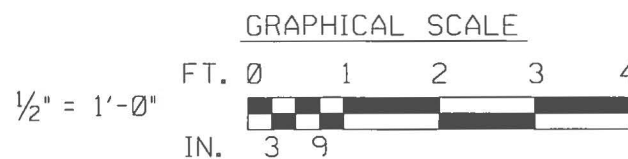
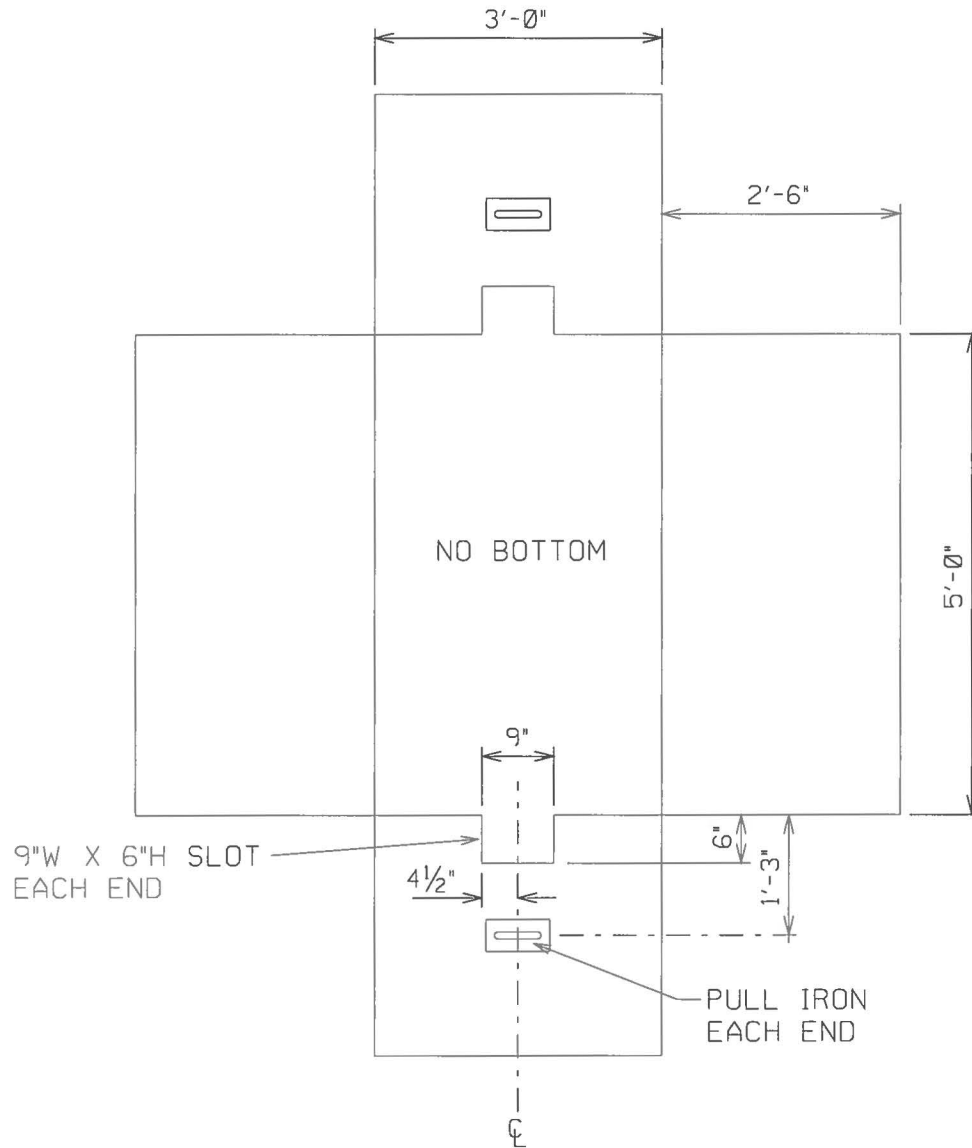
Field quality control shall be in accordance with HECO Specification CS7001, Standard Specifications for Construction of Underground Facilities.

End of Specification

APPENDIX A

TYPICAL DUCT ENTRANCE AND PULLING EYE LOCATIONS AND SIZES FOR USE NOT WITHIN STATE HIGHWAYS OR RIGHT OF WAYS

Figure A	3'x5' Non-vehicular Traffic Handhole
Figure 1	6'x11' and 6'x14' Side Entrance Manhole
Figure 2	6'x11' and 6'x14' Corner and Side Entrance Manhole
Figure 3	6'x11' and 6'x14' Center Entrance Manhole
Figure 4	6'x11' and 6'x14' Corner and Center Entrance Manhole
Figure 5	6'x11' and 6'x14' Flat Entrance Manhole
Figure 6	6'x11' and 6'x14' Corner and Flat Entrance Manhole
Figure 7	6'x11' and 6'x14' Single Row Side Entrance Manhole
Figure 8	3'x5', 4'x6', 5'x7' and 6'x11' Center Entrance Handholes



HAWAIIAN ELECTRIC CO., INC.
HONOLULU, HAWAII

3' X 5' NON-VEHICULAR TRAFFIC HANDHOLE
FIG. A

ORIGINAL
SPEC. NO.
CS9401-5 0

TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

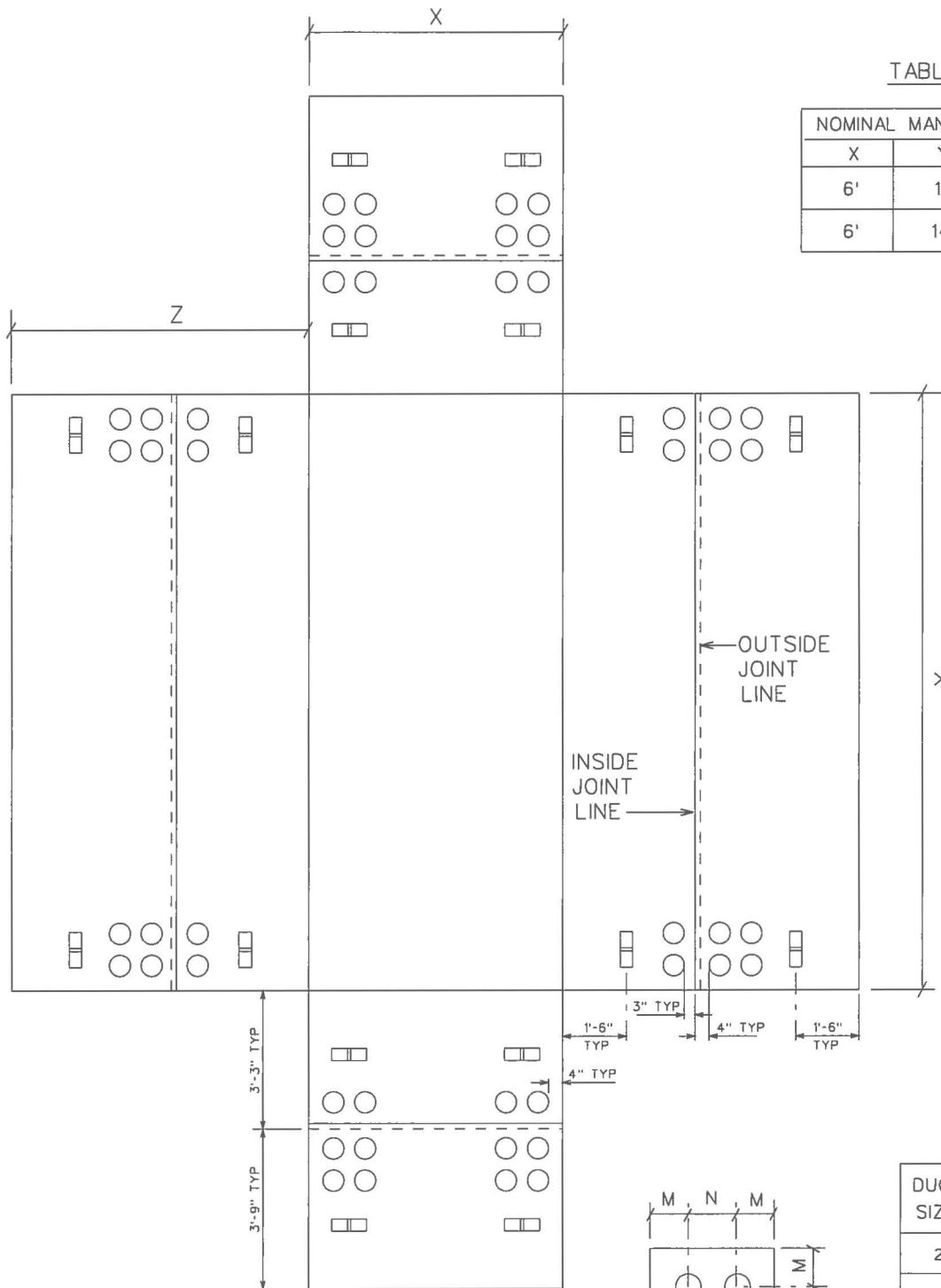


TABLE B

DUCT SIZE	DIMENSION	
	M	N
2"	4"	5"
3"	5"	6"
4"	5½"	7"
5"	6"	8"
6"	6¾"	9"

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.

GRAPHICAL SCALE

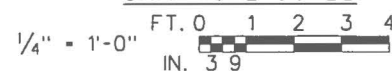


TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

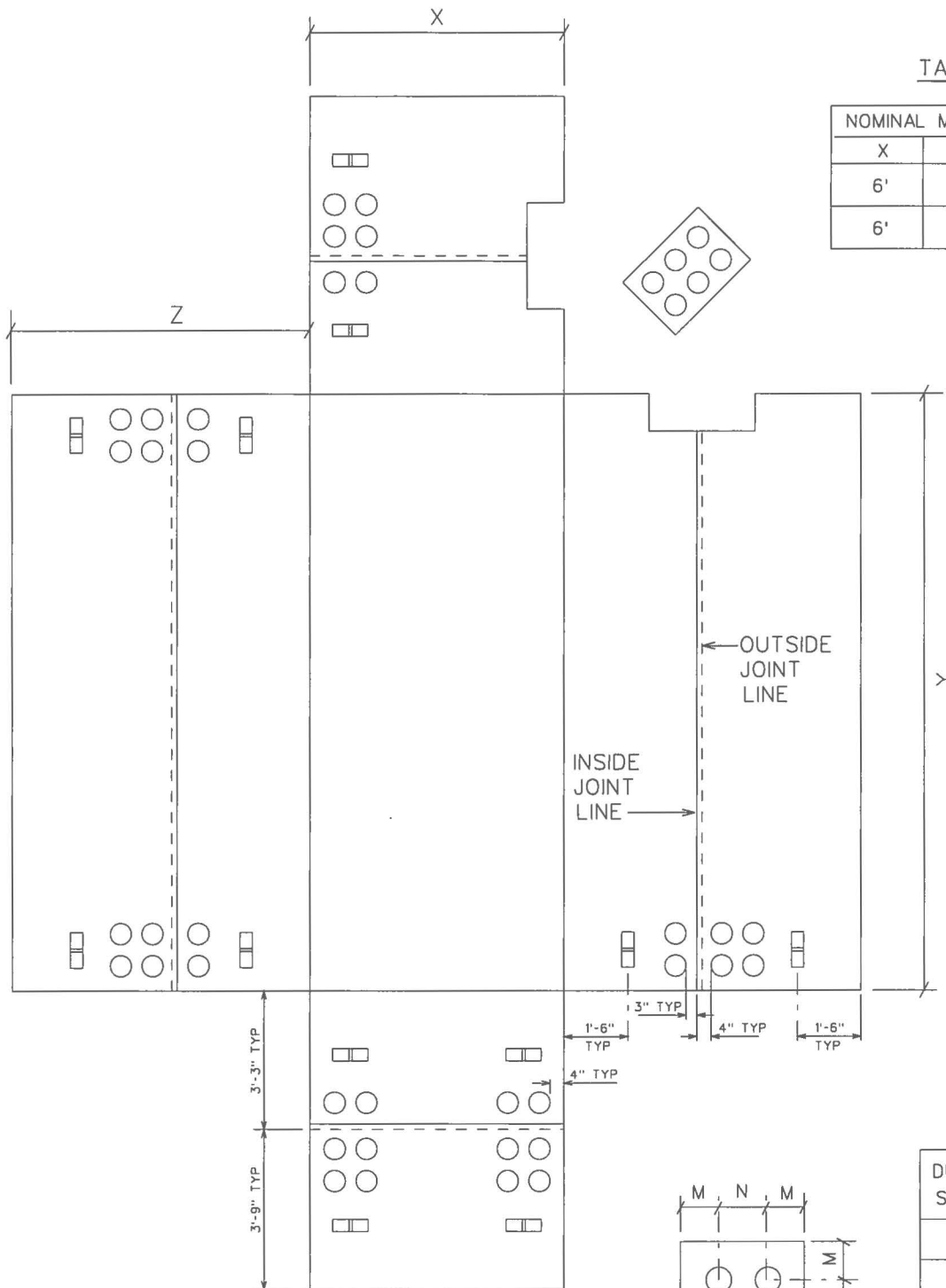
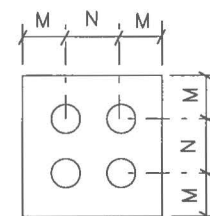


TABLE B

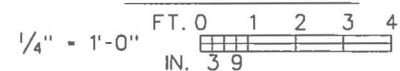
DUCT SIZE	DIMENSION	
	M	N
2"	4"	5"
3"	5"	6"
4"	5½"	7"
5"	6"	8"
6"	6⅝"	9"

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.



GRAPHICAL SCALE



HAWAIIAN ELECTRIC CO., INC.
HONOLULU, HAWAII

APPENDIX A: TYPICAL DUCT ENTRANCE LOCATIONS
FIG. 2 - CORNER AND SIDE ENTRANCE MANHOLE

ORIGINAL 9/14/94

SPEC. NO.
CS9401-5 1

TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

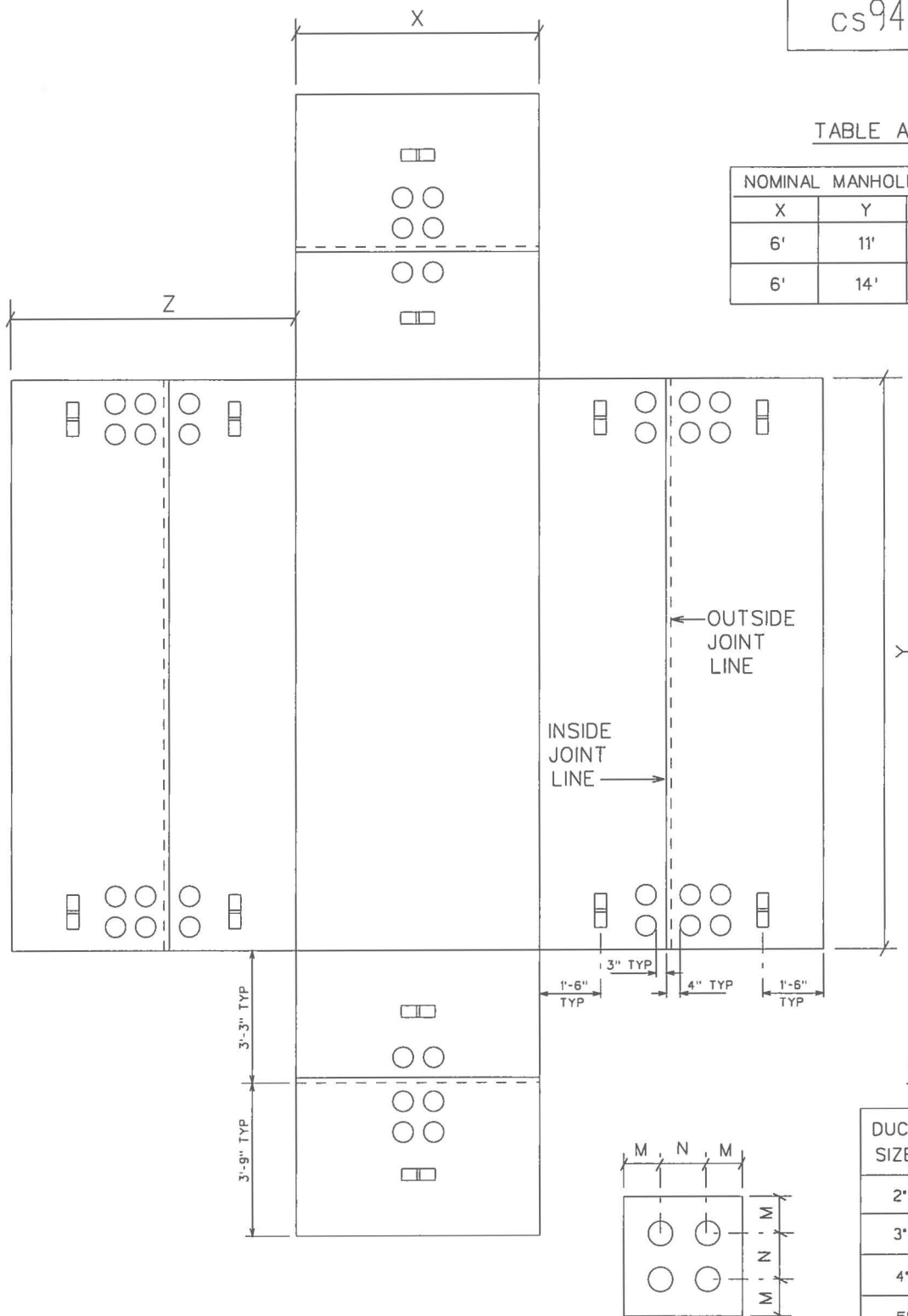


TABLE B

DUCT SIZE	DIMENSION	
	M	N
2"	4"	5"
3"	5"	6"
4"	5½"	7"
5"	6"	8"
6"	6⅝"	9"

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.

GRAPHICAL SCALE

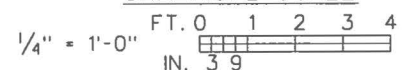


TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

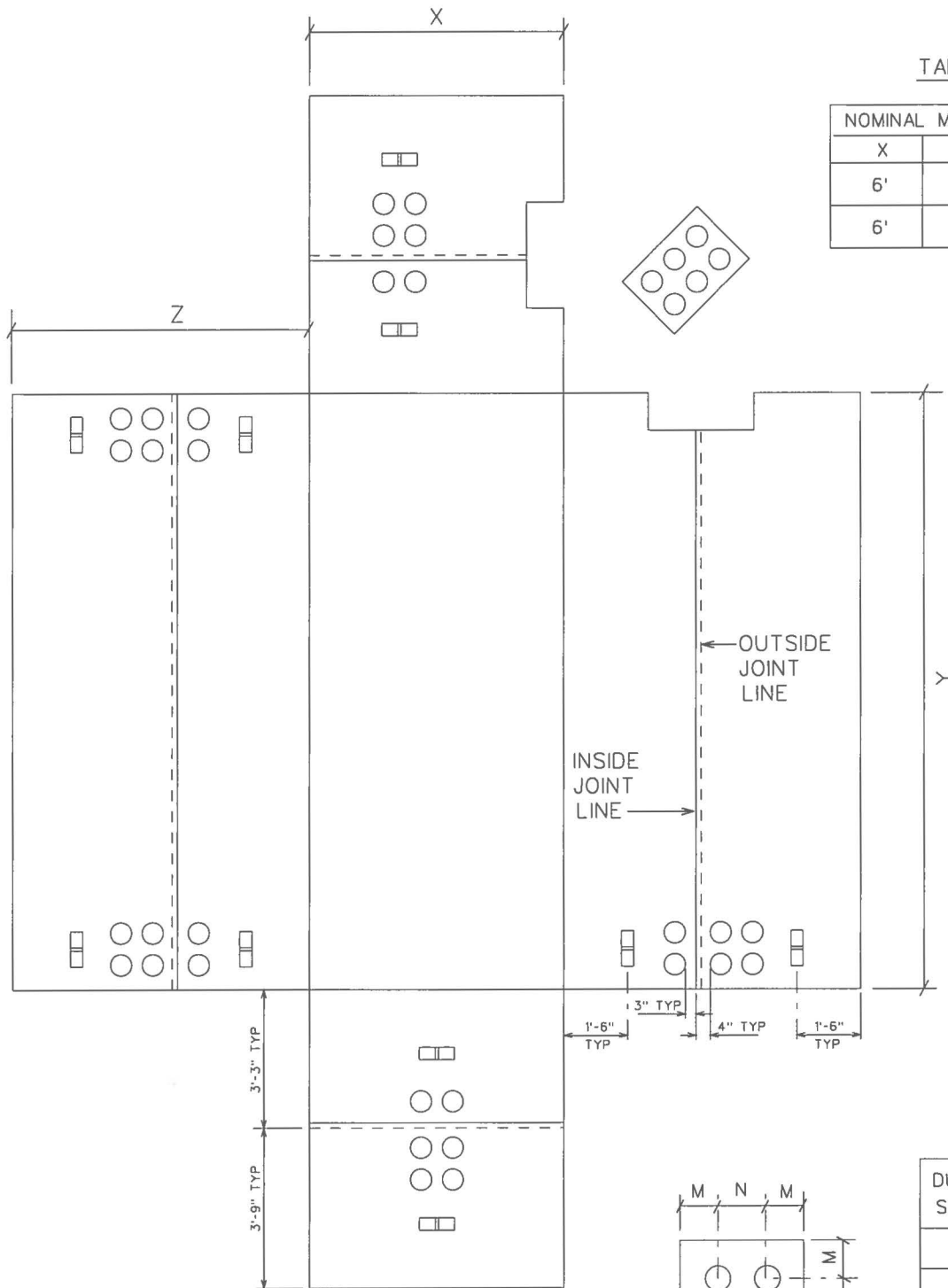
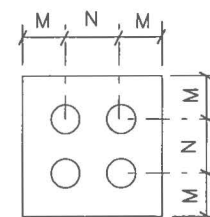


TABLE B

DUCT SIZE	DIMENSION	
	M	N
2'	4'	5'
3'	5'	6'
4'	5½'	7'
5'	6'	8'
6'	6¾'	9'

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.



GRAPHICAL SCALE

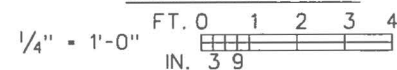


TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

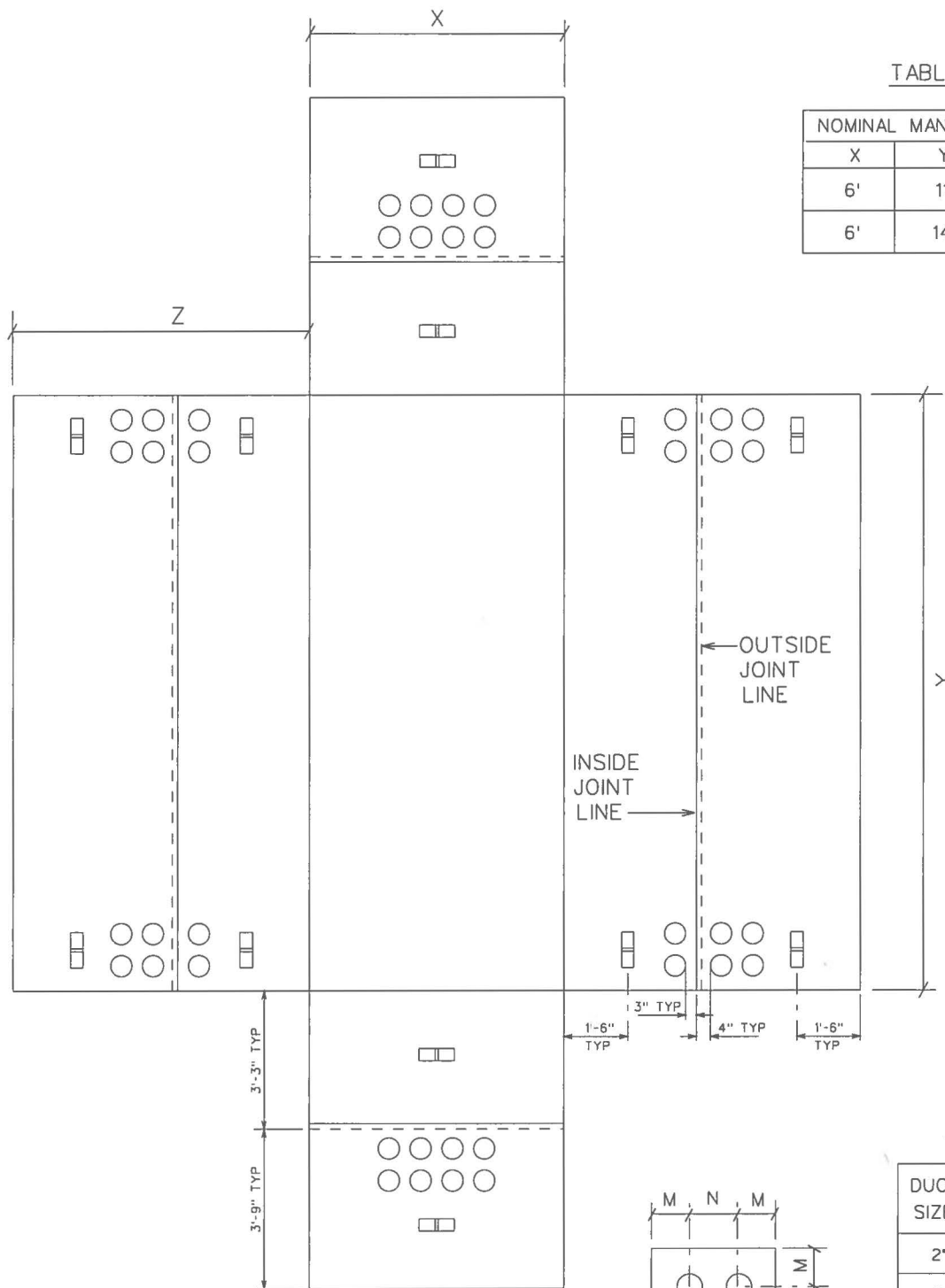
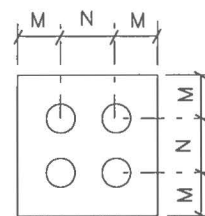


TABLE B

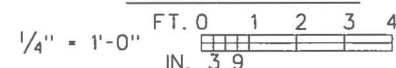
DUCT SIZE	DIMENSION	
	M	N
2'	4'	5'
3'	5'	6'
4'	5½'	7'
5'	6'	8'
6'	6⅝'	9'

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.



GRAPHICAL SCALE



cs9401f0625.01

TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	6'-6"
6'	14'	6'-6"

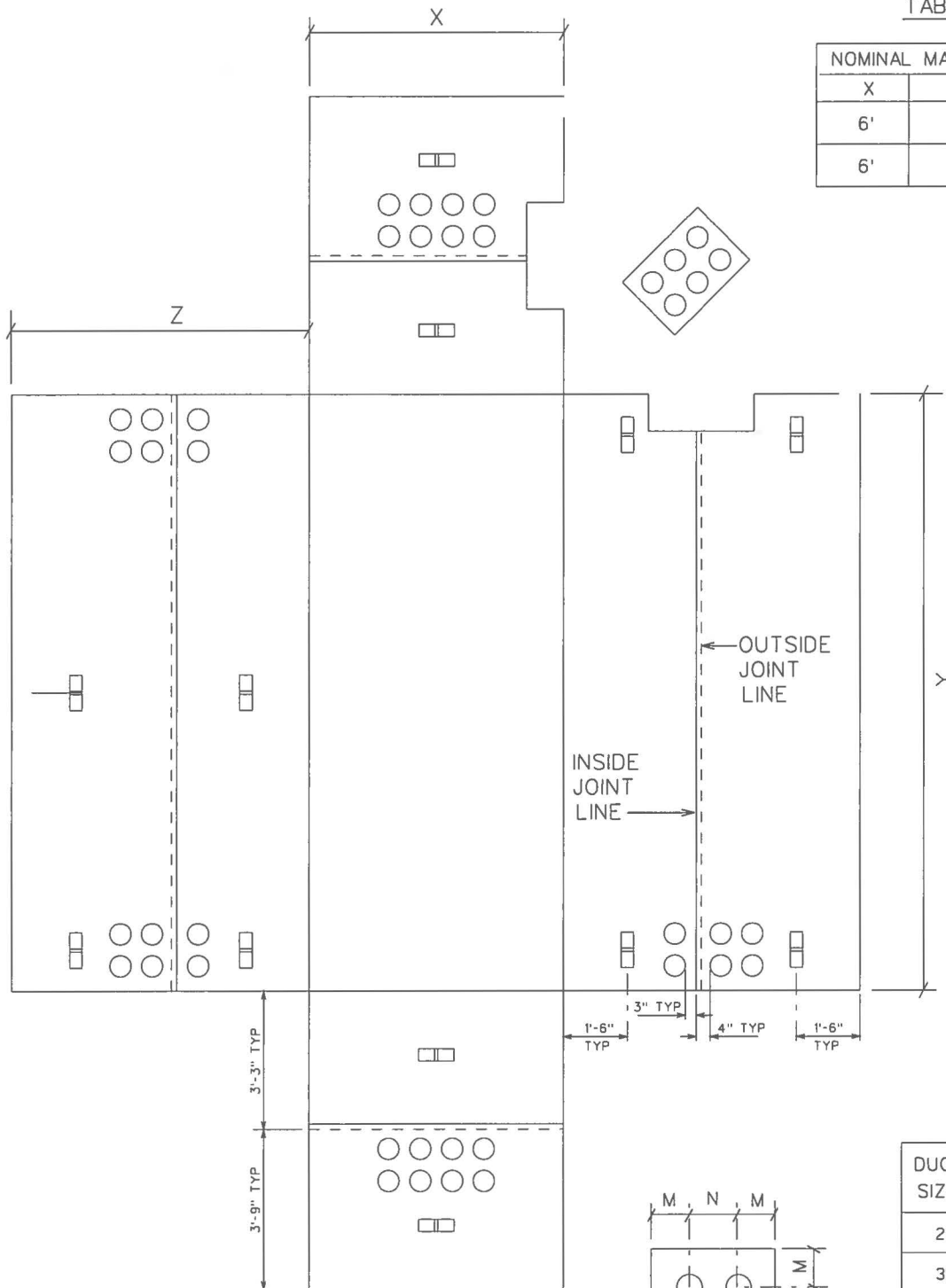


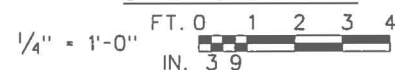
TABLE B

DUCT SIZE	DIMENSION	
	M	N
2'	4'	5'
3'	5'	6'
4'	5½'	7'
5'	6'	8'
6'	6⅝'	9'

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.

GRAPHICAL SCALE



HAWAIIAN ELECTRIC CO., INC.
HONOLULU, HAWAII

APPENDIX A: TYPICAL DUCT ENTRANCE LOCATIONS
FIG. 6 - CORNER AND FLAT ENTRANCE MANHOLE

ORIGINAL 9/14/94

SPEC. NO.
CS9401-5 1

TABLE A

NOMINAL MANHOLE SIZES		
X	Y	Z
6'	11'	7'-0"
6'	14'	7'-0"

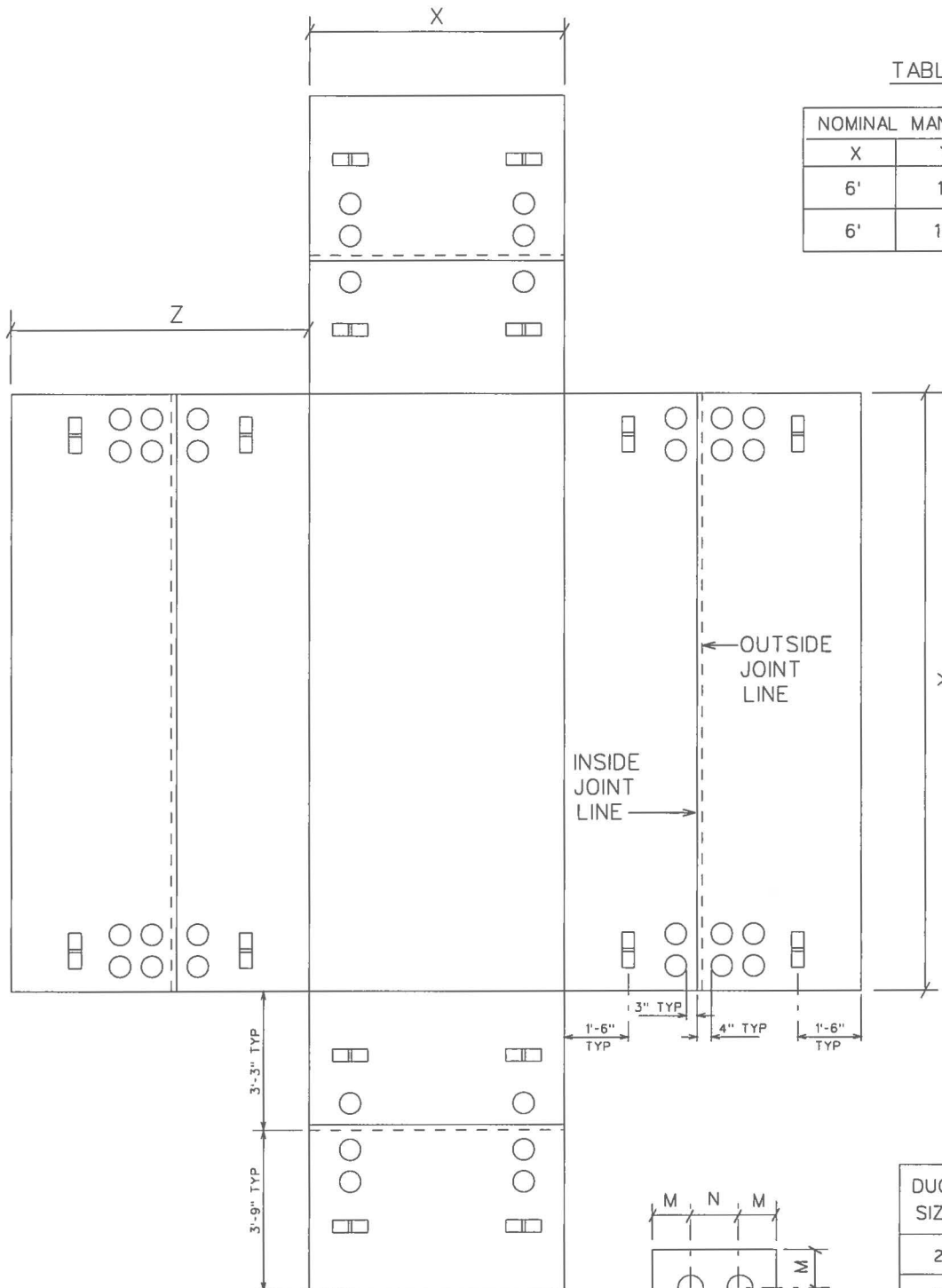
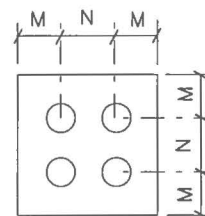


TABLE B

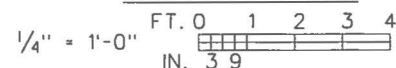
DUCT SIZE	DIMENSION	
	M	N
2"	4"	5"
3"	5"	6"
4"	5½"	7"
5"	6"	8"
6"	6⅝"	9"

NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS. PULLING EYE LOCATIONS WILL BE SPECIFIED ACCORDINGLY.
2. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
3. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
4. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.



GRAPHICAL SCALE

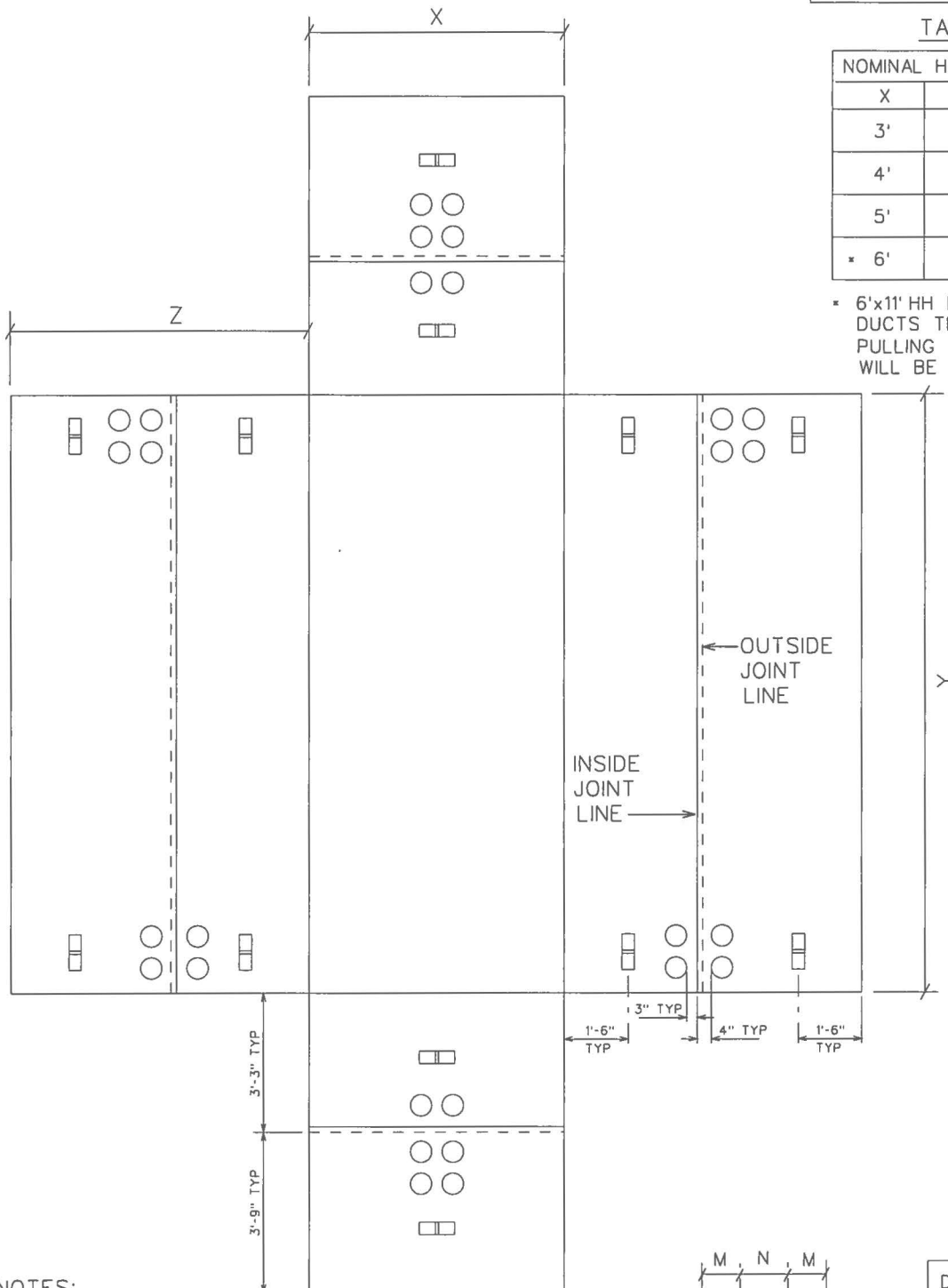


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TABLE A

NOMINAL HANDHOLE SIZES		
X	Y	Z
3'	5'	2'-6"
4'	6'	4'-6"
5'	7'	5'-5"
6'	11'	7'-0"

* 6'x11' HH MAY HAVE MORE DUCTS THAN SHOWN & PULLING EYE LOCATIONS WILL BE SPECIFIED.



NOTES:

1. ACTUAL DUCT SIZES, NUMBER & LOCATIONS WILL BE SPECIFIED IN PROJECT DRAWINGS.
2. HANDHOLES ARE FOR USE IN AREAS NOT SUBJECT TO VEHICULAR TRAFFIC.
3. REFERENCE HECO DWG. 16688 SHTS 1 & 2 FOR MISCELLANEOUS HANDHOLE DETAILS, AS APPLICABLE.
4. BOXES SHALL BE ABLE TO ACCEPT FUTURE DUCTS IN ANY LOCATION ON THE WALLS AND IN THE CORNERS.
5. TYPICAL CONDUIT SPACING GIVEN IN TABLE B.
5. CONSTRUCTION JOINTS ARE SHOWN FOR HANDHOLES NOT CAST IN ONE PIECE.

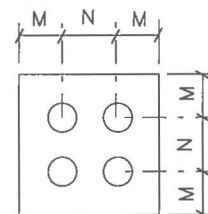
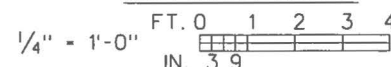


TABLE B

DUCT SIZE	DIMENSION	
	M	N
2"	4"	5"
3"	5"	6"
4"	5 1/2"	7"
5"	6"	8"

GRAPHICAL SCALE



HAWAIIAN ELECTRIC CO., INC.
HONOLULU, HAWAII

APPENDIX A: TYPICAL HANDHOLE CONFIGURATION
FIG. 8 - CENTER ENTRANCE HANDHOLES

ORIGINAL 9/14/94

SPEC. NO.
CS9401-5 1

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