

# Electric Service Installation Manual

A guide for successful installation of residential, commercial and industrial electrical services.



NINTH EDITION



**Hawaiian Electric**  
**Maui Electric**  
**Hawai'i Electric Light**



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# **Electric Service Installation Manual**

**Hawaiian Electric  
Maui Electric  
Hawai'i Electric Light**



Ninth Edition

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First printing: July, 2019

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Hawaiian Electric  
Maui Electric  
Hawai'i Electric Light

June 1, 2019

To Our Valued Customers,

We are pleased to present the 9<sup>th</sup> edition of the Electric Service Installation Manual (ESIM). The ESIM is a publication of Hawaiian Electric, Maui Electric, and Hawai'i Electric Light, and provides you with standards, guidelines and requirements for electric service and meter installations.

The changes in this manual are primarily clarifications and updates based on questions that we've received or discovered.

The effective date of this revision is July 1, 2019.

This manual is not intended to supersede or override Public Utilities Commission approved Company tariffs or federal, state or local laws, rules or regulations such as; the National Electrical Code (NEC), Electric Utility Service Equipment Requirements Committee (EUSERC), Occupational Safety and Health Administration (OSHA), Occupational Safety and Health (DOSH). Where the ESIM conflicts with other agency rules, the most stringent ruling shall take precedence.

A list of changes has been included before chapter 1 of the manual. This latest edition of the ESIM will again be available for download, free of charge, from our company's website or in a printed manual format, priced at \$10 per copy. To order a printed copy, please contact the Company at 543-7070(O'ahu), 871-2390(Maui), and 935-1171(Hawai'i Island).

Sincerely,

Anthony Hong  
Director  
Customer Installations  
Hawaiian Electric

Michael Grider  
Director  
Engineering  
Maui Electric

Dave Okamura  
Director  
Engineering  
Hawai'i Electric Light



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## Significant Changes To This Edition

### Chapter 1 General Requirements

- Added new section for Labeling of Equipment
- Revised Parallel Operation/Customer Generation section

### Chapter 2 Overhead Service

- No significant changes

### Chapter 3 Underground Service

- Added Clearances around transformer pad
- Added new section for Switchvault Pads
- Added additional requirements for Handholes, Vaults, and Manholes

### Chapter 4 Metering

- Primary Metering Clearance increased to 8 feet
- Raceways longer than 3 feet require hinged covers
- Labelling of Metering Equipment moved to chapter 1
- Clarified requirements for CT Metering
- Clarified requirements for Grounding and Bonding
- Added CGS+ Metering Requirements

### Chapter 5 Other Requirements

- No significant changes

### Chapter 6 IPP Metering

- Revised outdoor meter location layout



CHAPTER

1

General Requirements

## 1.1 About This Book

Electric Service Installation Manual describes requirements for new electric services and metering. It is published jointly by Hawaiian Electric, Maui Electric, and Hawai'i Electric Light for use by engineers, contractors, home owners, developers, and architects.

The installation of a new electric service is a cooperative effort between the customer and the power company. The purpose of this manual is to identify our companies' requirements.

## 1.2 General

In this manual, the terms “the company,” “power company,” “electric utility,” and “utility” all refer to your local electric power company.

Service installations must meet the latest requirements of the power company, the National Electrical Code (NEC), Electric Utility Service Equipment Requirements Committee (EUSERC), applicable ordinances of the respective counties, federal and state laws including those of the Occupational Safety and Health Administration (OSHA), the Division of Occupational Safety and Health (DOSH), and the National Electrical Safety Code (NESC).

Contact the Company early, when requesting electric service.

It is the customer's responsibility to ensure that all equipment and facilities furnished meets the company's requirements. All facilities must be reviewed and inspected by the Company prior to any installation of cables and metering equipment. Any work performed without prior inspection and approval by the Company is subject to condemnation, and the customer shall be responsible for all costs necessary to correct the installation in order to meet the company's standards.

To request electrical service, contact the applicable company. See Figure 1-1 for contact information. Be prepared to provide this information:

- Name(s) of the applicant, owners, architect, electrician, and consultant.
- Mailing address of the applicant.
- Business address, occupation, and social security number of the applicant.
- Whether the applicant is the owner, agent, tenant, etc. of premises.
- Location of the premises. For example: address, tax map key, district, subdivision, lot number, and location map.
- The date the applicant will be ready for service. For commercial developments, also dates for construction power, testing, and permanent service.
- The purpose for the service. Include a description of the equipment, desired voltage, load, and pump specifications if applicable.
- Rate schedule desired, if an optional rate schedule is available.
- Required product references:
  - Meter elevation diagram.
  - Single-line diagram.
  - Plot plan, to scale with existing utilities for reference.

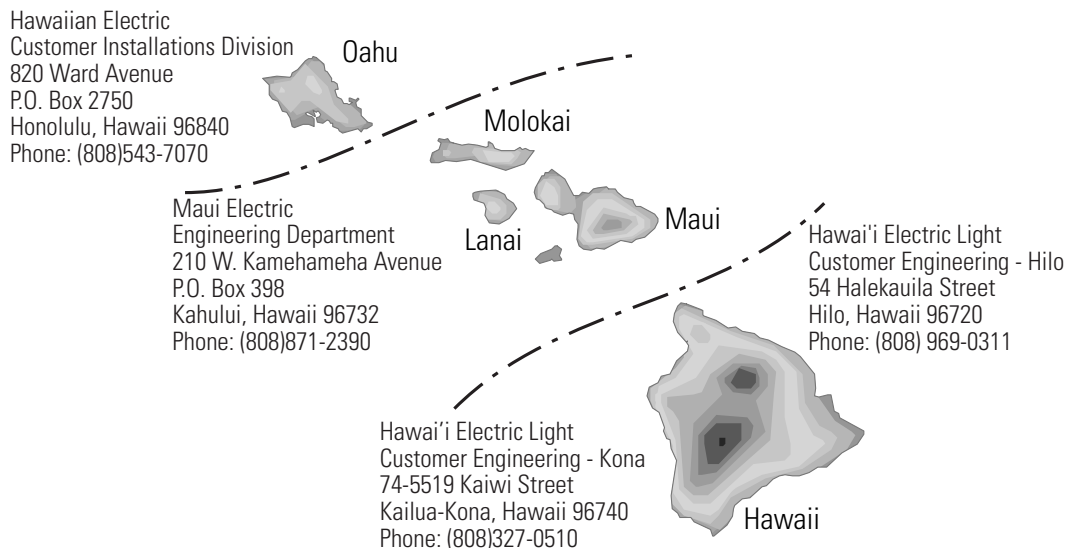
- Load calculations.
- Civil and mechanical drawings, if required.
- Required for commercial services:
  - Three copies of the meter equipment drawing showing switchboard, meter pedestal, switchgear, and the manufacturers' design drawings of the switchboard/switchgear in reference to EUSERC drawings.
  - Meter room location layout.
  - Building elevations showing power company facilities.
  - Layout and positioning of meter enclosure (front and rear views), pedestal or steel post structure.
- Other information as the power company might reasonably require.

In addition, for large residential customers, subdivision and commercial projects, complete and submit a Request For Electric Service.

### 1.3 One-Call System

Before digging near any utility facilities, call Hawaii's One-Call Center at 1-866-423-7287. For information on Hawaii's One-Call System, visit [www.callbeforeyoudig.org](http://www.callbeforeyoudig.org).

Power company representatives are available to provide additional information, interpretation of requirements, or advice with regard to specific projects requiring electric service.



**Figure 1-1. Contact information.**

### 1.4 Tampering

Tampering with power company property is a criminal offense prosecuted under Hawaii Revised Statutes 269-71, 708-825, 708-826, or 708-827. The judgment may require payment of triple damages.

## 1.5 Locked Areas

Readily accessible, unlocked spaces are strongly preferred, for metering facilities and other equipment owned by the power company. When metering facilities or other equipment owned by the power company must be located in vaults, rooms, or other enclosed areas which are locked by the customer, the requirements described below must be met:

- Areas locked by the customer must be protected by doors or covers, fitted with a hasp which will accommodate a padlock or cylinder lock which will accommodate a Best Universal Lock Company cylinder. The power company will supply and install the padlock or core. If the room containing metering and related equipment is accessible to both the utility workers and the customer, the utility will also supply a core or padlock which will accommodate a utility master key and a customer-owned key, similar to the arrangement for access doors. The customer-owned key will operate only that lock and will not open other locks operable by the utility's master key. Doors leading into such areas must be arranged so as to be readily opened from the inside by any person who may be inside the area, in accordance with the egress requirements of the latest edition of the National Fire Protection Association Life Safety Code.
- In situations similar to the paragraph above, but where two or more customer/utility master locks may be required, the customer instead supplies an accessible location for a utility key-box (Supra-S Key Box or equivalent), and a master key to all access doors along the route to rooms that contain power company equipment and to doors to rooms containing both customer and utility equipment. The customer furnishes the key-box, unless otherwise specified by the power company.
- If the customer plans to make modifications or additions which would render the metering facilities or other equipment inaccessible, the customer must consult with the power company before making such modifications or additions, and make arrangements satisfactory to the utility for continued access by its workers.

## 1.6 Easement Areas

Consult with the utility early, if construction is planned in or near an easement or area where access is granted to the power company. Construction may be permitted, but subject to certain restrictions or design modifications.

## 1.7 Two or More Buildings on One Lot

If more than two dwellings or buildings are located on the same lot, consult with the power company to determine acceptable locations for service attachment and metering. Do this before proceeding with the electrical wiring of the buildings.

## 1.8 Labeling of Equipment

### A . Metering Equipment

Customers shall provide, install, and maintain a permanent label at each commercial, industrial, and multi-unit residential meter socket to accurately identify the space being



supplied. Where multiple meters are installed, labels shall be placed on the non-removable panels of meter sockets. Labels shall match the information which was provided for the corresponding service request (application for service). The service disconnecting means shall also be labeled as required by the National Electrical Code. For example, labels should identify the number of the apartment, suite, or unit. In addition, a label identifying the Company\* and “DO NOT BREAK SEALS” shall be placed on all other metering equipment (i.e. splice can, CT can, raceway, etc.), and on Company sections/compartments of switchboards and switchgear.

\* HECO, MECO, or HELCO

## **B . Main Service Disconnect**

Where a main service disconnect is allowed to be installed on the line side of meters per section 4.3F (Meter and Main Service Disconnect Configurations), it shall be labeled with information to identify the location of the downstream meters it supplies (i.e. 2nd floor, Ewa Side). In addition, the downstream metering equipment (i.e. switchboard, meter center, etc.) which it supplies shall be labeled to identify the location of the main service disconnect. Labels for the downstream metering equipment shall be placed on the incoming service compartment. These labels are not required where the main service disconnect is within the same room and in close proximity to the meters downstream.

## **C . Emergency or Standby Generator Equipment**

For installations where emergency or standby generators are capable of energizing the service, the service entrance equipment shall be labeled to indicate the type (standby, emergency, etc) and location of the on-site generator per NEC requirements. In addition, the metering equipment shall also be labeled to identify the location of the generator service disconnect/transfer switch.

## **D . Lettering and Label Types**

Block lettering shall be used for all label characters, with a preferred font size of 3/8-inch tall lettering. Where space for a label is limited, a minimum font size of 1/4-inch tall lettering is acceptable. Labels shall be designed for permanent applications, examples of which include engraved, laminated phenolic (or equivalent) nameplates, and Almetek’s “pressure sensitive letters and numbers” (weather resistant adhesive labels designed for outdoor use). Labels made with label makers (such as Brother P-Touch Labelers, Dymo Embossed Label Makers, etc.) and felt tip pens are not acceptable. Customers shall insure that labels are kept current, legible, and accurate.

# **1.9 General Service Requirements, 2 kV to 15 kV Service**

This section covers permanent electric service of 5,000 kVA or less, delivered at a nominal voltage of 2,400 volts or more, but not more than 15,000 volts. See Chapter 5, Other Requirements, for service connection configurations. Additional requirements for temporary service are contained in the utility’s tariff. For services greater than 5,000 kVA, consult with your power company for the requirements.

## A. Equipment Furnished by Customer

The customer furnishes, installs, and maintains all protective and controlling equipment, and all necessary transforming equipment, except for instrument transformers used by the power company for revenue metering. See Closed Transition Switching (see below) for metering information. Whole-house surge protectors and/or similar devices are also recommended, especially for customers with sensitive equipment. The controlling equipment must be readily accessible to and operable by power company workers at all times. When controlling equipment is in a locked area, the lock shall conform to requirements indicated under Locked Areas or Equipment. Customer equipment must not be connected ahead of the utility's meter.

## B. Drawings

The customer submits four copies of the drawings. Include drawings for protective and controlling equipment, and the revenue metering compartment and equipment. Include one-line and schematic diagrams showing:

- For protective and controlling equipment: the type, size, and ratings for normal current, load break, interrupting and fault-close, and latch
- For relays: the style, type, and proposed settings
- Location and ratio of customer's instrument transformers, potential transformers
- Fuse sizes and locations
- Meter panel layout

Incorporate the power company's comments from the review process before the drawings are used to manufacture the equipment.

## C. Switchgear Bus

When the power company's service terminates in the customer's switchgear, the bus between the utility's service termination and the customer's protective equipment must be fully insulated for 15 kV. The minimum spacing, as measured from the outside surfaces of the cables or bare bus, is not less than 7-1/2 inches between phases, and not less than 6 inches from phase to ground or to the nearest un-energized surface. The length of bus between the service termination and the protective equipment must not exceed 6 feet. The requirement for insulated bus will be waived for services of 100 amps or less, when it is connected to the utility's system and fused by the utility.

## D. Instrument Transformers

Instrument transformers which are used by the utility for revenue metering, are not available for use by the customer.

## E. Closed Transition Switching

For customers with two services and circuit breaker protective equipment, the preferred configuration allows the utility to transfer the customer's load from one service to the other by closed transition switching, not open transition switching. This prevents the inconvenience of momentary service interruptions during planned switching by the utility for maintenance or other purposes. See Chapter 5, Other Requirements, Switching and Protection, for additional information.

## 1.10. Parallel Operation / Customer Generation

Connection of customer generation shall not be made to electric service equipment without prior written approval from the Company and legal agreement between both parties. This applies to all permanent as well as portable emergency or standby sources designed to energize the customer's electrical system. The customer shall notify the Company's respective department/division below prior to installing such equipment and shall submit plans of the installation for the Company's review and comment.

Customer generation must comply with all requirements of the ESIM, as well as all other requirements within the applicable tariff and rules. For example, customer generation utilizing a secondary utility meter as part of the design must comply with all applicable metering requirements in chapter 4 of this manual, in addition to any requirements of the applicable tariff rules.

### A. Types of Customer Generation

Three types of customer generation available for Customers are:

- Parallel Operation with Credit compensation for Exported energy delivered to the Company [Net Energy Metering (NEM), Feed-In Tariff (FIT) Tier 1 and 2, Customer Grid Supply (CGS), Customer Grid Supply Plus (CGS+), Smart Export, Net Energy Metering Plus (NEM+)]
- Parallel Operations without Credit compensation for Exported energy delivered to the Company [Standard Interconnection Agreement (SIA), Customer Self-Supply (CSS)]
- Standby or Emergency Generators.

For Customer generation at 46 kV and above (FIT Tier 3 and IPP's), see chapter 6 for Independent Power Producer (IPP) requirements.

#### 1. Parallel Operation, with Compensation for Exports to the Company

Hawaiian Electric customers

- Feed-In Tariff (Tier 1 and 2) – (808)-543-4044 or [fit@hawaiianelectric.com](mailto:fit@hawaiianelectric.com).
- Net Energy Metering – Customer Grid Supply, Customer Grid Supply Plus, Smart Export – (808)-543-4760 or [connect@hawaiianelectric.com](mailto:connect@hawaiianelectric.com).

Hawai'i Electric Light customers

- Feed-In Tariff (Tier 1 and 2) – (808)-969-0358 – [helcofit@hawaiielectriclight.com](mailto:helcofit@hawaiielectriclight.com).

- Net Energy Metering – Customer Grid Supply, Customer Grid Supply Plus, Smart Export – (808)-969-0358 or connect@hawaiianelectric.com.  
Maui Electric customers
- Feed-In Tariff (Tier 1 and 2) – (808)-871-8461 ext. 2445 or mecofit@mauielectric.com.
- Net Energy Metering – Customer Grid Supply, Customer Grid Supply Plus, Smart Export – (808)-871-8461 ext. 2445 or connect@mauielectric.com.

## 2. Parallel Operation without Compensation for Exports to the Company

Hawaiian Electric SIA customers – SIAinfo@hawaiielectriclight.com or (808)543-7707.

Hawaiian Electric CSS customers – connect@hawaiianelectric.com or (808) 543-4760.

Hawai'i Electric Light customers – connect@hawaiielectriclight.com.

Maui Electric customers – Engineering Department (808)871-2390.

## 3. Standby and Emergency Generators (Permanent and Portable)

Hawaiian Electric customers – Customer Installations Division (808)-543-7070.

Hawai'i Electric Light customers – Customer Engineering Division

Hilo: (808)-969-0311 or Kona: (808)-327-0510.

Maui Electric customers – Engineering Department (808)-871-2390.

In addition, standby and emergency generator installations shall follow the requirements below:

- Emergency and stand-by power sources shall only be utilized when the Company is unable to provide normal service.
- The emergency transfer device or scheme shall be designed, constructed, and installed to prevent the Customer's emergency power source from feeding back into the Company's distribution system.
- Generators shall not be installed where metering facilities could be subject to noise levels greater than 85 dB.

## B. Meter Socket Adapter (Meter Collar)

The use of a meter socket adaptor, herein referred to as a "meter collar", shall be permitted as an additional interconnection option for the customer generation system or electric vehicle to the customer premises. A meter collar is an "extension" device placed between the meter socket and the utility meter. Meter collars, where used, shall comply with all of the following requirements. Their usage shall comply with all applicable requirements listed in this manual and the AHJ (authority having jurisdiction.):

1. Listed by UL.
2. Suitable for use as service equipment.
3. Equipped with an integrated overcurrent protective device sized appropriately for the generation system.

4. Equipped with a means to facilitate a weatherproof connection for field wiring. This connection shall have a means to be locked or sealed by the Company.
5. Factory-furnished labeling.
6. Compatible with ring-type meter sockets.
7. Internally bonded and grounded to provide connection to the neutral circuit within the meter socket
8. Approved part numbers include: (suggest listing each P/N associated with breaker sizes, or “XX” where “XX” denotes the overcurrent protection rating).
9. The meter collar shall be furnished by the customer.
10. For Hawai'i Electric Light, the meter collar shall be installed by the electric utility or its assigns. On Oahu and Maui County, Hawaiian Electric and Maui Electric customers or its assigns shall install the meter collar.
  - a. In Oahu and Maui County, customers are not allowed to remove the meter to install the collar. Customers must coordinate with Hawaiian Electric or Maui Electric for the meter removal and replacement.
11. Customer generation interconnection shall be performed by the customer or its assigns.

The Company, at its sole discretion, may permit the use of a meter collar to facilitate a connection for Electric Vehicle Supply Equipment or other applications.

NOTE: All existing, approved methods to interconnect customer generation equipment to electrical service equipment remain permissible.



CHAPTER  
**2**

**Overhead Service**

## 2.1 General

Overhead services will not be supplied to any building or premise in an area where city and/or county regulations require that services be underground. The customer or contractor must obtain approvals from the city and/or county prior to energizing service.

## 2.2 Service Drop

The power company will, at its expense, furnish and install a single span of service conductors from its pole or other aerial support, to the customer's approved point of attachment. The utility will connect to the service entrance conductors, provided such support is of a type acceptable to the utility and complies with all applicable ordinances and requirements.

## 2.3 Service Drop Attachment

For the location of the service drop attachment, see Figures 2-1, 2-2 and 2-3. Service drops must be installed at heights and locations such that the service drop conductors are:

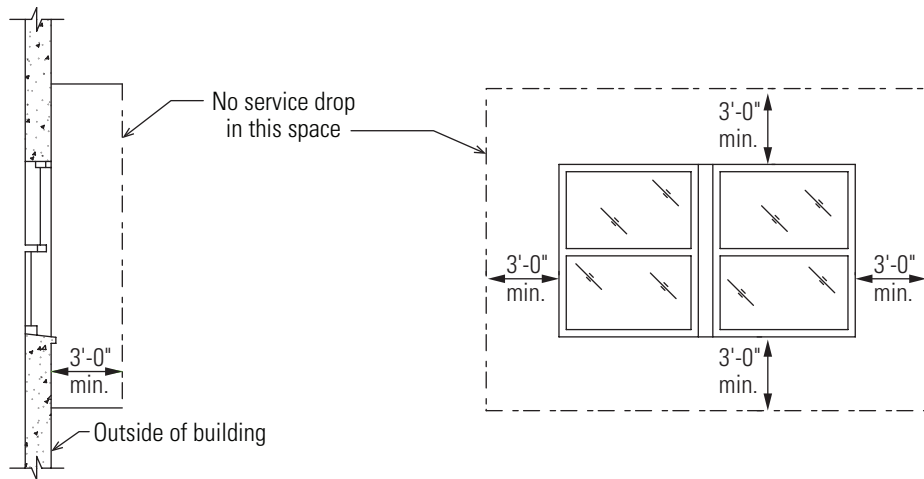
- Running free of obstruction from trees, structures, poles, masts, antennas, vents, flood lights, etc.
- Readily accessible for installation, inspection and maintenance.
- Installed where the weatherhead and point of attachment are safely accessible.
- Attached at only one point on the building.
- Substantially supported at the building.

For supply conductors of 0 to 750 volts, a lateral and horizontal clearance of at least 5'-0" is required between the supply conductors and nearby buildings, bridges, or other structures to which the supply conductor is not attached, and on which people might work (except generating stations and substations). See the NESC.

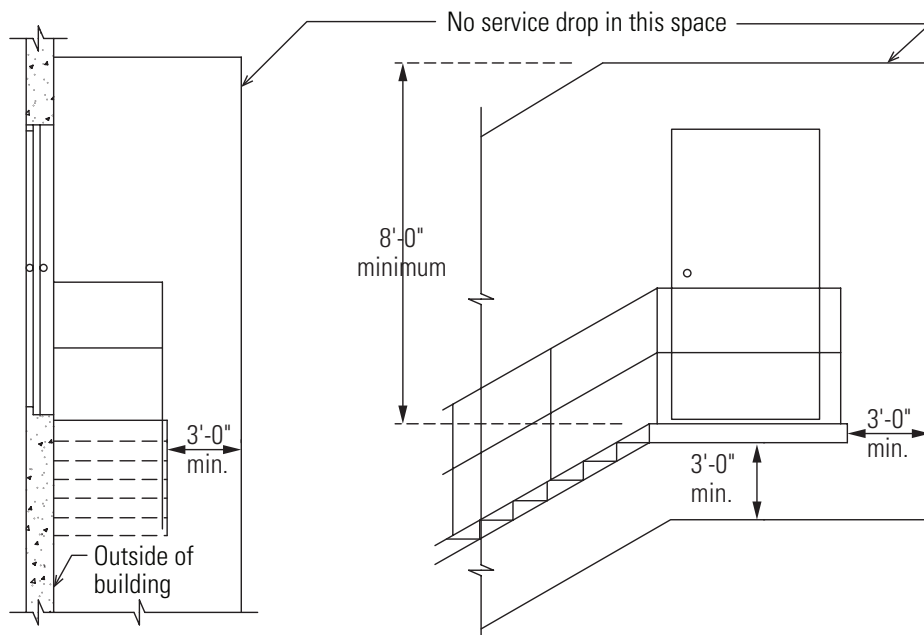
Supply conductors of 0 to 750 volts must have a vertical clearance of at least 8'-0" above buildings and bridges (or other structures, which do not ordinarily support conductors and on which men can walk) whether attached or unattached.

Service drops must be installed so that they clear fire escapes, exits, windows, doors and other points at which human contact might be expected, a clearance of at least 3 feet as shown below. See also: NESC.





**Figure 2-1. Service drop clearances from windows.**



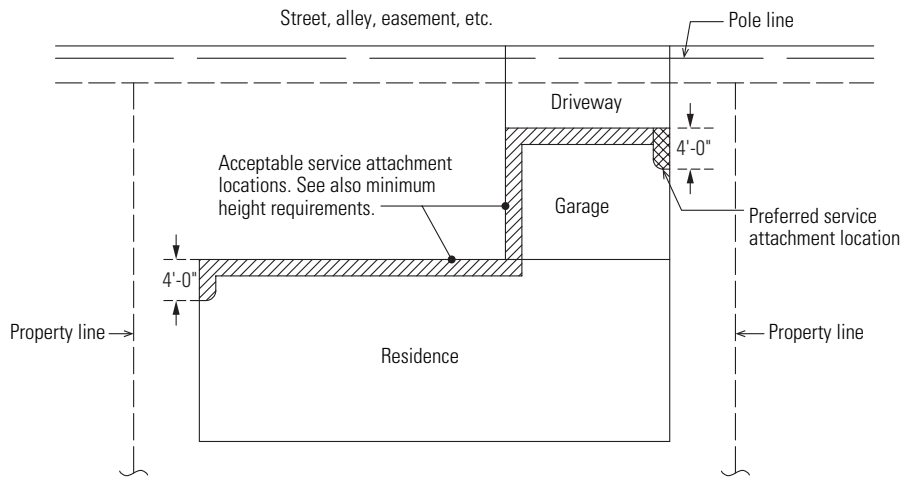
**Figure 2-2. Service drop clearances from doors, balconies, stairways, walkways, etc.**

## 2.4 Location of Overhead Services

The preferred service attachment is on the corner of the residence, not more than four feet in either direction from the corner. The side from which the meter is to be served shall be designated by the power company.

If overhead lines are along the rear property line, the point of attachment for the service may be located near, or at the rear corner of the residence. The conduit and wiring necessary to connect the point of attachment to the meter must be provided by the customer, and installed within four feet from the front corner of the residence.

All service locations are subject to the power company's approval.



**Figure 2-3. Location of overhead residential services.**

## 2.5 Methods of Attaching Service Drops

The power company:

- Designates the location of the service mast, and the minimum height above ground for the point of attachment of the service drop.
- Supplies the insulator and hardware for attaching the service drop at the customer's mast.
- Makes the tap at the service drop conductors.

All conduit, masts, and hardware must be rigid galvanized conduit.

Masts, conduit, and other equipment must be grounded and bonded as required by the latest edition of the NESC.

All structures must be able to safely support workers and equipment required to make the connections.

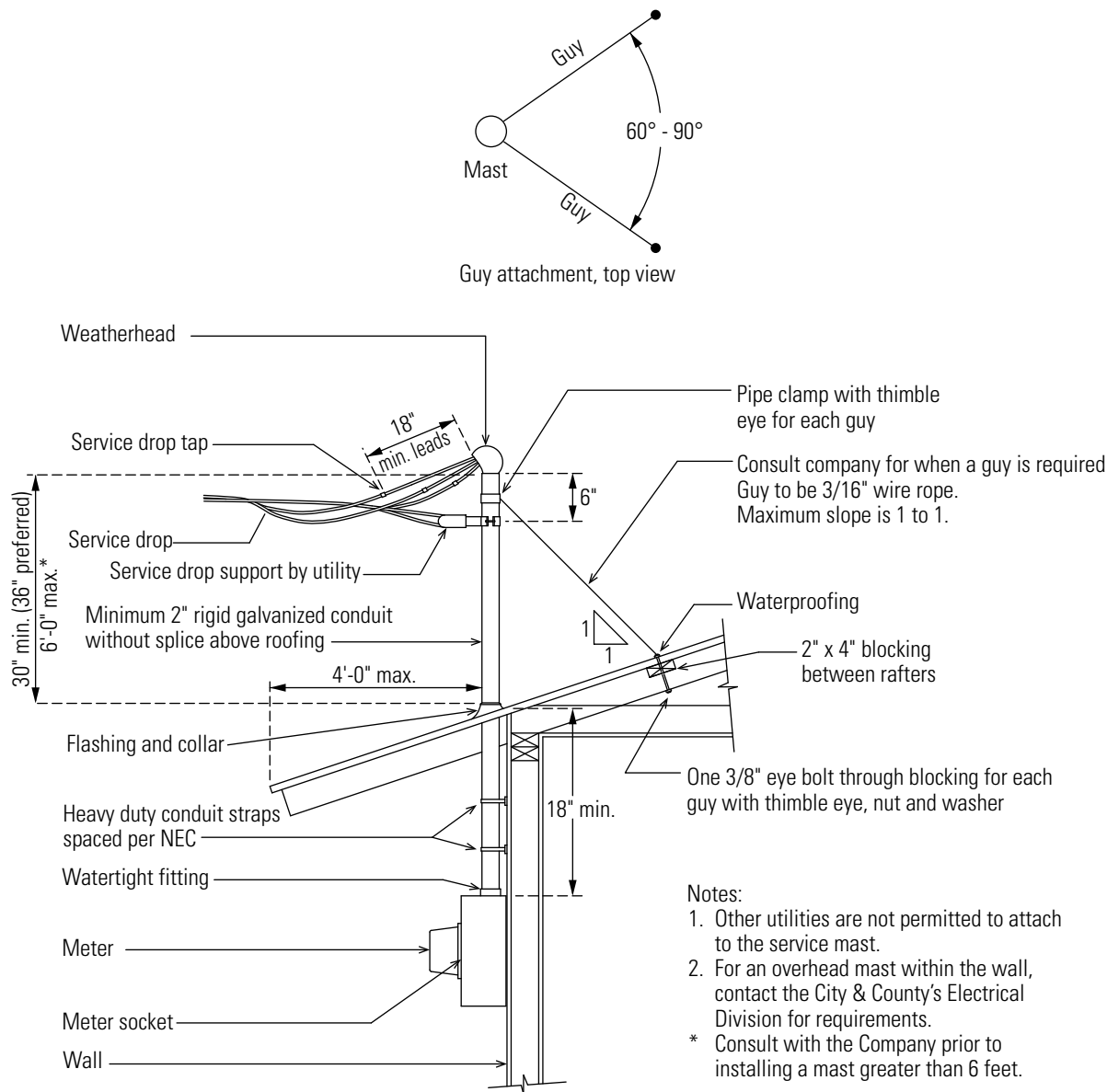
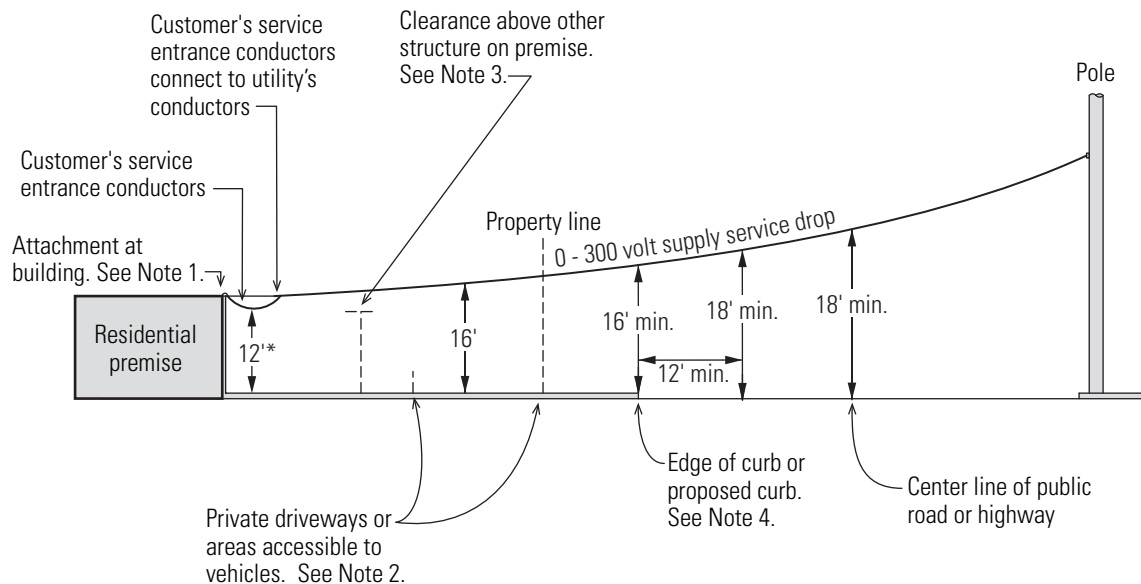


Figure 2-4. External mast attachment.

**A. Service Entrance Conductors**

The customer's service entrance conductors must be long enough to reach the service drop tap, plus an additional 18 inches for forming a drip loop.

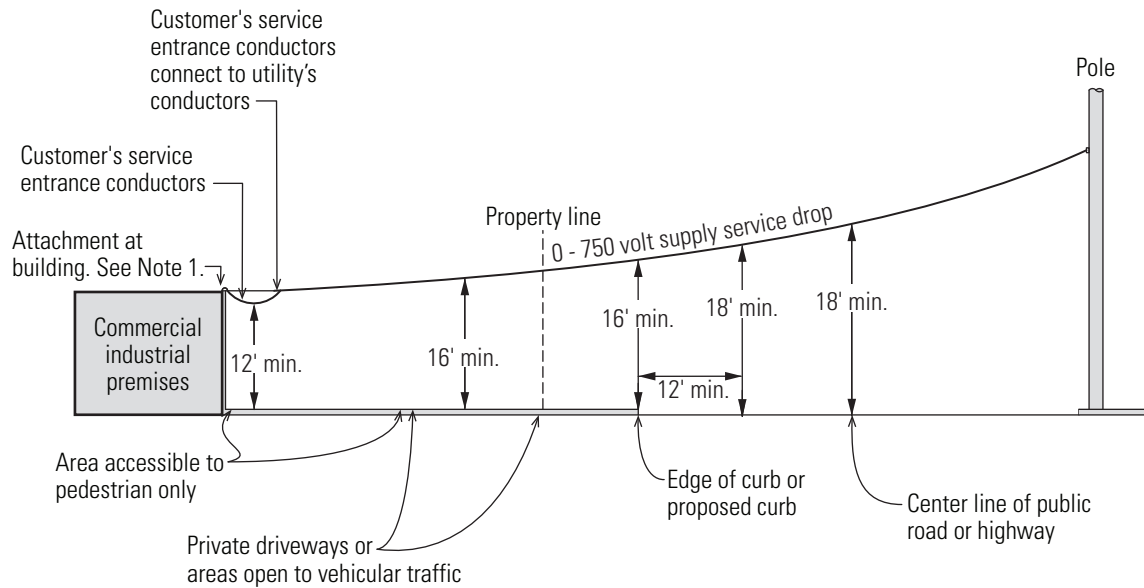


\* Refer to the NESC exceptions where the building height does not allow for these clearances.

Notes:

1. The point of attachment of service drop conductors to a building, above areas or sidewalks accessible only to pedestrians, shall not be less than 10 feet 6 inches. Refer to the NESC and National Electric Code (NEC) 230-24(b), Table 232-1, #8c, for further clarification.
2. The minimum vertical clearance above private driveways or areas accessible to vehicles not exceeding 8 feet, for residential purposes only, shall not be less than 12 feet 6 inches. Refer to NESC 232-1(7a), for further clarification.
3. The minimum vertical clearance above structures, which do not ordinarily support conductors and on which men can walk whether attached or unattached, shall be 8 feet. Refer to the NESC for specific conditions under which minimum clearances may be modified.
4. Service drop conductors shall have a vertical clearance of not less than 18 feet above public thoroughfares, except that this clearance may grade (slope) from 18 feet, at a position not more than 12 feet horizontally from the curb line, to a clearance of not less than 16 feet at the curb line. Refer to the NESC for further clarification.
5. The radial clearance between supply service drop conductors and communication service drop conductors shall not be less than 24 inches. Where within 15 feet of the point of attachment of either service drop, this clearance may be reduced to 12 inches. Refer to the NESC, Clearance Between Supply Service Drops and Other Conductors.

**Figure 2-5a. Service drop clearances, residential premises.**



## Notes:

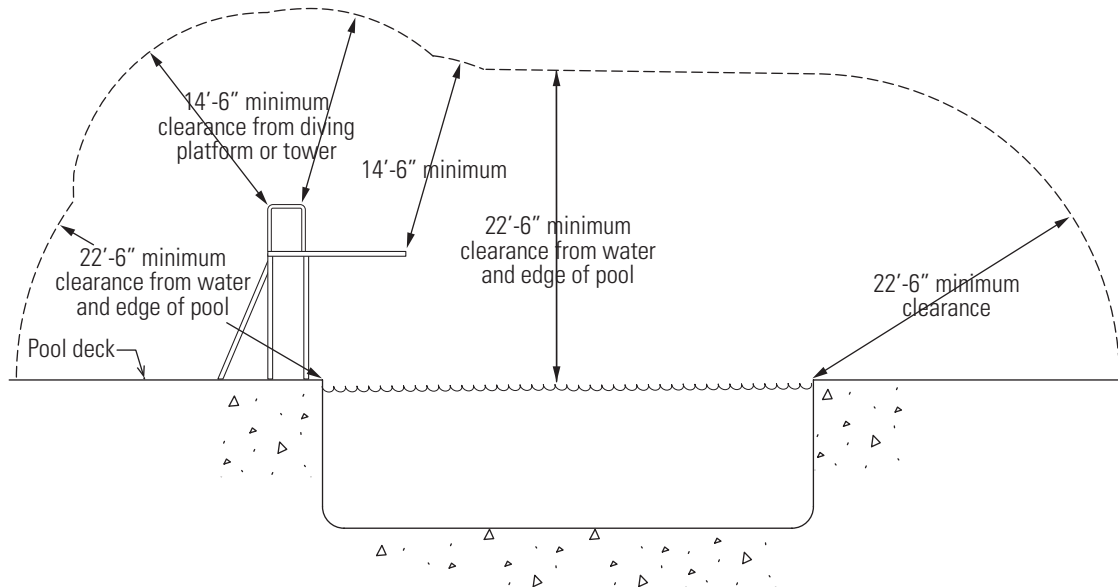
1. The radial clearance between supply service drop conductors and communication service drop conductors shall be not less than 24 inches. Where within 15 feet of the point of attachment of either service drop, this clearance may be reduced to 12 inches.
2. The minimum vertical clearance above bridges, fences, walls or other structures upon which people can walk, is 8 feet. For vertical clearance above buildings, See NESC.

**Figure 2-5b. Service drop clearances, commercial premises.**

## 2.6 Swimming Pool Clearances for Utility Service Drop

Where possible, avoid installing utility service drops above public and private swimming pools.

The drawings below illustrate the minimum clearances, when utility service drops are installed above swimming pools. Refer to the latest edition of the NEC for minimum height requirements.



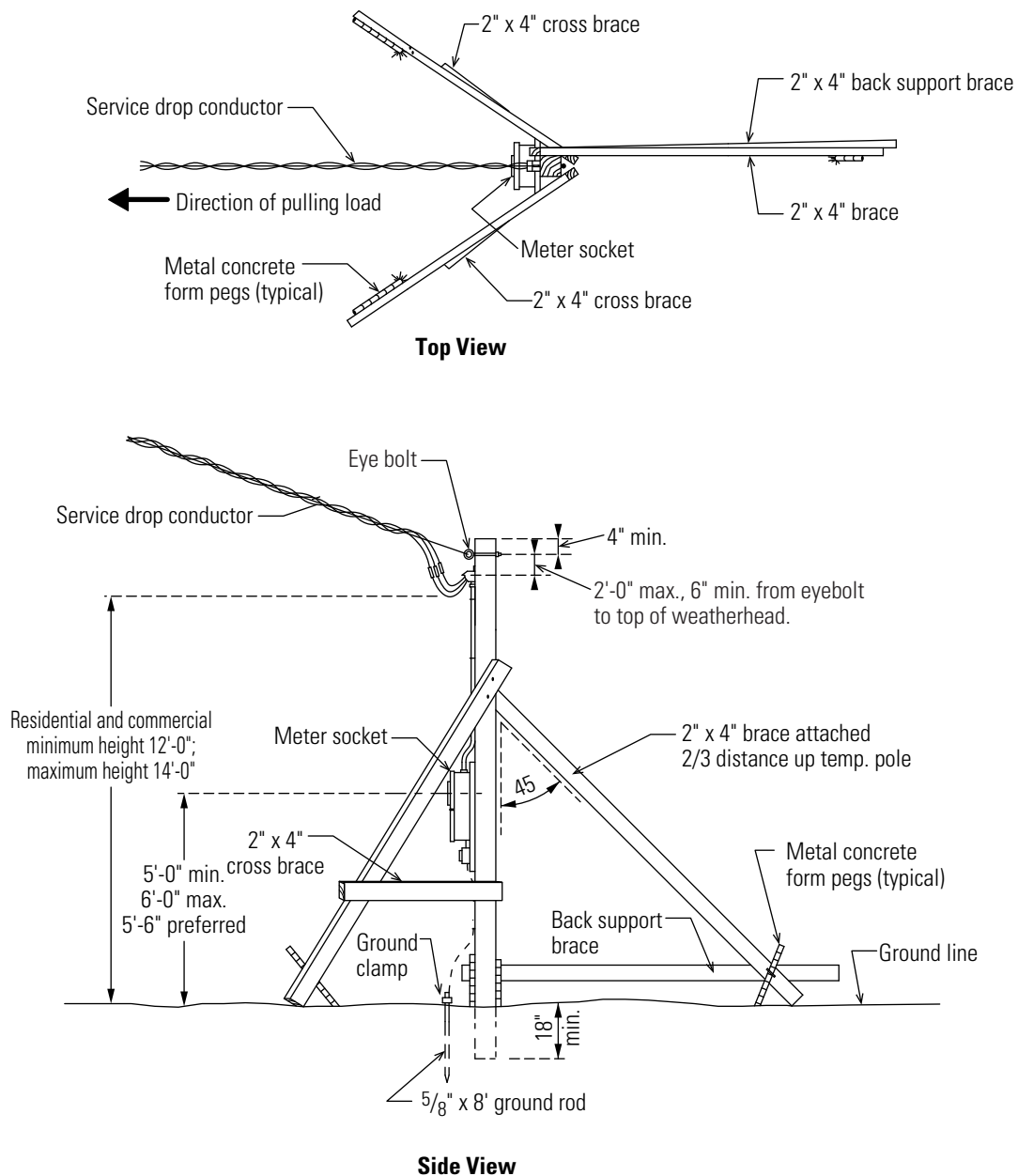
**Figure 2-6. Swimming pool clearances for utility service drops.**

## 2.7 Temporary Service

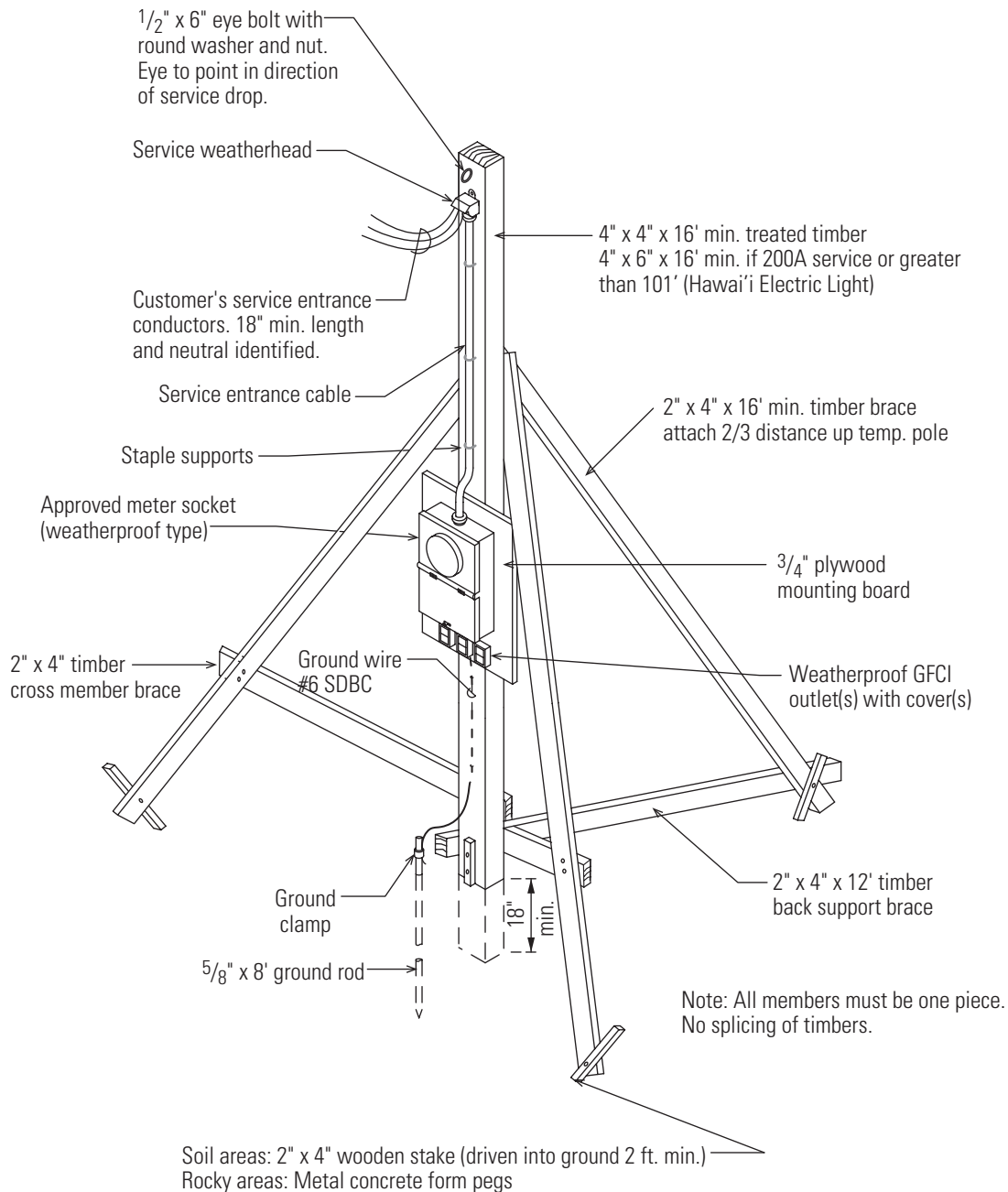
The customer furnishes a sturdy stand per power company standards, and locates it where specified by the power company. If the stand is to be in service for longer than one year, consult with the utility for additional requirements.

All timbers may be rough. Attach braces to the stand, and secure the stand with bolts or nails. Attach the wood brace at a point two-thirds of the height of the stand, above ground. All materials must be for outdoor use. Buried portions of stand and stake(s) must be treated and tamped. All facilities must meet NEC requirements.

For pole heights over 15 feet, consult with the utility's engineering department.



**Figure 2-7a. Temporary overhead service stand, top and side views.**



Note: Customer's connection to ground must be 25 ohms or less. If the ground connection is greater than 25 ohms, the customer is required to install a second ground rod in accordance with NEC 250.56.

HELCO requires two ground rods spaced a minimum of 6'-0" apart

**Figure 2-7b. Temporary overhead service stand, isometric view.**



## CHAPTER

**3**

# Underground Service

## 3.1 General

The customer (or the customer's representative) is responsible for contacting the Company prior to commencement of construction. The utility will determine the appropriate design for the underground service.

If the customer requests underground service, or if the city or county requires underground service by ordinance, service may be provided by the installation of an underground riser to an existing pole or from an existing underground distribution system. The customer is required to provide and install all conduits, handholes, or pullboxes, trenching, and backfill. Consult the Company prior to construction, for a cost estimate and other requirements.

Design specification guidelines applicable to construction of underground facilities may be found on our website. Please follow these guidelines to aid in preparing your service request proposal. However please note that these guidelines are provided for general assistance only. Specific requirements that must be met for a particular project will be provided by the Companies' Planner or Engineer who is assigned to your particular (Project/Review Request/ . . .). Depending on the specific needs and actual conditions of your project, be advised that your design may be subject to more stringent requirements than those included in the design specification guidelines, may need to be modified to comply with specific applicable standards, or applicable law.

The company inspects all trenching prior to the burial/covering of conduits. City and county inspection and approval will also be required prior to the installation of the underground service by the company.

For long service runs, or runs with many bends, the customer may be required to install a pull box or handhole. A maximum of two 90 degree bends is allowed on conduits, between the property line and the meter socket. For conduit runs involving two 90 degree bends or more, contact the power company for specifications.

Conduits for service conductors must be Schedule 40 PVC, direct-buried at a depth of at least 18 inches. Flexible ducts or conduits are not acceptable. Conduits under driveways must be Schedule 40 PVC encased in concrete and buried at a depth of at least 18 inches, or Schedule 80 PVC direct-buried at a depth of at least 18 inches. Conduits in easements must be Schedule 40 PVC concrete encased. The minimum factory bend for all conduits is 36 inches.

The duct is PVC Schedule 40 pipe. Bends due to changes of grade, must have a minimum radius of 20'-0". After the conduits are installed, the customer may need to pass a smooth bullet-shaped wooden test mandrel through the entire length of each conduit to test for freedom from burrs and obstructions. All ducts must contain a muletape pull line, Wesco catalog #BLWP18-3000 or equivalent. Use select backfill.

**All ducts in a single uninterrupted run shall be of the same schedule PVC – transitioning of different schedules is not allowed. Install ducts with the manufacturer's schedule markings facing up.**

The trench must be at least 8 inches wide for 2-inch conduit, and at least 9 inches wide for 3-inch conduit, and 10 inches wide for 4-inch conduit.

Use care when excavating near the service stub – the service line is energized. A contractor, licensed to work near energized facilities is required whenever excavation work is performed near the Company's facilities. Refer to chapter 1, section 1.3, to determine the location of the Company's facilities. Contact the Company if you are unable to locate the conductor stubs.

The customer may be required to install a pad for a padmount transformer within his property, if the service run is too long to be served by the secondary system, or if required due to load.

## 3.2 Underground Service from Overhead

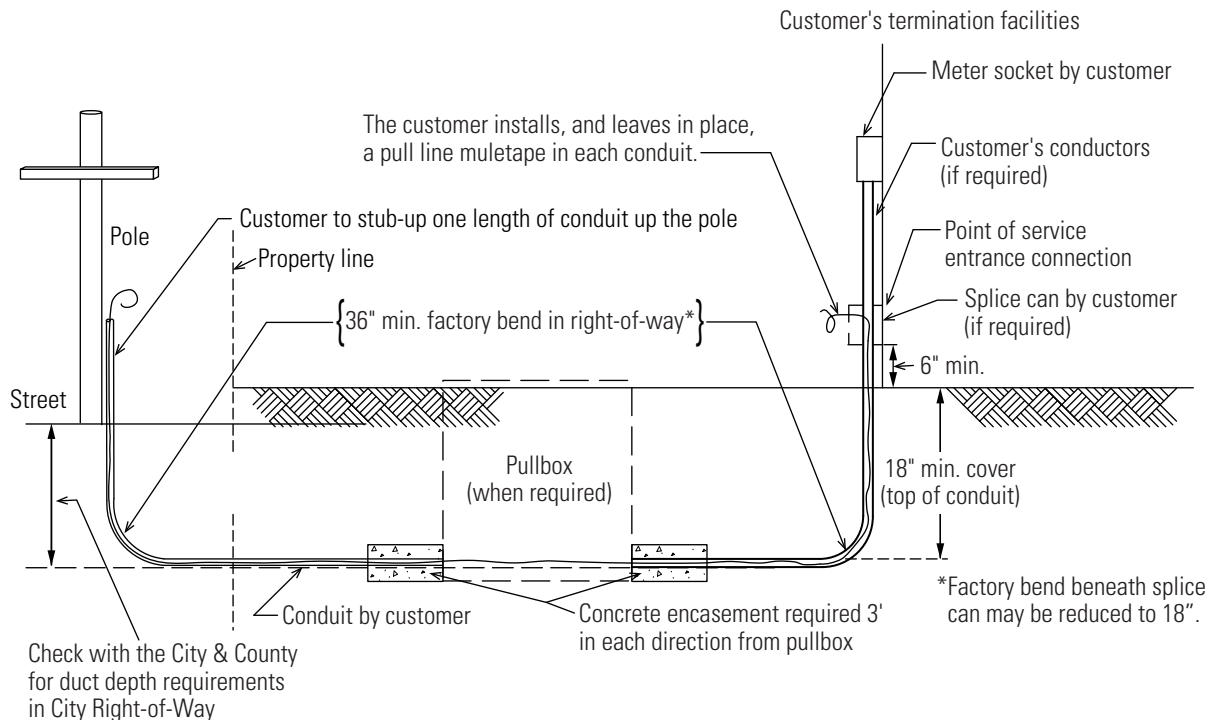


Figure 3-1. Underground service from overhead distribution.

## 3.3 Underground Service from Underground

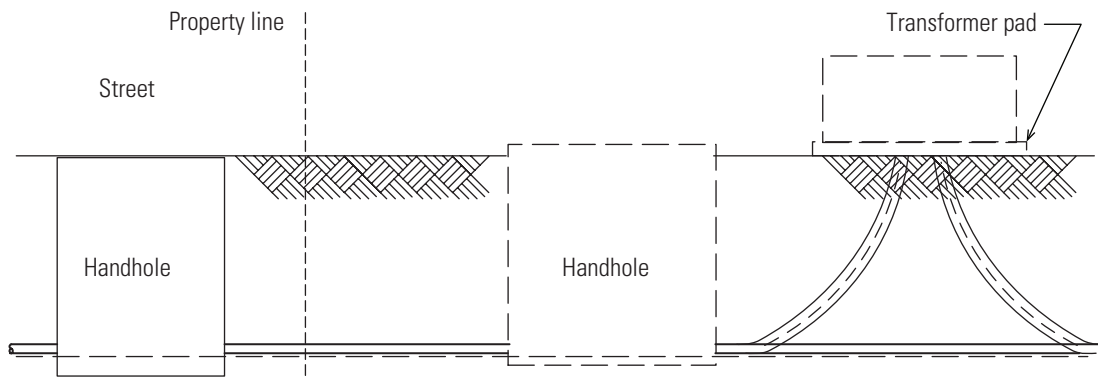


Figure 3-2. Underground service from underground distribution.

### 3.4 Trenching and Backfilling

Requirements for trenching and backfilling of ducts furnished for the Company can be found on our website. Refer to STD 30-1005.

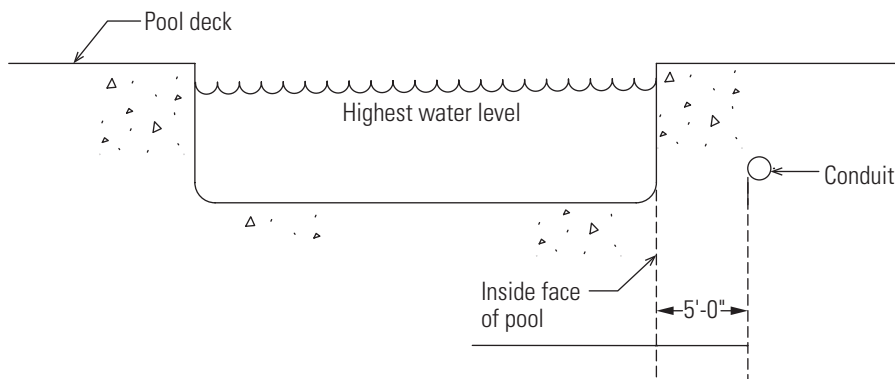
#### A. Marker Tape

Electrical warning marker tape is required above all conduits. Marker tape requirements can be found on our website. Refer to STD 30-1005.

### 3.5 Underground Utility Duct Separation

Ducts for electrical supply conductors must be separated from other utilities or foreign substructures. For applicable duct separation requirements, refer to STD 30-1006 of our construction standards which is available on our website.

#### A. Underground Service Clearance for Swimming Pools



**Figure 3-3. Underground service clearances for swimming pools.**  
(Similar for septic tanks, cesspools and leach fields.)

### 3.6 Recessed Conduit in Walls

Consult with the power company, before installing conduit in walls.

Conduit for conductors is Schedule 40 PVC, encased in concrete, and installed from the meter socket or pullbox, down the wall and into trench with a bend. The minimum factory bend is 24 inches for 2-inch PVC and 30 inches for 3 and 4-inch PVC.

The conduit must be 2-inch Schedule 40 PVC when the service conductors are no larger than #2 AL. See Figure 3-4 for details.

When the size of the service conductors is 3/0 or 350 MCM, the conduit size must be 3 inches, unless otherwise specified by the utility. The requirement for 2 inches concrete encasement is maintained.

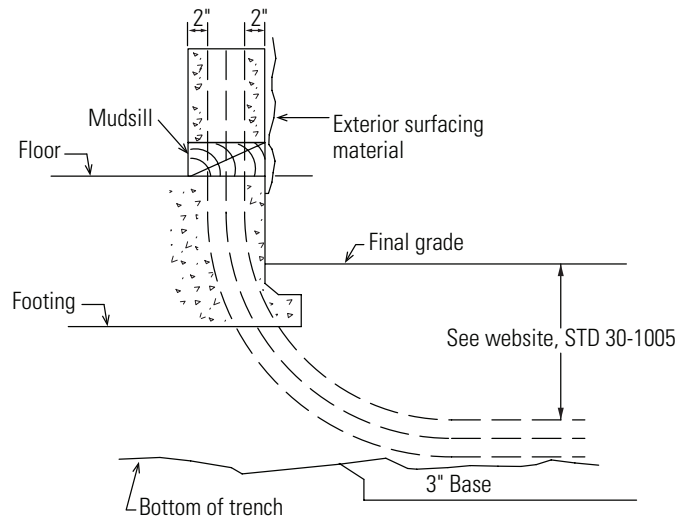


Figure 3-4. Recessed conduit in a wall.

### 3.7 Splice Can

A splice can, as specified by the company, must be installed ahead of the meter socket. Mount splice cans not less than 6 inches, nor more than 3 feet from the finished grade to the bottom of the splice can. The splice can must have provisions for seals which will be installed by the company. If more than one conductor per phase is required or if more than one meter will be connected, contact the Company for splice can sizes.

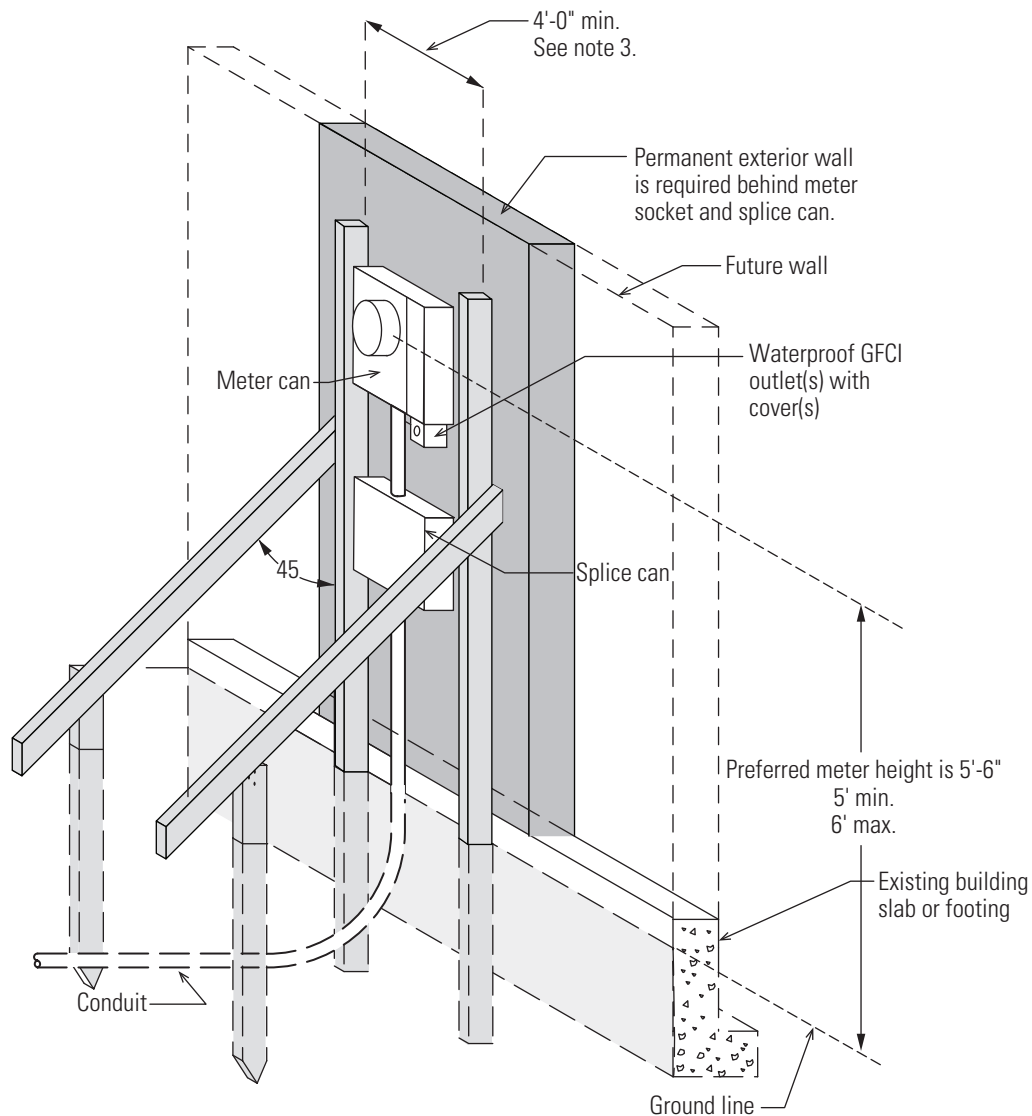
Size of Conduit (min.)	Size of Service Cable (min.)	Size of Service Cable (max.)	Size of Splice Can
2"	#2 AL	#1/0	10"W × 12"H × 6"D
3"	#3/0 AL	#4/0	12"W × 18"H × 8"D
3"	#350 MCM AL	#350 MCM CU	18"W × 24"H × 10"D
3"	#3/0 Quad	#350 Quad	24"W × 30"H × 12"D
4"	#500 MCM AL	#500 MCM CU	24"W × 30"H × 12"D

Table 3-1. Splice can size requirements.

### 3.8 Temporary Service

The customer furnishes a sturdy stand, per company standards, and locates it where specified by the company. If the stand is to be in service for longer than one year, consult with the utility for additional requirements.

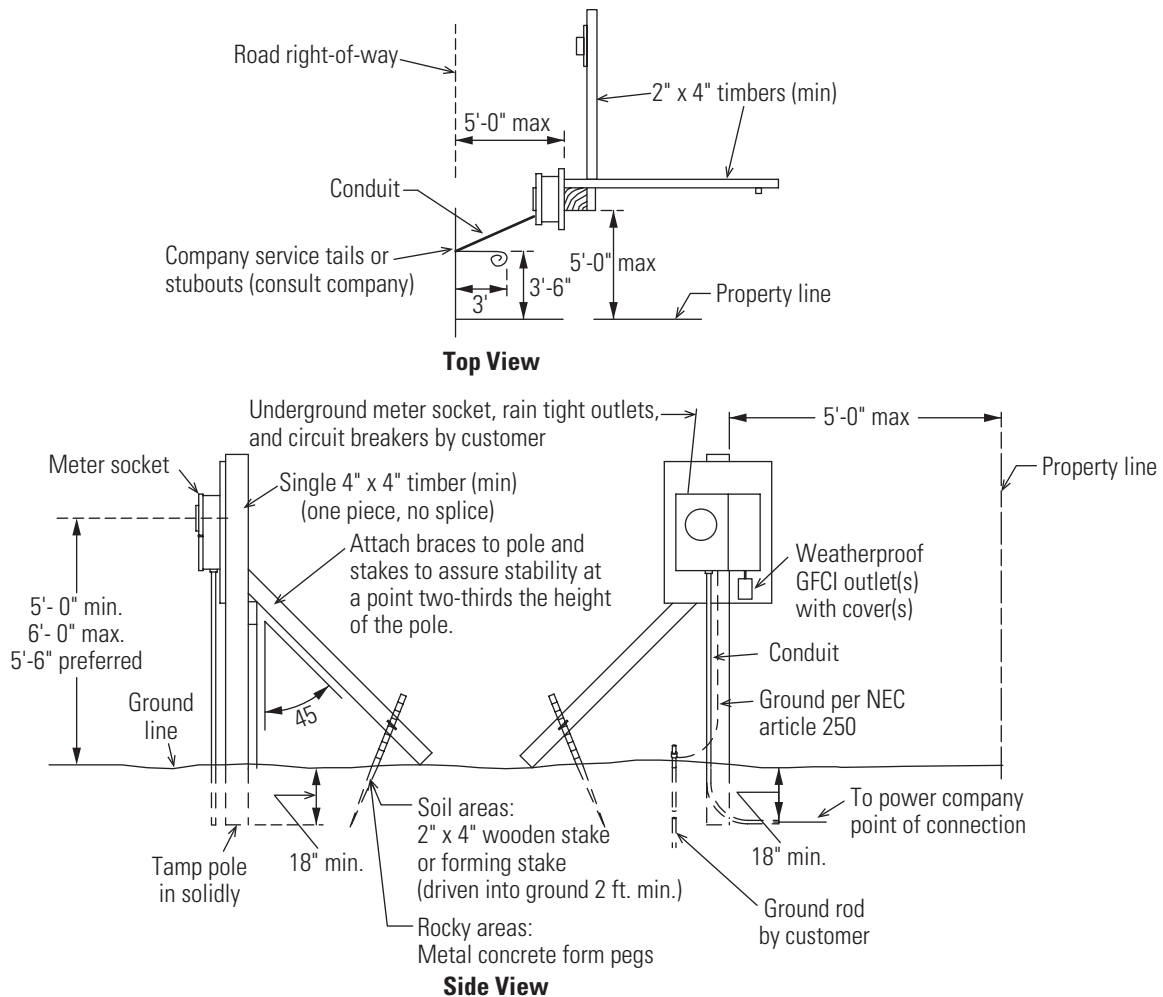
All timbers may be rough. Attach braces to the stand, and secure the stand with bolts or nails. Attach the wood brace at a point two-thirds of the height of the stand, above ground. All materials must be for outdoor use. Buried portions of stand and stake(s) must be treated and tamped. All facilities must meet NEC requirements.



Notes:

1. Customer's contractor shall verify requirements with the local power company and local government prior to installation.
2. The metering equipment shall be later used for permanent service. Any adjustments required after the meter and service installation may result in additional costs from the power company.
3. Frontal working clearance of 4 feet by 4 feet by 7 feet is required.

**Figure 3-5. Temporary / permanent service stand, isometric view. Not allowed for MECO (Maui).**



## Notes:

1. Consult with the utility's customer engineering division when connecting to service box.
2. Customer shall furnish a sturdy pole and locate it as specified by company. Pole to be in service for one year or less. Customer shall consult the utility if the pole is to be in service over one year. All timbers may be rough.
3. Braces shall be attached to pole stakes with bolts or nails in such a way as to assure stability. Attach wood brace at a point 2/3 the height of the pole above ground. Buried portions of pole stake(s) shall be treated and tamped.
4. Customer does all necessary trenching and backfilling.
5. Customer locates and exposes (18" min.) company's service tails. Due caution should be taken while excavating, as company's cables are energized.
6. Customer to install a 13" x 24" (minimum) pullbox for the Company to splice in.
7. No splicing of timber.
8. In rocky areas, iron form pins may be used in lieu of 18" minimum bury.
9. Electrical facilities shall be installed per NEC.
10. All materials for outdoor application.
11. Meter must face road or driveway.

**Figure 3-6. Temporary service stand.**

## 3.9 Transformer Pads

Concrete transformer pad details and requirements may be obtained on our website. Refer to STD's 30-5001, 30-5010, 30-5011, 30-5015, and 30-5017.

### A. Location

Requirements for the location of pads for transformers include:

- No permanent or temporary structure or object may be erected or placed within areas where clearances are required. (Refer to transformer concrete pad details).
- When the concrete pad is located in the vicinity of existing or future combustible material or combustible buildings, the customer must provide safeguards as outlined in the NEC, subject to the approval of the city and building inspector.
- The front side of the concrete pad must face vehicular access, and be free of obstruction at all times.
- When parts of building structures are located directly over the concrete pad, a minimum clearance of 9'-0" from the surface of the pad is required.
- The customer must provide and install adequate protection for transformers. Consult with the Company for type and location. Location clearances and protection details may be obtained on our website. Refer to STD 30-5000.

### B. Customer Responsibilities

The customer is responsible to:

- Furnish materials and construct the facilities for the padmount transformer including the concrete pad, primary and secondary ducts, and anchor bolts. When required, the concrete curb and rock fill around the pad must be furnished and installed by the customer.
- Install the duct from the pad to the riser pole or handhole as designated on the plan.
- Grade sufficiently around the pad site to prevent future filling in of the pad. When required, construct a retaining wall of suitable material to prevent future filling of pad.
- Compact by rolling the site in accordance with city and county specifications for compacting sidewalk areas.

Allow 5 working days advance notice, for inspections by the power company.

The power company must have:

- 24-hour access to the transformer without passing through locked areas.
- A minimum of 10'-0" wide vehicular access to the transformer.

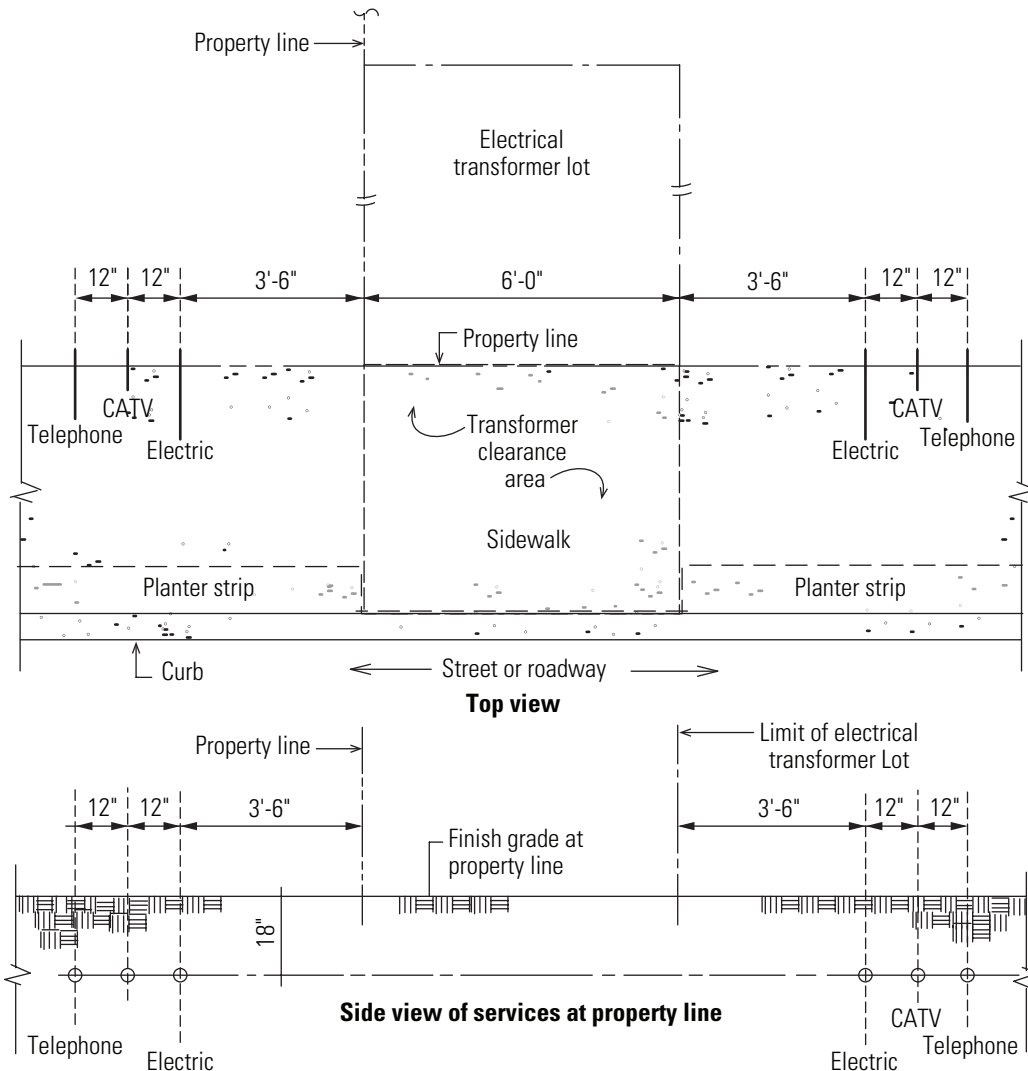
### C. Clearances Around Padmount Transformers

Refer to STD 30-5000 and 30-5002 of our construction standards, which is available on our website for clearance requirements.

Consult with the power company's engineering department prior to installation of a transformer pad. Required minimum clearances include:



- 8'-0" front clearance for 12 kV, 10'-0" front clearance for 12/25 kV & 25 kV, for hot stick operation. The Company's handholes and manholes may be installed within this clearance area. Planter strips or landscaped areas are not recommended within this clearance area.
- The slope of a grade in front of the pad must not exceed 1/4" rise to 1'-0" run. Keep the slope at a flat grade.
- Sloping terrain may begin no closer than 2'-0" from the end of the transformer pad, and from the same elevation as the flat grades.
- Sloping terrain is restricted to a 1'-0" rise per 2'-0" run, or flatter.
- The maximum height of sloping terrain is 7'-6".



Install utility boxes within the sidewalk area in accordance with city and county requirements.

**Figure 3-7. Clearance at padmount transformer and separation of underground services at the property line.**

## 3.10 Switch Vault Pads

Concrete switch vault pad details and requirements may be obtained on our website. Refer to STD 30-5052.

### A . Location

Requirements for the location of pads for switch vaults include:

- No permanent or temporary structure or object may be erected or placed within areas where clearances are required. (Refer to transformer concrete pad details).
- When the concrete pad is located in the vicinity of existing or future combustible material or combustible buildings, the customer must provide safeguards as outlined in the NEC, subject to the approval of the city and building inspector.
- The front side of the concrete pad must face vehicular access, and be free of obstruction at all times.
- When parts of building structures are located directly over the concrete pad, a minimum vertical clearance of 9'-0" from the surface of the pad is required.
- The customer must provide and install adequate protection for switch vaults. Consult with the Company for type and location. Location clearances and protection details may be obtained on our website. Refer to STD 30-5000.

### B . Customer Responsibilities

The customer is responsible to:

- Furnish materials and construct the facilities for the switch vault including the concrete pad, necessary ducts, and anchor bolts. When required, the concrete curb and rock fill around the pad must be furnished and installed by the customer.
- Install the duct from the pad to the riser pole or handhole as designated on the plan.
- Grade sufficiently around the pad site to prevent future filling in of the pad. When required, construct a retaining wall of suitable material to prevent future filling of pad.
- Compact by rolling the site in accordance with city and county specifications for compacting sidewalk areas.

Allow 5 working days advance notice, for inspections by the power company. The power company must have:

- 24-hour access to the switch vault without passing through locked areas.
- A minimum of 10'-0" wide vehicular access to the switch vault.
- 5'-0" sweeps up into switch vault pad duct locations

### C . Clearances Around Switch Vaults

Refer to STD 30-5000 and 30-5002 of our construction standards, which is available on our website for clearance requirements.

Consult with the power company's engineering department prior to installation of switch-vault pad. Required minimum clearances include:

- 8'-0" front clearance for 12 kV, 10'-0" front clearance for 12/25 kV & 25 kV, for hot stick operation. The Company's handholes and manholes may be installed within this clearance area. Planter strips or landscaped areas are not recommended within this clearance area.
- Consult with the Company regarding sloping requirements around a switch vault pad
- Coordinate pad location with County approved grading plan.

### 3.11 Retaining Walls

Slope and retaining wall requirements may be obtained on our website. When sloping requirements cannot be met, a retaining wall must be installed. Refer to STD 30-5002.

When pads cut into hillsides, these requirements apply:

- The concrete area must be at least 3-1/2" thick. For drainage, slope the concrete toward the front or sidewalk. Gravel may be used instead of concrete.
- Retaining walls, fences, and foundations are installed by the customer, and are outside the easement area.
- Retaining walls must be of sufficient height to protect the equipment from erosion and run-off of dirt and water. A drainage swale behind the wall must be installed to divert water around the equipment.
- Retaining walls must meet state and city codes and requirements for retaining walls. (Must be submitted for utility company review.)
- For walls taller than 24" high, acceptable protection such as a fence must be installed at the top of the wall to prevent falls. Alternatively, the wall can be extended to a sufficient height to prevent falls. Increased clearance area may be required for transformer pads. Consult with the Company for clearance requirements.
- Weep holes, if required, must not drain in the area occupied by power company equipment.

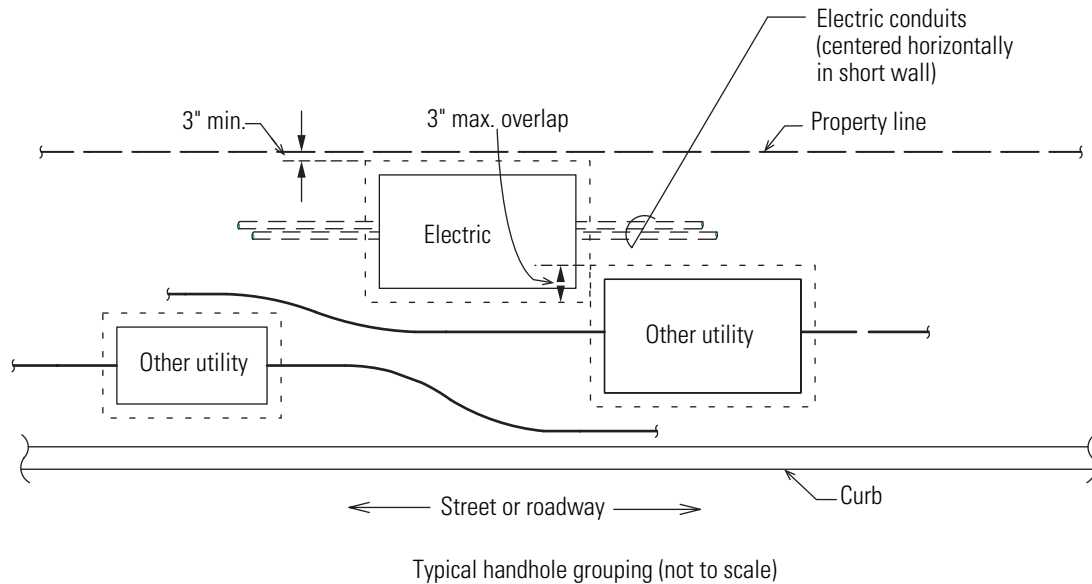
### 3.12 Underground Construction

Typical construction details and requirements for handholes, manholes, and pads for equipment other than transformers may be obtained on our website. Consult with the Company for the applicable type and location.

#### A. Handholes, Vaults and Manholes

- Handholes, vaults, and manholes located in landscaped or undeveloped areas will require a concrete apron to be constructed around the perimeter of the facilities. Consult with the company for a typical apron detail.
- Traffic rated handholes and vaults must be utilized in locations subject to incidental vehicular traffic such as curbless subdivisions. In lieu of traffic rated handholes and vaults, post barriers (bollards) may be installed around the perimeter of the required working space clearance.
- Manholes will be required in locations subject to constant vehicular traffic.

- Handholes, vaults, and manholes located in an open field will require post barriers (bollards) to be installed around the perimeter of the equipment's working space clearance.
- The customer or their representative will be required to provide handhole/manhole layout details (butterfly diagram) for all new handholes and manholes.



Note: Consult with the company for site specific requirements.

**Figure 3-8. Typical handhole placement requirements.**

## CHAPTER

## 4

# Metering

## 4.1 Introduction

This chapter describes the requirements for the Company's revenue metering installations. In addition, meter installations shall conform to the National Electrical Code (NEC) and to all local regulations.

This chapter is divided into the following sections:

- General Information
- General Requirements
- Electrical Rooms and Meter Closets
- Freestanding Meter Enclosures, Pedestals, and Steel-Post Structures
- Self-Contained Metering (0 to 600 Volts)
- Transformer-Rated Metering
- Typical Service Entrance Grounding and Bonding Diagrams
- Specialized Metering

## 4.2 General Information

The general information provided in this section describes the responsibilities for the Company and customer, and conditions for energizing a service.

### A. Company Responsibilities

The Company will furnish, install\*, own, and maintain the instrument transformers, test switches and their associated secondary wiring\*\*, and revenue meters (henceforth to be called "meter").

- \* For Maui Electric and Hawai'i Electric Light: customers shall install the Company provided instrument transformers.
- \*\* For Hawai'i Electric Light: Customers shall furnish and install the secondary wiring for instrument transformers, per Hawai'i Electric Light meter standards. The Company will terminate all wiring

### B. Customer Responsibilities

The customer shall furnish, install, and maintain the following:

- Meter sockets, including plastic meter socket covers and meter sealing rings for open sockets.
- Conduits, raceways, connectors, lugs, and wiring\*.
  - \* For Hawaiian Electric and Maui Electric - Except for the secondary wiring for instrument transformers, which will be furnished by the Company.
- Grounding and bonding.
- Splice cans and junction boxes.
- Protective equipment, including circuit breakers and switches.

And where applicable:

- Meter enclosures and pedestals.
- Instrument transformer enclosures with transformer mounting brackets.
- Meter centers.
- Switchboards/switchgear.
- Concrete pads for metering equipment such as pedestals, switchboards, or switchgear

Three (3)\* sets of drawings of the proposed metering installation shall be submitted to the Company for review and comment. This includes, but is not limited to, the one-line diagram, plan view(s), and equipment elevation details. Information such as working clearances, equipment clearances, equipment elevation heights, bollard locations, and potential obstructions shall be identified on the drawings. Metering equipment shall be properly labeled (e.g. the number of jaws, the type of by-pass, size of CT and splice cans, ampacity rating of the main breaker, etc.).

One set of drawings with the Company's comments will be returned to the customer. Where the Company has no major comments, the drawings will be returned with a stamp of acceptance. All comments shall be satisfactorily addressed prior to the start of construction.

Where a meter installation involves a switchboard, switchgear, or pedestal three (3)\* sets (four sets for the HELCO service territory) of the manufacturer's shop drawings shall also be submitted for review prior to equipment fabrication. These drawings shall identify all equipment dimensions, include a one-line diagram, and reflect references to all applicable Electric Utility Service Equipment Requirements Committee (EUSERC) drawing numbers. For meter pedestal installations, refer to section 4.5B (Freestanding Meter Pedestals) for additional requirements.

A minimum of three (3) weeks shall be allowed for the Company to review and provide comments for all meter installation drawings.

Six months' firm notice shall be provided to the Company for all primary metered services due to lead times for procuring instrument transformers.

\* For Hawaiian Electric: One (1) set of drawings or as requested.

### C. Conditions for Energizing Services

The Company will energize the service after the following has been completed:

- Metering equipment (such as meter sockets, CT cans, splice cans, etc.) has been installed and passed an inspection by the Company.
- Metering equipment has been properly labeled as required in section 1.8A (Labeling of Metering Equipment) and concurs with information provided by the customer on the service request (application for service).
- Service disconnecting means has been installed.
- The local inspection authority has approved the installation. Typically, this authority is the city or county building department.

- For certain situations, the Company may require that the customer's contractor be present when the service is energized (such as when assistance is needed to pull service cables through current transformers for transformer-rated services).

## 4.3 General Requirements

This section describes the requirements that are applicable to all meter installations served by the Company. In addition to this section, other meter installation requirements in subsequent sections of this chapter shall be followed.

### A. Meter Locations

Metering equipment shall be installed at a convenient location on the customer's premises. The location of all metering equipment requires Company approval prior to installation. Where multiple meters are installed, all meters shall be installed at one central location. Meter locations shall be free from obstructions, abnormal temperatures, corrosive environments, and vibrations. All meters and their associated equipment shall be readily accessible at all times (24 hours) by Company personnel (for emergencies, meter reading, inspection, testing, maintenance, etc.)

#### 1) Locations for Residential Meters (Single Family Homes and Townhouse type)

Metering equipment shall be installed at ground floor level. These locations shall be in an area that is closest to the street and within 4'-0" from the corner of the residence or building (as shown in Figure 4-1 below). The preferred location of the meter socket is at the front of the residence, outside of the garage, and on the side wall or facing the street.

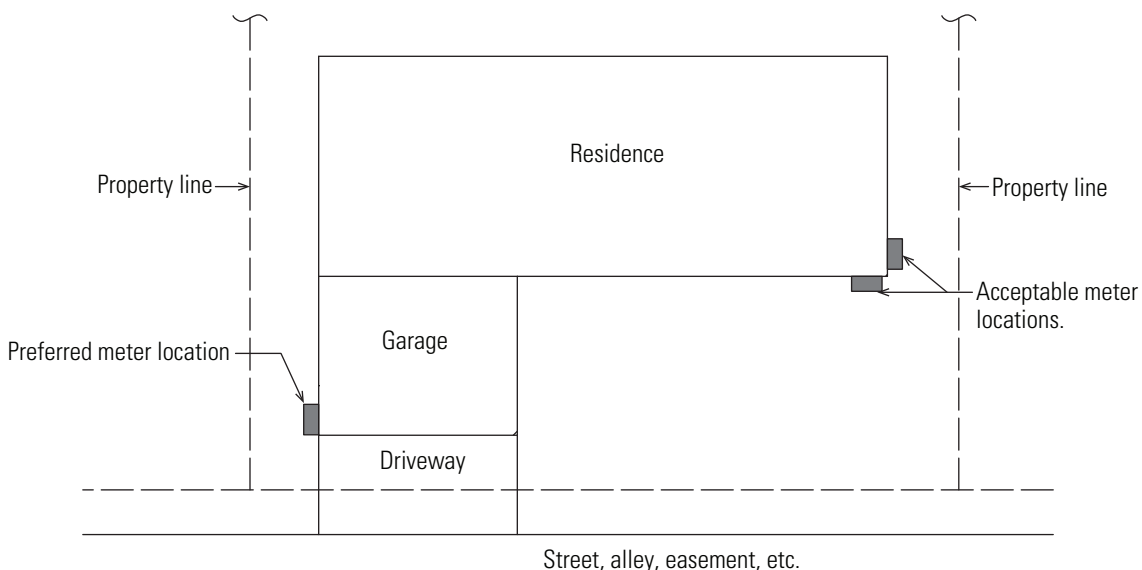


Figure 4-1. Locations for residential meters.

#### 2) Locations for Commercial, Industrial, and High Rise Residential Meters

Metering equipment shall be located on the ground floor level unless approved by the Company. Due to variations in design of commercial, industrial, and high rise residential



facilities, meter locations for these installations shall require Company approval. Drawings shall be submitted as described in section 4.2B (Customer Responsibilities).

### 3) Unacceptable Meter Locations

The following are examples of unacceptable meter locations:

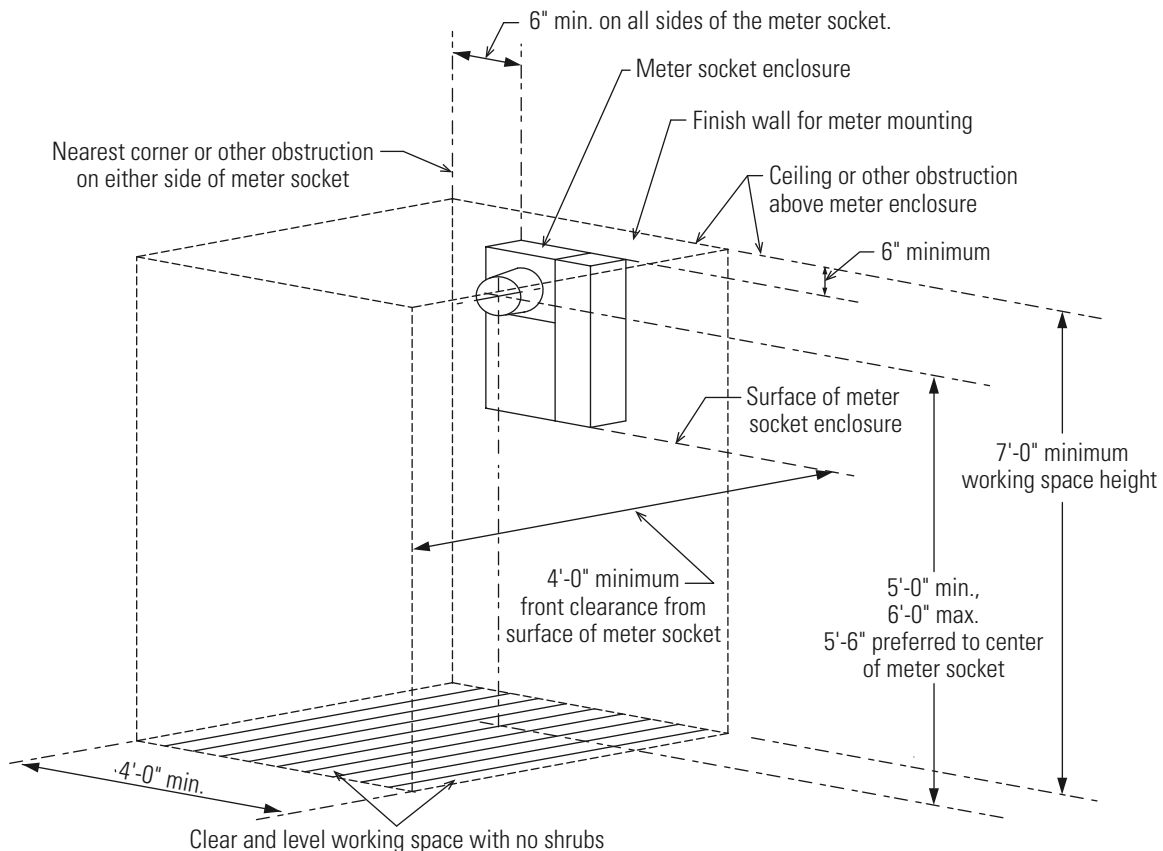
- Locations which are not readily accessible such as inside garage walls, carports, breezeways, etc. or in areas that may be enclosed. If renovations are made to a carport, garage, patio, or a similar structure that will enclose any metering equipment, the customer shall relocate the metering equipment to an accessible location.
- On or around corners, doors, windows, and door/window openings. Minimum clearance requirements from these locations are stipulated in section 4.3B (Clearances Around Metering Equipment).
- In an elevator shaft or hatchway.
- In a stairwell.
- In an attic, basement, or an area not readily accessible to Company personnel.
- In a restroom, bath, shower, powder, or toilet rooms.
- Locations with moving or rotating machinery.
- Near any high-voltage compartment, switchboard, or other bare or exposed live electrical parts. The minimum clearance between the meter equipment and such parts shall be 5'-0" and be effectively screened (enclosed) or separated by a suitable barrier (permanent wall) or protection from those parts. Clearances shall be in accordance to the latest version of the NEC. Where the NEC rules are more stringent, these clearance requirements shall be followed.
- Areas which are used for trash chutes, storage, janitorial rooms, etc.
- Areas where the meter protrusion could obstruct or create a hazard to pedestrian and/or vehicular traffic.
- Locations where noise levels exceed 85 decibels, (see Hawaii OSHA regulation 12-200-9, Protection against Noise Exposure).
- In a generator room or mechanical/machine room.
- Rooms where fuel or hazardous materials are stored
- Locations where excessive moisture, abnormal temperature, vibration, fumes, dust, saltwater spray, corrosive environments or similar deterioration agents are present.
- Near gas lines/equipment.
- Areas protected by alarm systems, security gates or doors, guard dogs, etc., unless approved by the Company.
- On any portion of a building where future landscaping, fencing, or other building construction will make the meter inaccessible.
- Within any fenced-in areas, such as along freeways.
- On Company poles.

- On piers, docks, or berths. A minimum clearance of 10 feet shall be provided between the metering equipment and the edge of the water, or in compliance with the requirements set forth by the authority having jurisdiction.
- Areas where use of a ladder, fixed rungs, pull down stairway, etc. is required for access to the location of metering equipment.

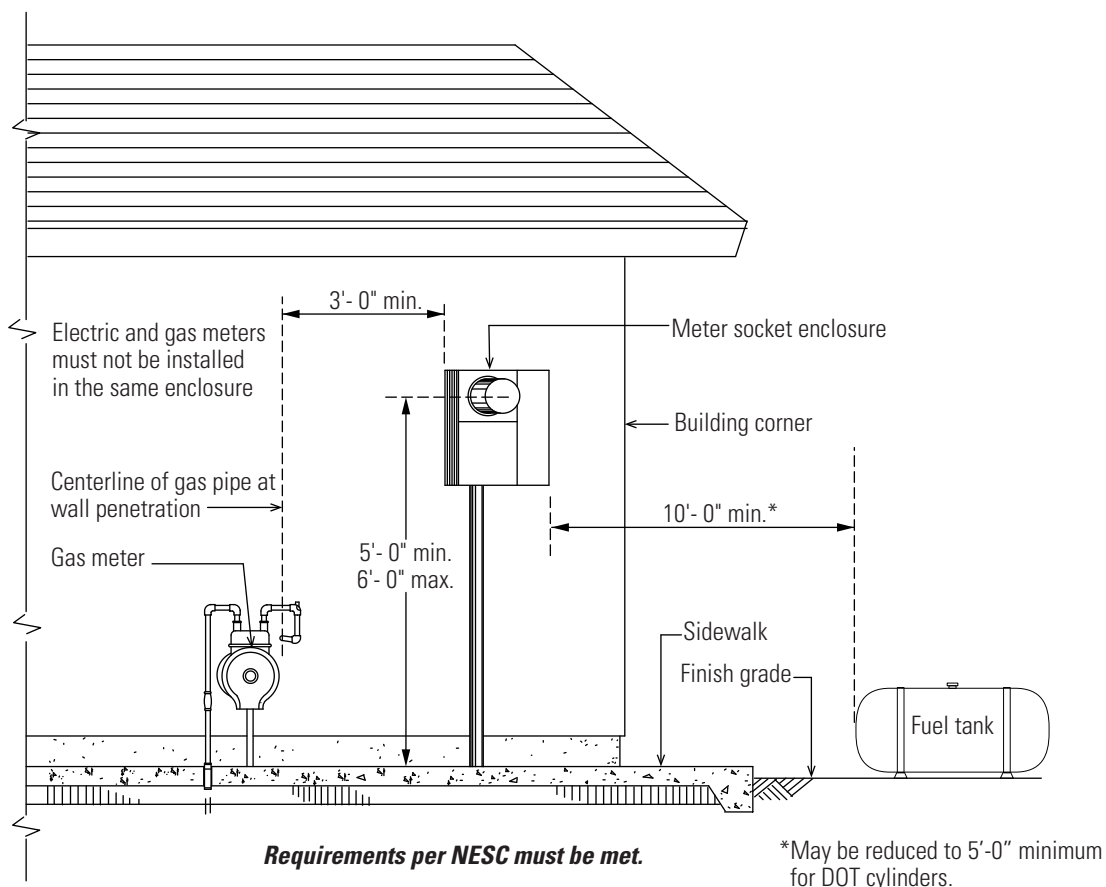
## B. Clearances Around Metering Equipment

The following clearances shall be provided around all metering equipment (meter socket, splice can, CT can, raceway, switchboard, switchgear, etc.):

- Equipment clearance of six inches around metering equipment (above, below, and to the sides). This clearance shall be maintained from any corner, door, entryway, window, obstruction, or to any load side equipment.
- Frontal working clearance of 4 feet by 4 feet by 7 feet (see figure 4-2). Where the total width of the metering installation is greater than 4 feet, this clearance shall be widened accordingly. This working clearance shall be level and clear to allow for the use of a ladder. In addition, this working clearance shall be kept free from any obstructions such as walls, fences, trees, hedges, other structures, and equipment.
- Frontal working clearance from primary voltage (over 1000 volts) metering switchgear shall be increased to 8 feet. This clearance applies to all doors of any primary metering switchgear.



**Figure 4-2. Clearance around meters.**



**Figure 4-3. Clearances between residential electric meters and gas facilities.**



**Figure 4-4. Meter Electrician performing a meter test. Notice the need for workspace clearance between the meter socket panel, and the pole on the floor.**

## C. Mounting Heights for Meters

Meter mounting height requirements are listed below in Tables 4-1 (for self-contained meters) and 4-2 (for transformer-rated meters). Unless otherwise noted, mounting heights shall be measured from the centerline of the meter socket to finished grade or floor.

Location and Description of Meter Installation	Service	Minimum	Preferred	Maximum	See Figure
<b>Individual Meters</b>					
Accessible to public contact	Residential, Commercial	5'-0"	5'-6"	6'-0"	4.2
Within a meter room, meter closet, or enclosed area not accessible to public contact	Residential, Commercial	4'-6"	5'-6"	6'-6"	
<b>Grouped Meters (Section 4.6C)</b>					
Accessible to public contact	Residential, Commercial	5'-0"	5'-6"	6'-0"	4.21
Within a meter room, meter closet, or enclosed area not accessible to public contact	Residential, Commercial	4'-6"	5'-6"	6'-6"	4.21
<b>Freestanding Installations (Section 4.5)</b>					
Meter Enclosures	Residential	3'-0"	5'-6"	6'-0"	4.14
	Commercial	3'-0" *	5'-6"	6'-0"	4.14
Meter Pedestals	Commercial	4'-6"	5'-6"	6'-0"	4.16
Steel-Post Structures	Commercial	5'-0"	5'-6"	6'-0"	4.17
<b>Switchboard Meters and Meter Centers (Section 4.6D)</b>					
Accessible to public contact	Residential, Commercial	4'-6"	5'-6"	6'-0"	
Within a meter room, meter closet, or enclosed area not accessible to public contact	Residential	3'-0"	5'-6"	6'-6"	4.23
	Commercial	3'-0" **	5'-6"	6'-6"	4.23

**Table 4-1. Mounting heights for self-contained meters (up to 600 volts).**

- \* For Hawaiian Electric and Hawai'i Electric Light: This dimension shall be measured from the centerline of the commercial test bypass to finished grade or floor
- \*\* For Hawaiian Electric and Hawai'i Electric Light: This dimension shall be measured from the centerline of the commercial test bypass to finished grade or floor. For self-contained metering switchboards where space for three (3) rows of meters per section is required, this dimension may be reduced to 2'-8".

Location and Description of Meter Installation	Service	Minimum	Preferred	Maximum
<b>Current Transformer Cabinet Installations (Section 4.7A)</b>				
Accessible to public contact	Residential, Commercial	5'-0"	5'-6"	6'-0"
Within a meter room, meter closet, or enclosed area not accessible to public contact	Residential, Commercial	4'-6"	5'-6"	6'-6"
<b>Switchboard Meters and Meter Centers (Section 4.7B)</b>				
Accessible to public contact	Commercial	4'-6"	5'-6"	6'-0"
Within a meter room, meter closet, or enclosed area not accessible to public contact	Commercial	4'-6"	5'-6"	6'-6"

**Table 4-2. Mounting heights for transformer-rated meters.**

## D. Metering Equipment Requirements

Customers shall insure all metering equipment (meter socket, splice can, CT can, raceway, etc.) meets the following requirements:

- UL Rated (Underwriters Laboratory), NEMA Rated (National Electrical Manufacturers Association), and designed to meet ANSI (American National Standards Institute) standards requirements.
- Sealable and/or lockable by the Company.
- Rain tight with a NEMA 3R (or higher) rating when installed outdoors.
- Made with stainless steel and have a NEMA 3R (or higher) rating where exposed to corrosive environments (e.g. saltwater spray, industrial discharge, etc.).
- Installed level, plumb, and secured to a permanent or acceptable structure
- Bonded to the grounding system in accordance with the requirements of the latest version of the NEC.
- Where a raceway is longer than three (3) feet, it shall be equipped with a hinge. This hinge shall be on the top of the raceway.

In addition,

- 1) Metering equipment shall not be recessed within walls without Company approval.
- 2) LBs shall not be used for line side conduits unless approved by the company. Where approved, one-way security screws shall be used to seal all LB covers.

## E. Meter Socket / Splice Can Requirements

In addition to the above requirements in section 4-3D (Metering Equipment Requirements), meter sockets shall also be:

- Ring-type and comply with ANSI C12.7
- Designed to receive watthour meters that meet ANSI C12.10
- Furnished with plug-in-type jaws or terminals and stainless steel spring mounted retaining clips.
- Equipped with the required number of jaws as noted below in Table 4-3.
- Covered with plastic meter socket covers designed and manufactured for such use. Covers shall be secured to the meter socket with a meter sealing ring. Covers should be marked or identified, so they can be returned to the owner after meters are installed. Bladed plastic covers and cardboard inserts used in place of plastic covers are not allowed.

Meter sockets shall not be equipped with a Manual Circuit Closing (MCC) bypass or HQ-type lever bypass.

For additional meter socket requirements, see sections 4.6 (Self-Contained Metering) and 4.7 (Transformer-Rated Metering)

Splice cans (or raceways) shall be installed for all secondary voltage services except switchboards and pedestals (which have incoming compartments) and single meter overhead

services. This includes all underground services, transformer rated services, grouped meter installations, meter enclosures, and steel-post structures.

Classification of Service			Number of Jaws	
Voltage	Phases	Number of Wires	Self-Contained	Transformer-Rated
120/240	1	3	4	8
120/208	1	3	5	8
240	3	4	7	-
2400	1	2	-	5
7200	1	2	-	5
120/208Y	3	4	7	13
277/480Y	3	4	7	13
2400/4160Y	3	4	-	13
7200/12470Y	3	4	-	13
14400/25000Y	3	4	-	13

**Table 4-3. Number of jaws required for meter sockets.**

## F. Meter and Main Service Disconnect Configurations

Customers shall furnish and install a circuit breaker, fusible switch, or other service disconnecting means to control the service and energy registered by a meter, prior to the service being energized by the Company. Fusible type pull-out devices or other similar devices are not allowed.

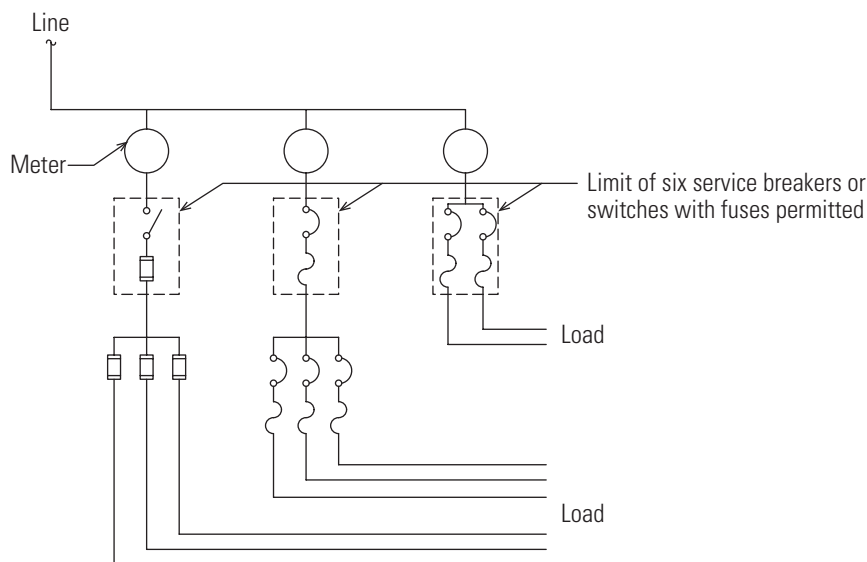
A service disconnecting means is typically installed on the load side, or after Company meters or metering equipment.

A service disconnecting means may be installed on the line side or before the Company's meters where:

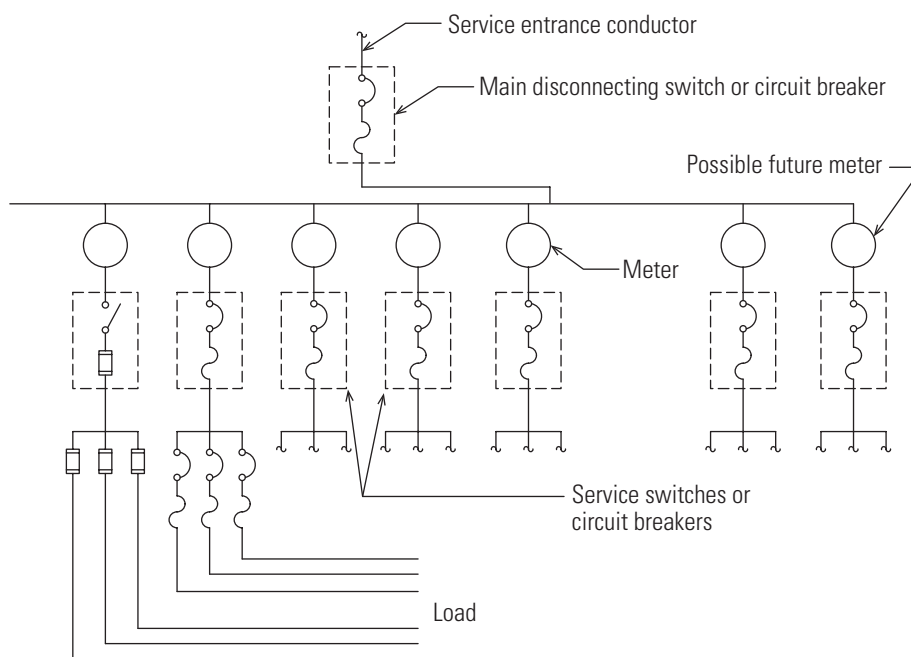
- A single set of service entrance conductors supply 7 or more meters, see Figure 4-5B.
- A single set of service entrance conductors supplies 2 to 6 meters, and it is determined that future growth will require more than 6 meters. Metering equipment for future growth shall be furnished and installed during initial installation.
- In accordance with the latest requirements of the NEC, Article 240 Overcurrent Protection, Code 240.21, Location in Circuit.

Where a line side service disconnecting means is installed, it shall be labeled as noted in section 1.8A (Labeling of Metering Equipment).

**For Maui Electric & Hawai'i Electric Light:** When there is more than one main disconnect, labels are required to clearly identify location and total quantities (for example, 1 of 5, 2 of 5, ...). Labels shall comply with Section 1.8, Labeling of Equipment.



Multiple meter installation without main disconnecting switch

**A. Six or fewer meters**

Multiple meter installation with main disconnecting switch

**B. Seven or more meters****Figure 4-5. Meter and main service disconnect configurations.****G. Service Entrance Conductors**

Customers shall be responsible for the sizing and installation of service entrance and load conductors in accordance with the latest version of the National Electrical Code. Conductor size and type (aluminum or copper) shall be selected in accordance with the manufacturer's ratings for the meter socket. Bonding and grounding conductors shall not be pulled from or tapped to the company's distribution service transformer.

Where service requires parallel or multiple conductors per phase, terminal lugs shall be designed and rated for such application. Single conductor terminal lugs shall not be used for terminating multiple conductors.

Customers shall label all service entrance conductors and identify them by phase, neutral, ground, or high leg where applicable. For example: 1-2-3-N-G, or black-red-blue-white-green. Conductors used for three phase services shall be marked per the requirements listed below in Table 4-4.

Service Voltage	Service Type	Phase A - B - C	Neutral	Ground
Secondary	120/208	Black - Red - Blue	White	Green
	240, 4-Wire	Black - Orange (High-leg) - Blue	White	Green
	277/480	Brown - Orange (High-leg) - Yellow	White	Green
Primary	Primary voltage	1 - 2 - 3	White	Green

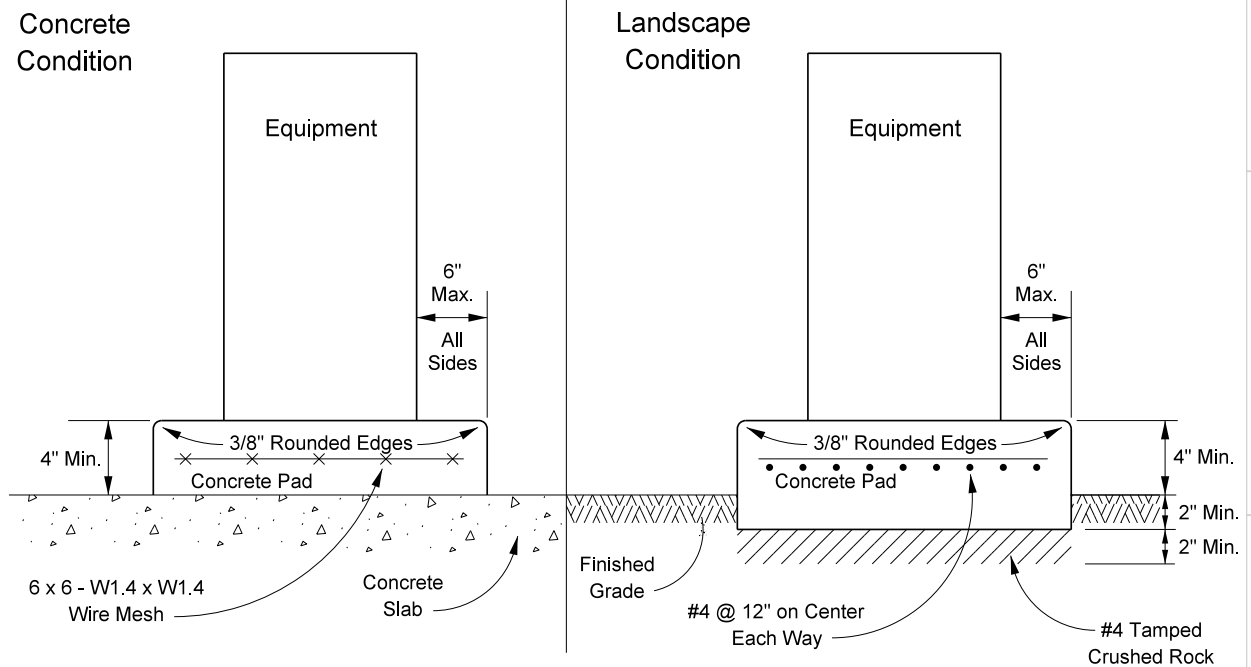
**Table 4-4. Labeling for three-phase service entrance conductors.**

## H. “Labeling of Metering Equipment” has been relocated to Chapter 1, Section 1.8A

### I. Concrete Pads

Concrete pads shall be installed to elevate service entrance and metering equipment (such as switchboards, switchgear, pedestals, etc.) and their enclosures (where required) above finished grade to prevent contact with water runoff or ponding. The customer is ultimately responsible to ensure that the structural design of the concrete pad is capable of supporting all design loads and is in accordance with all applicable building codes. Figure 4-6 below, shows examples of the minimum requirements of a basic design and shall be upgraded as necessary. Concrete pads shall have a maximum horizontal protrusion of six inches from the face of the equipment to the edge of the pad. Where equipment is housed within an enclosure, the protrusion shall be measured from the face of the enclosure to the edge of the pad. The Company shall not be held responsible for an inadequate concrete pad and reserves the right to require design calculations and drawings stamped by a structural engineer licensed in the State of Hawaii.





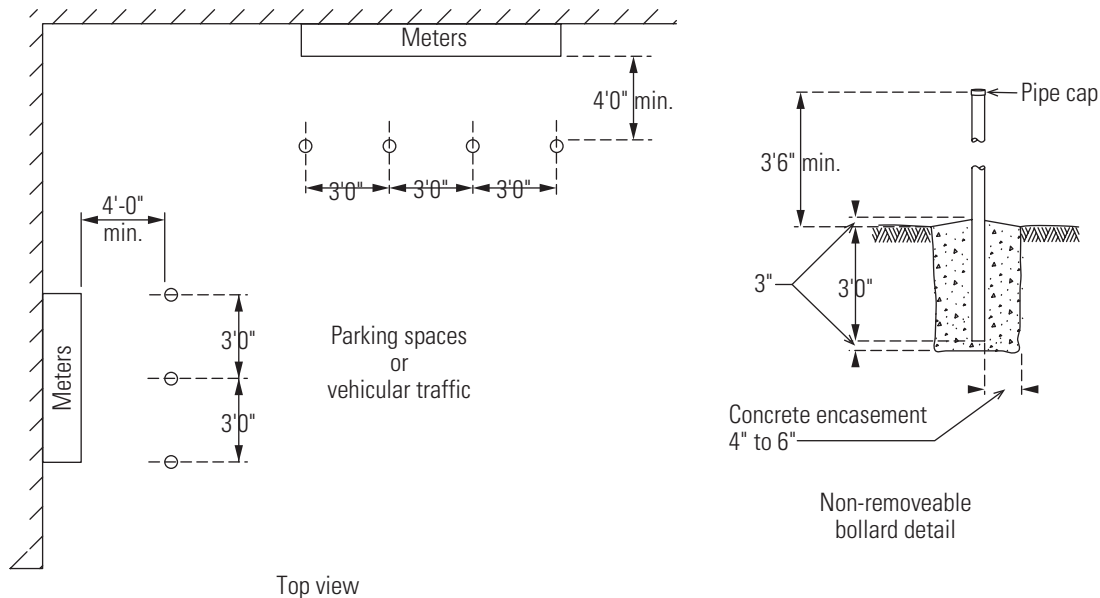
**Figure 4-6. Requirements for concrete pads.**

## J. Bollards

Where exposed to vehicular traffic, metering equipment shall be protected by permanent, non-removable bollards (i.e. barrier posts or stanchions). Bollards shall be designed per figure 4-7 below. Bollard spacing shall be 3'-0" to prevent vehicular contact with metering equipment. In addition, a minimum working clearance of 4'-0" shall be provided fronting all metering equipment. Bollards shall be spaced to allow doors (such as for meter panels, meter closets, etc.) to swing to its maximum open position.

Bollards shall be constructed of 4 inch galvanized steel pipe with a minimum wall thickness of 0.188 inches. Bollards shall be painted yellow per ANSI Z535.1 in compliance with OSHA 1910.144 (Safety Color Code for Marking Physical Hazards). A two inch wide strip of reflective tape shall be placed six inches below the top of the post. The base of bollards shall be buried a minimum of 3'-0" and encased with a minimum of 6 inches of concrete when installed in stable earth, or 12 inches in sandy or unstable soil.

Customers shall be responsible for verifying the location of all underground services prior to beginning excavation (see Chapter 1, One Call System).



**Figure 4-7. Bollards.**

## K. Replacing or Upgrading Service Entrance Equipment

When performing work to replace or upgrade service entrance conductors or equipment (meter sockets, splice cans, CT cans, etc.) the modified installation shall meet the latest requirements of the Company, city, county, NEC, and EUSERC. These modifications include converting service entrance conductors from overhead to underground. The Company shall perform all work such as cutting seals and temporarily removing meters and metering equipment. The customer or their contractor shall not break seals nor remove any meters.

## L. Separation of Unmetered Conductors

Unmetered service entrance or line conductors shall be kept isolated from metered or load conductors. Line and load conductors shall not be located in the same enclosed space, compartment, or wireway. In addition, pipe or conduit that contain load conductors shall not pass through sealed (unmetered) compartments. Where necessary, line and load conductors shall be separated with permanent barriers to easily distinguish them from each other.

Unmetered compartments/sections shall not be used for splicing or making taps to customer generation which includes connections to Distributed Energy Resource (DER) programs such as Customer Grid-Supply (CGS) or Customer Self-Supply (CSS), and Feed-In Tariff (FIT) installations (see section 1.10 Customer Generation).

In addition, no customer equipment or devices shall be mounted on or within any Company sealed line side compartment. Examples of such equipment include but are not limited to ammeters, voltmeters, relays, instrument transformers, fuses, storage batteries, and battery chargers.

## M. Sealing of Metering Equipment

The Company will seal all line side metering equipment (such as meters, CT cans, splice cans, service entrance equipment, line conductor wireways and compartments, etc.). The Company shall perform all work such as cutting seals and entering sealed enclosures or compartments.

## N. Switchboard and Switchgear General Requirements

Switchboards (for secondary service) and switchgear (for primary service) used for service entrance equipment and Company metering shall be constructed in compliance with the latest revision of the Electric Utility Service Equipment Requirements Committee (EUSERC) specifications. The following requirements shall also apply to metering switchboards and switchgear:

- Metering compartments and unmetered sections shall not be used for splicing or making taps.
- Unmetered service entrance conductors shall be kept isolated from customers' load conductors per section 4.3L (Separation of Unmetered Conductors). Metered buses or conductors shall not enter or pass through any Company sealable/designated sections or compartments.
- Where an unmetered bus must pass through the back of a load compartment, the unmetered bus shall be permanently sealed using rivets or one way screws. In addition, signage shall be installed to identify unmetered buses on both the covering of the bus and on the door of the associated load compartment.
- Compartments for unmetered buses or conductors, and metering equipment sections shall have provision for sealing or locking by the Company per section 4.3D (Metering Equipment Requirements).
- Metering compartments or sections (which includes all line side equipment) shall be used exclusively for the Company's metering equipment. Customer equipment such as ammeters, voltmeters, relays, instrument transformers, fuses, storage batteries, battery chargers, etc., are not allowed in or on these compartments/doors.
- Where compartment heaters are installed, they shall be connected to the load side of the meter. Heaters shall not interfere with the installation or removal of Company metering equipment.
- Switchboards and switchgear shall be grounded and bonded in accordance with the latest requirements of the NEC. The ground rod and tie to the building grounding system shall not be installed in Company designated compartments or sections.
- For installations of seven or more meters, see section 4.3F (Meter and Main Service Disconnect Configurations).
- Switchboards and switchgear shall be installed on a concrete pad. Concrete pads shall meet the requirements of section 4.3I (Concrete Pads).
- Enclosures shall comply with all applicable EUSERC specifications. Where installed outdoors, enclosures shall be weatherproof or NEMA 3R rated. Where exposed to

corrosive environments (e.g. saltwater spray, industrial discharge, etc.), it is strongly recommended that enclosures be constructed with stainless steel.

- Oahu Only: Check with the Company for switchboard installations in the Downtown Network System. Adapter plates will be required at switchboard buss section.
- Where exposed to vehicular traffic, bollards shall be installed to protect the metering installation (see section 4.3J Bollards).
- For switchboard and switchgear meter mounting height requirements, refer to section 4.3C (Mounting Heights for Meters).
- The frontal working clearances from doors for switchgear is 8'-0". This clearance applies to all doors (front and back) which house metering equipment.
- For primary services where multiple service feeders are required, each feeder shall be separately metered. Switchgear for this type of service shall be equipped with a separate compartment or section for each incoming service feeder and its related metering equipment.

## 0. Sub-Metering

Sub-metering or installing a meter after Company meters is not allowed for residential services.

The customer shall not resell any of the electric energy received by him from the Company, except for use solely as motor fuel for light duty plug-in electric vehicles. A light-duty vehicle is defined as a passenger car or passenger car derivative capable of seating 12 passengers or less.

## 4.4 Electrical Rooms and Meter Closets

The requirements for installing metering equipment in locations such as electrical rooms or meter closets are provided in this section. Metering equipment may be installed in these locations to protect it from public access (such as for high-rise residential or commercial installations)

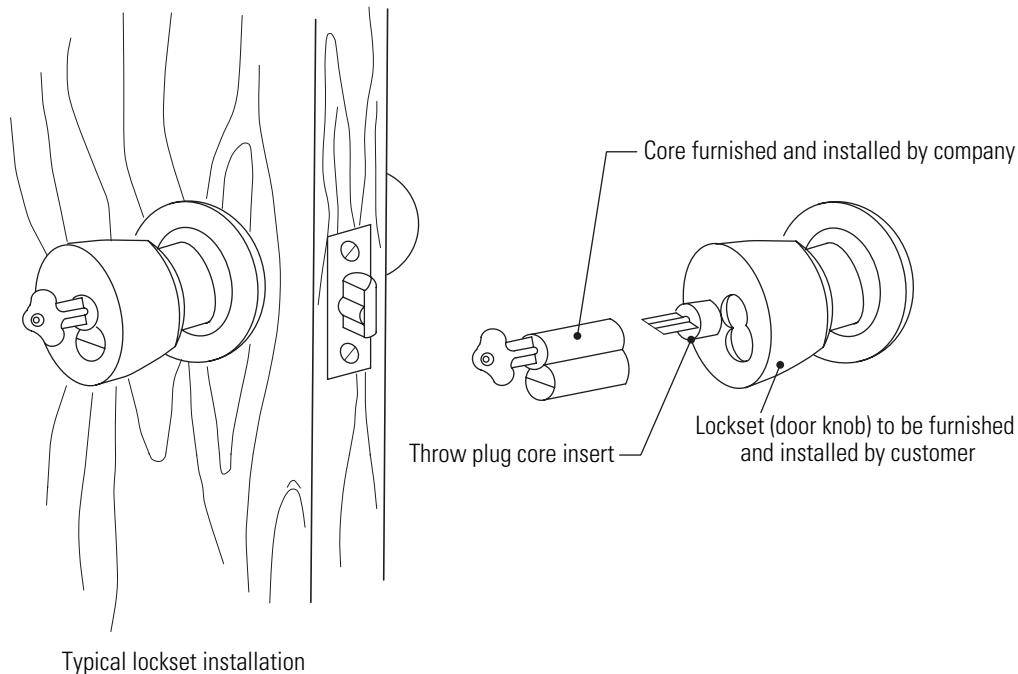
This section is divided into the following subsections:

- Access
- Other Utility Equipment
- Foreign Equipment
- Illumination and Electrical Outlets

### A. Access

Metering equipment located within confined or enclosed areas (such as electrical rooms, meter closets, etc.) shall be accessible from the exterior of the building, or through another Company approved entryway. Access shall be through a vertical doorway with minimum dimensions of 3'-0" wide by 6'-6" tall. Where doors leading to the metering equipment are required to be locked, refer to Chapter 1 (Locked Areas) for options to provide the

Company with access into these locations. Company lock cores shall be installed on doors equipped with a lockset (see Figure 4-8 below.)

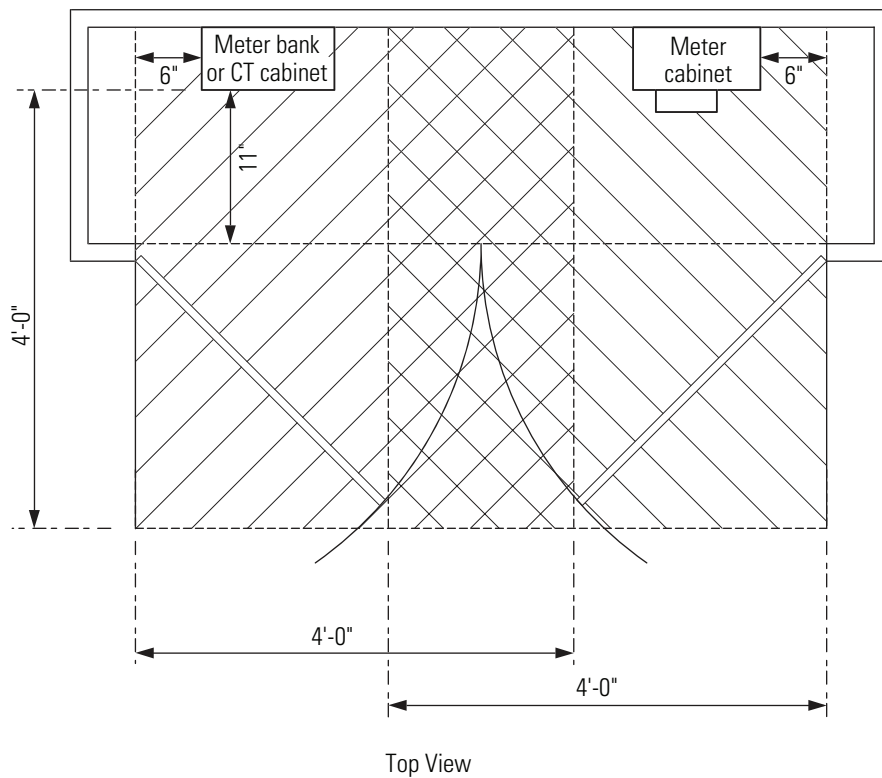


Notes:

1. Locksets shall be furnished and installed by the customer.
2. All locksets shall accommodate the Company's Best (brand) core insert. Cores will be furnished and installed by the Company.
3. Individual keys will be furnished by the Company.
4. Contact the Company's Customer Installations Department for more information prior to installation.

**Figure 4-8. Door Locksets**

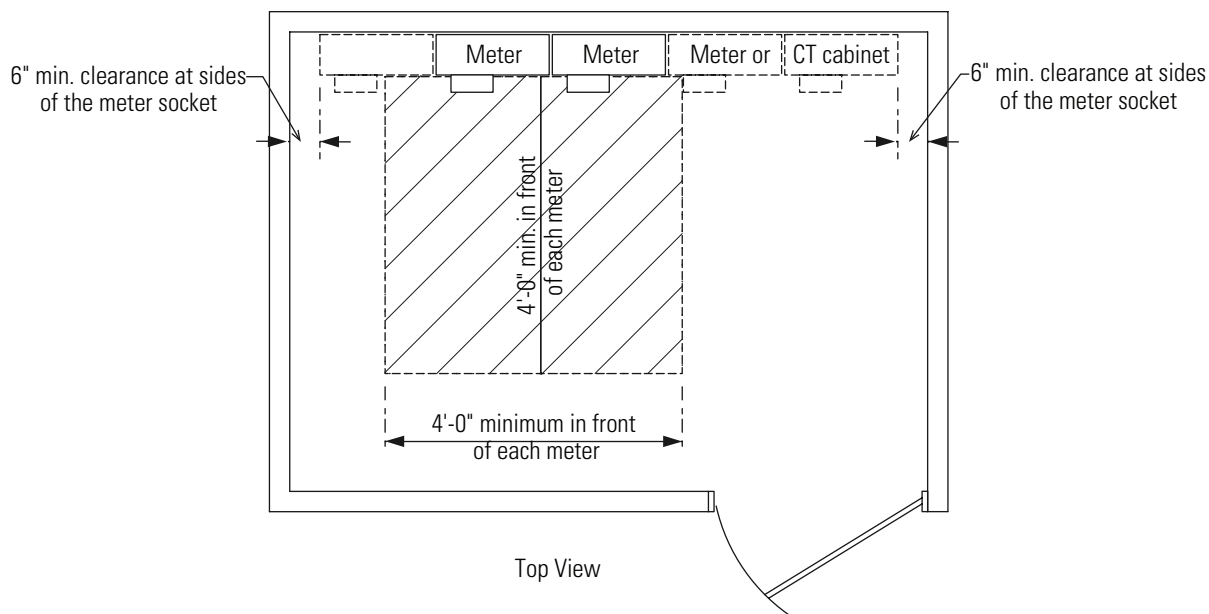
In addition, a minimum working clearance of 4'-0" shall be provided fronting all metering equipment (see Figures 4-9 - 4-11). Double door frames or similar framing shall not obstruct this clearance.



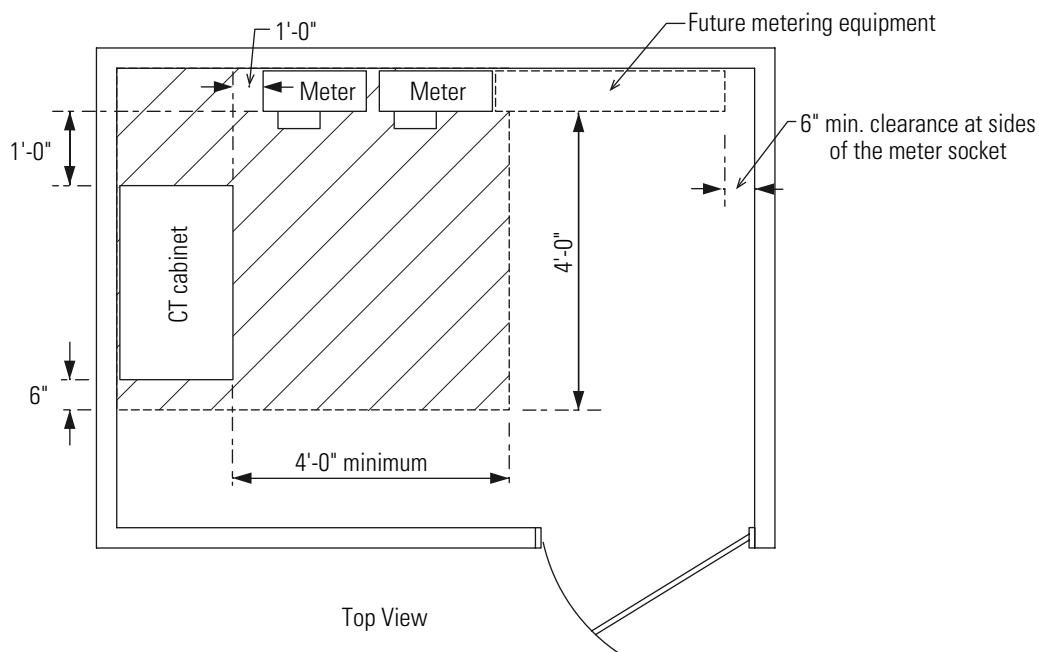
Notes:

1. A minimum clearance of 11 inches shall be provided between the face of the meter socket and the closet door.
2. The minimum ceiling elevation of the meter closet shall be 7 feet.

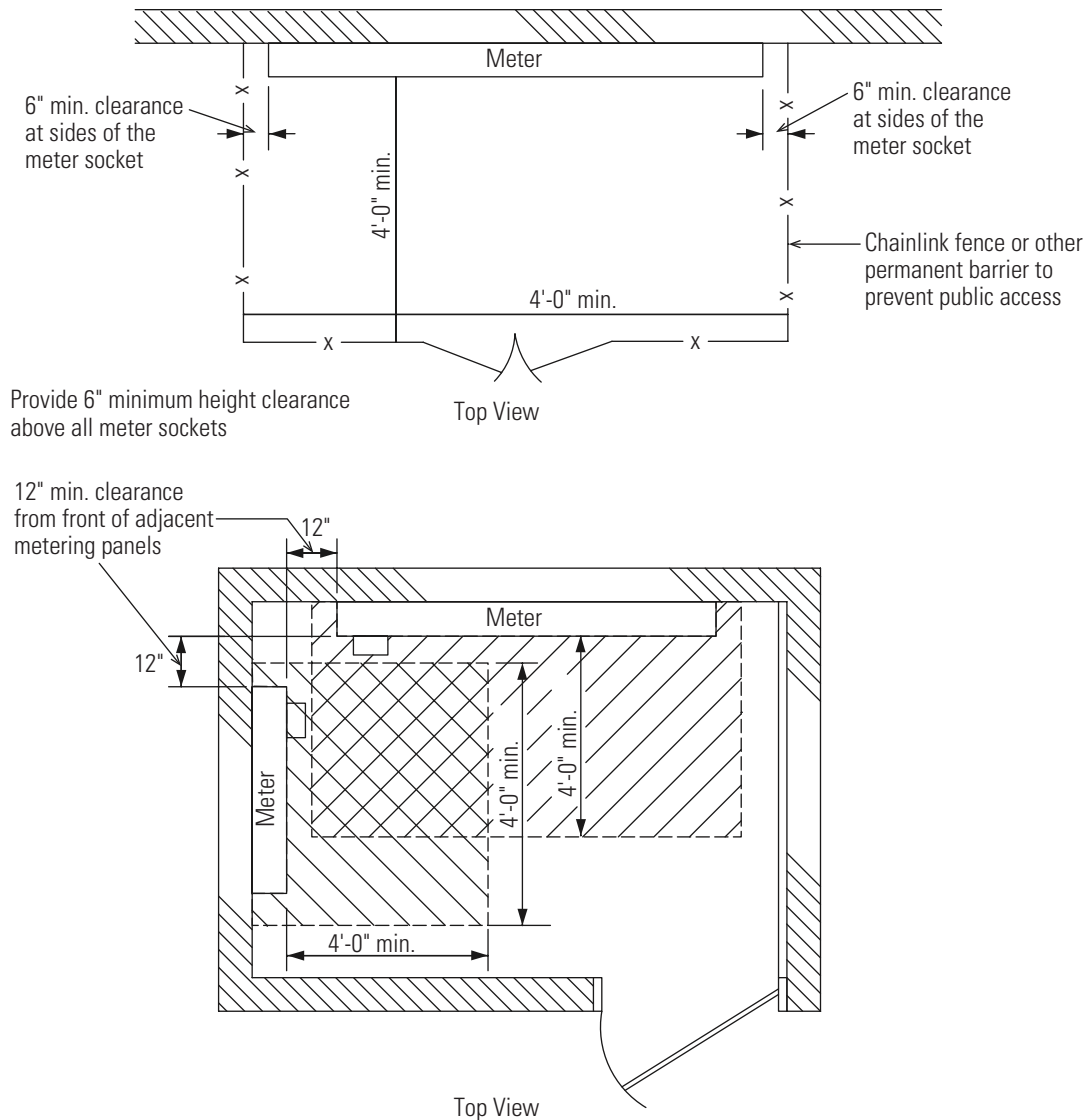
**Figure 4-9. Meter closet working space.**



Provide 6" minimum height clearance above all meter sockets.



**Figure 4-10. Examples showing meter room working spaces.**



**Figure 4-11. Enclosed area working space.**

## B. Other Utility Equipment

Other utility equipment (such as Telephone, CATV, etc.) may be installed in electrical rooms, meter closets, or enclosed areas where it does not obstruct the required working clearance of metering equipment (see section 4.3B Clearances Around Metering Equipment). In addition, grounding for such equipment shall not alter or reduce the integrity of the electric service grounding system. Communication equipment panels/doors shall not open into any metering equipment.

## C. Foreign Equipment

The following are examples of equipment which are not permitted in electrical rooms, meter closets, or enclosed areas:

- Gas equipment, including piping systems.
- Mechanical equipment and generators.



- Storage of miscellaneous equipment, materials, liquids, gases, etc.
- Wet filled batteries, and battery charging equipment.
- Irrigation and garden/landscaping sprinkler controllers.
- Water heaters or boilers including any piping systems under pressure.

**Exception:** Fire sprinkler piping systems and sprinkler heads shall be allowed in these locations as required by local fire or building codes. The appropriate inspection authority shall determine placement and shielding of sprinkler heads. Sprinklers shall not obstruct the required working clearances of metering equipment.

#### D. Illumination and Electrical Outlets

Lighting shall be provided within an electrical room, meter closet, or enclosed area in accordance with local building codes and NEC requirements. A minimum illumination intensity level of 50 foot-candles shall be provided in these areas. Electrical outlets shall be installed in accordance with local building codes and the latest requirements of the NEC.

### 4.5 Freestanding Meter Enclosures, Pedestals, and Steel-Post Structures

Freestanding meter enclosures, pedestals and steel-post structures are permanently installed and self-supported for housing or installing service entrance and metering equipment. These installations may be permitted in locations where the following is unavailable:

- Existing exterior walls or adequate wall space in an approved location.
- Permanent buildings or structures near the area of service (such as for traffic signal service, irrigation service, etc.)

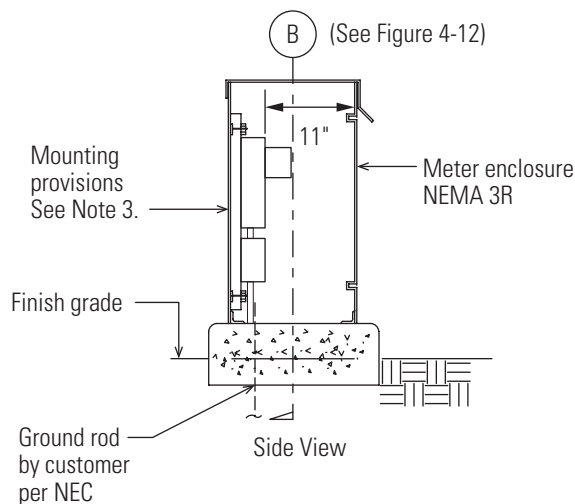
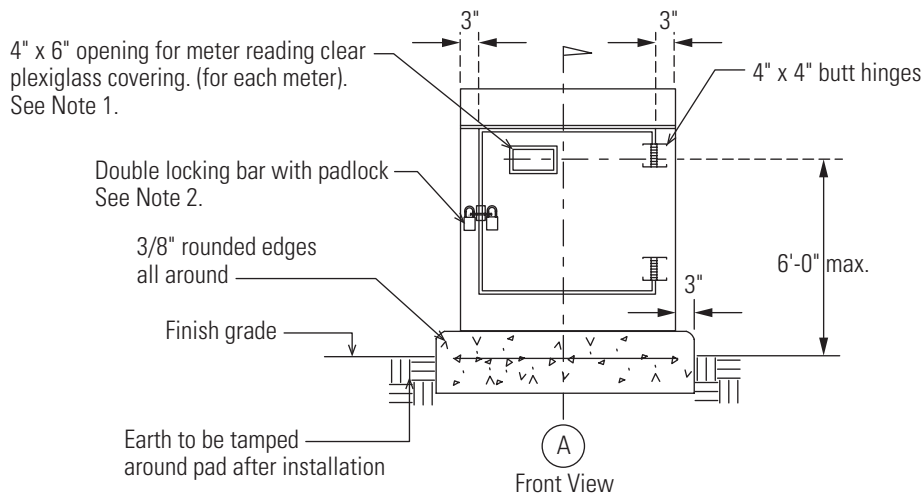
Where installed in close proximity to streets or highways, safety shall be taken into consideration in the orientation of these installations. For example; Company personnel should be facing oncoming traffic when reading the meters. Where vehicular traffic is not an issue, they shall be oriented such that the meters can be easily read from the sidewalk or other safe and accessible area. Consult with the Company for proper orientation of these installations.

In addition to the following requirements in this section, these installations shall comply with the specifications in section 4.3 (General Requirements).

#### A. Freestanding Meter Enclosures

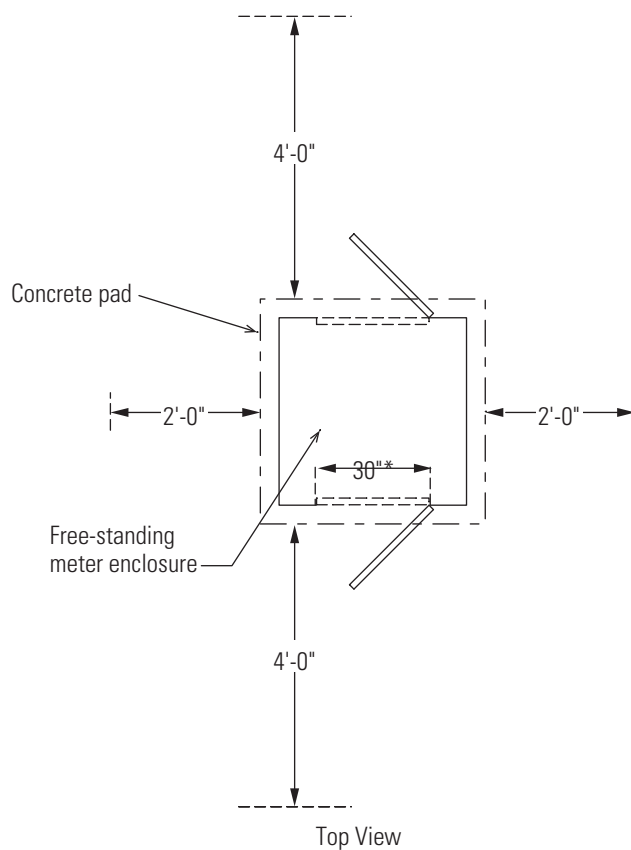
Freestanding meter enclosures are surface mounted cabinets which provide physical protection for the installed equipment from exposure to environmental conditions. They are equipped with a lockable door to prevent unauthorized access.

Meter enclosures shall be installed per the details and notes in Figure 4-12 below. Minimum working clearances shall be provided as shown in Figure 4-13. Service entrance and metering equipment shall be installed inside enclosures as specified in Figure 4-14.

**Section A****Notes:**

1. Enclosures shall be equipped with a 4" x 6" meter viewing window for rate schedules G and R. Viewing windows shall be aligned with the meter socket. Viewing windows are not required where service loads are greater than 5000 kWh per month or 25 kW (demand meters).
2. Customers requiring access into enclosures shall furnish and install a double locking bar and padlock for securing doors. Double locking bars shall be fabricated to accommodate padlocks with 3/8" shackles. A separate padlock will be furnished and installed by the Company.
3. Metering equipment inside enclosures shall be installed on metal brackets or unistruts. Plywood backboards shall not be used.
4. Enclosures shall be securely mounted on concrete pads with four 5/8" diameter anchor bolts. For concrete pad requirements, refer to section 4.3I.
5. A minimum frontal clearance of 11 inches shall be provided between the meter socket and the enclosure door.
6. Enclosures shall be painted with a minimum of one coat of shop primer and finished with two coats of epoxy enamel.

**Figure 4-12. Freestanding meter enclosures.**

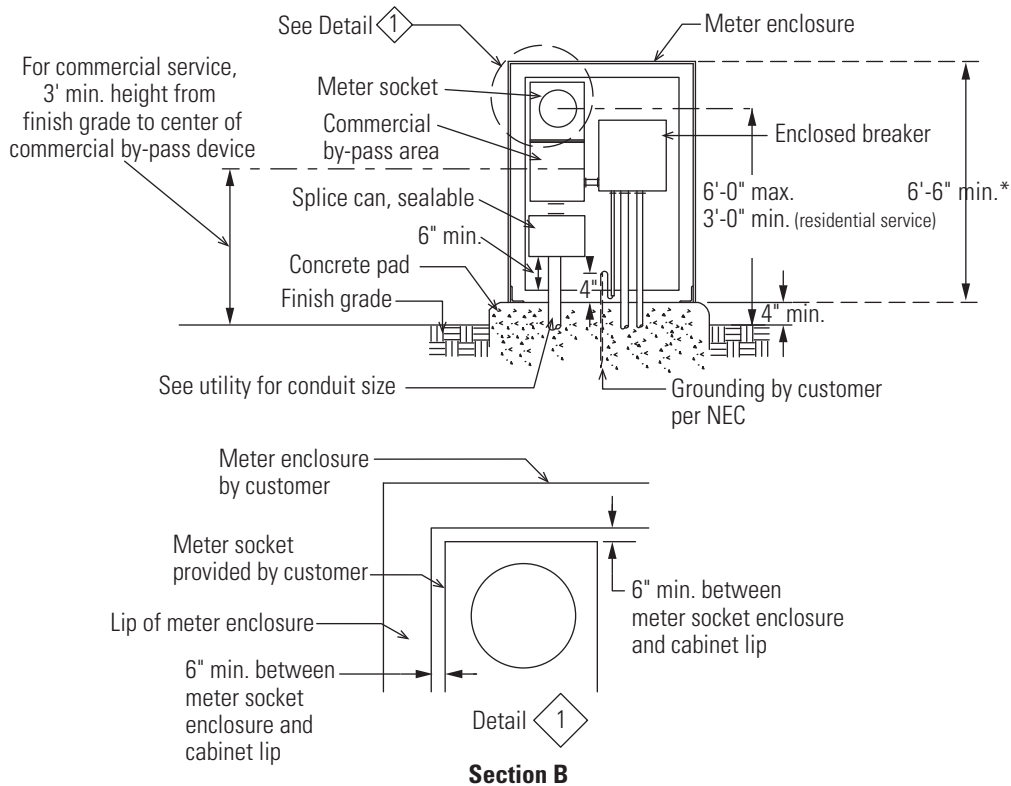


Notes:

1. Minimum frontal working clearance of 4'-0" shall be provided on sides with accessible openings.
2. Minimum clearance of 2'-0" shall be provided on all other sides to allow for maintenance.

\* Requirement by County of Hawaii.

**Figure 4-13. Working clearance for freestanding meter enclosures.**



Notes:

1. A minimum clearance of six inches shall be provided between the top and sides of a meter socket and lip of the enclosure.
2. For meter mounting height requirements, refer to section 4.3C (Mounting Heights for Meters).

\* Requirement by County of Hawaii

**Figure 4-14. Equipment clearances for freestanding meter enclosures.**



**Figure 4-15. Freestanding meter enclosures shall have a minimum clearance of six inches between the top/sides of the meter socket and the lip of the enclosure opening to provide meter electricians with space to see and align meter blades with meter socket jaws.**

## B. Freestanding Meter Pedestals

Freestanding meter pedestals are equipped with factory installed service entrance and metering equipment (such as service conductor landing lugs, meter sockets, main service disconnects, etc.)

Customers shall submit the manufacturer's design drawings of metering pedestals for the Company to review and comment. Due to variations in design, metering pedestals shall be visually inspected by the Company prior to purchase and installation. Customers shall make arrangements for delivery to the Company for inspection. Pedestals which do not pass Company visual inspection shall not be installed.

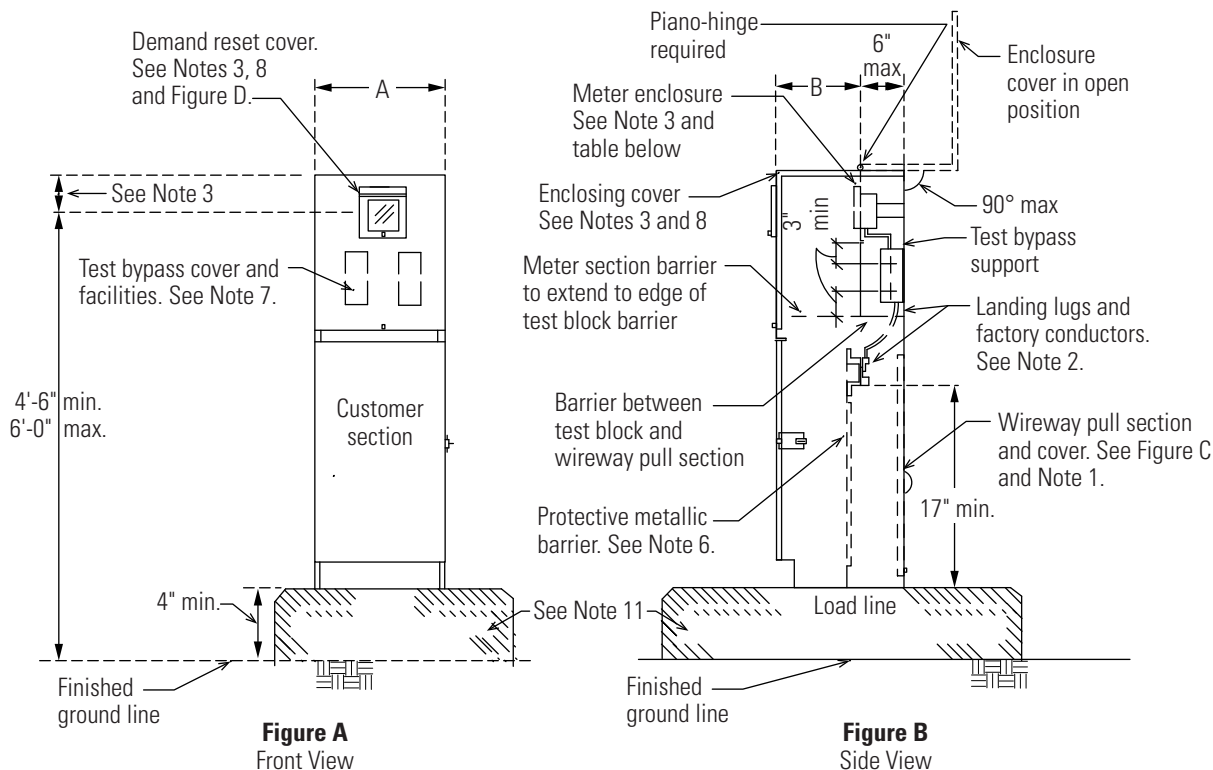


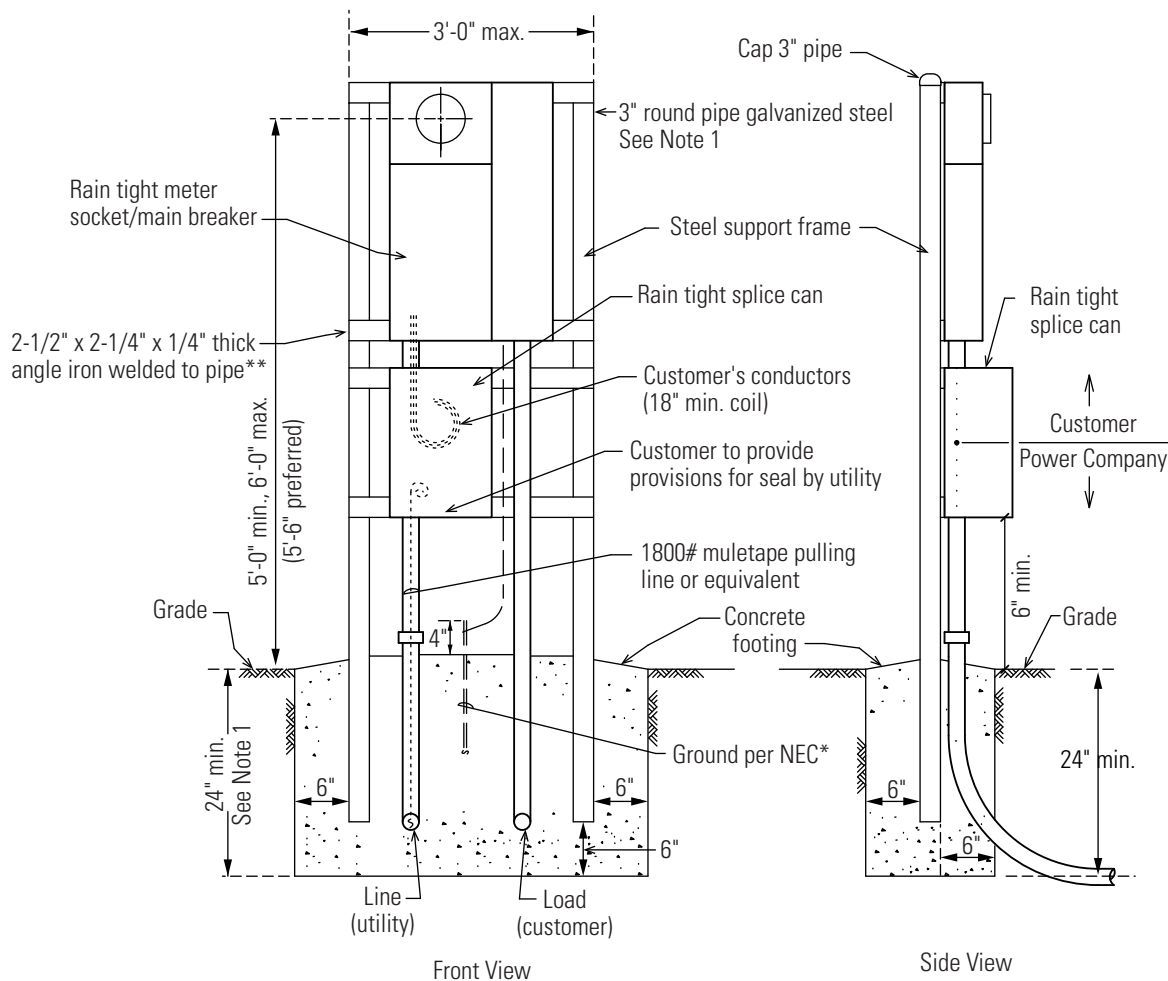
Figure 4-16 Notes:

1. Wireway pull sections shall be manufactured with the minimum dimensions as noted in the table in Figure 4-16. Bottom sections shall accept a 3-inch (minimum) conduit.
2. Service conductors shall be terminated on landing lugs. Service termination lugs shall be #6 through 250 kcmil pressure-type CU-AL listed. Insulated cables or buses shall be installed between the landing lugs and the commercial test bypass facility.
3. Pedestals shall be equipped with a hinged cover for enclosing the meter section. Covers shall weigh 25 pounds or less. A minimum frontal clearance of 11 inches shall be provided between the meter socket and enclosure cover. Enclosure covers shall be furnished with a steel demand reset cover equipped with a hinged polycarbonate viewing window. Viewing windows shall be aligned with the meter socket. Viewing windows are not required where service loads are greater than 5000 kWh per month or 25 kW (demand meters).
4. Meter sockets shall be ring-type, comply with ANSI C12.7, and designed to receive watthour meters that meet ANSI C12.10.
5. Internal equipment shall be installed with fasteners which cannot be unsecured from the outer surface of pedestals.
6. Unmetered and metered conductors or buses shall be separated by suitable barriers. Pedestals shall be equipped with a protective metallic barrier (16-gauge minimum) between the Company wireway and customer distribution section. A minimum clearance of 1/4 inch shall be provided between barriers and customer section walls to prevent damage by screws and bolts protruding into pull section area.
7. Pedestals shall be equipped with factory installed commercial test bypass blocks (with rigid insulating barriers) wired or bussed to meter sockets. Bypass covers equipped with a lifting handle shall be provided. Where cover widths exceed 16-inches, it shall be equipped with two handles. Connection sequence shall be Line to Load from left to right. Commercial bypass areas shall be permanently labeled to clearly identify Line and Load terminals. Label characters shall be 3/4" inch tall (minimum) block letters.
8. Exterior doors and covers (except for demand reset covers) shall be equipped a mechanism for pad locking. Company compartments (i.e. pull section, demand reset cover, etc.) shall have provisions for sealing per section 4.3D (Metering Equipment Requirements).
9. Warning labels to indicate "Hazardous Voltage Exist Inside" and instructions for "Unauthorized Persons Keep Out" shall be installed on Company wireway pull section covers and on the exterior front panel of meter section hinged covers. Labels shall comply with the latest requirements of ANSI Z535.
10. Pedestals shall meet the requirements of EUSERC 308. Where this manual has more stringent criteria, pedestals shall follow Company requirements.
11. Pedestals shall be installed on a concrete pad per the requirements of section 4.3H (Concrete Pads).

**Figure 4-16. Freestanding meter pedestal.**

## C. Freestanding Steel-Post Structures

Freestanding steel-post structures are fabricated with structural steel pipes, angles, etc. and are designed to mount service entrance equipment. The customer is ultimately responsible to ensure that the structural design of the freestanding steel-post structure is capable of supporting all design loads and is in accordance with all applicable building codes. Figure 4-17 and the accompanying notes below shows an example of the minimum requirements of a basic design and shall be upgraded as necessary. The Company shall not be held responsible for an inadequate structure and reserves the right to require design calculations and drawings stamped by a structural engineer licensed in the State of Hawaii.



Notes:

1. Where CT metering is installed, the minimum pipe diameter for support frames shall be 4-inches and the concrete footing thickness shall be increased to 30-inches (minimum).
2. Meter socket center line elevation shall be between 5'-0" and 6'-0" above finished grade.
3. Plywood backboards shall not be used for mounting service entrance and metering equipment.
- \* For Hawai'i Electric Light: Two (2) ground rods shall be installed and separated by a minimum distance of 6'-0".
- \*\* In lieu of angle iron, uni-strut channel bolted to vertical pipe support may be acceptable. Consult with the Company prior to fabrication.

**Figure 4-17. Freestanding steel-post structure.**

## 4.6 Self-Contained Metering (0 to 600 Volts)

Self-contained meters carry total load current at the supplied service voltage. In addition to the requirements of this section, self-contained meter installations shall comply with the specifications in section 4.3 (General Requirements).

Self-contained metering shall be used where service loads do not exceed the following conditions:

- 320 continuous amps or less for single-phase residential services.

- 200 continuous amps or less for three-phase residential services.
- 200 continuous amps or less for commercial and industrial services.

Consider using transformer-rated metering when future load plans are likely to exceed the ampacity ratings above (see section 4.7 Transformer-Rated Metering.)

Meter sockets for self-contained meter installations shall meet the following requirements:

- Have a minimum ampacity rating of 100 amps and maximum ampacity rating not less than the ampacity rating of the main service disconnect or breaker.
- For single phase, 120/208 volt, three-wire (network) services, the fifth terminal shall be installed at the 9 o'clock position (see Figure 4-19).
- Where a commercial test-bypass is required, permanent labels shall be installed in the bypass area to clearly identify Line and Load terminals.
- Meter sockets shall be located per the requirements in section 4.3A (Meter Locations), and be equipped with the required number of meter socket jaws (see Table 4.3).
- It is recommended that the ampacity rating for service entrance conductors match the ampacity rating of the meter socket.

## A. Residential Services

Self-contained meter sockets for single-phase residential service shall not contain a commercial test bypass. Meter sockets for three-phase residential services shall be equipped with a commercial test bypass.

### 320 AMP Self-Contained Metering

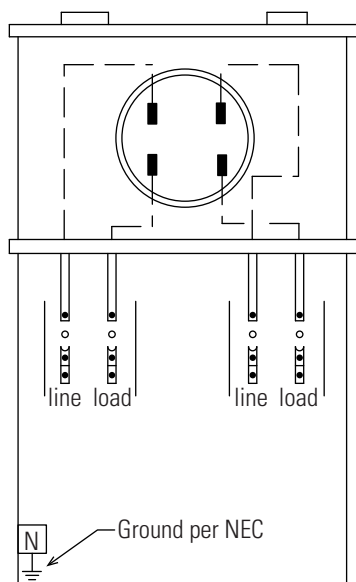
Where single-phase, 120/240 volt residential service loads are likely to exceed 200 amps, 320 amp self-contained meter sockets shall be installed. These meter sockets shall have a maximum ampacity rating of 400 amps. Meter sockets shall be similar to Circle AW's Meter Mains U404MC or U4042MC.

## B. Commercial Services

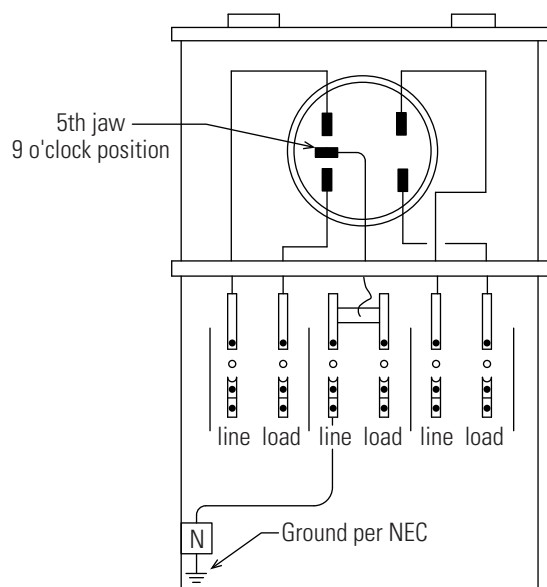
All self-contained meter sockets for commercial services shall be equipped with a commercial test-bypass. A commercial test-bypass makes it safe for Company personnel to work on a de-energized meter socket without interrupting electric service to customers.

Self-contained meter socket wiring requirements for single-phase commercial services and three-phase services are shown in Figures 4-18 to 4-20.



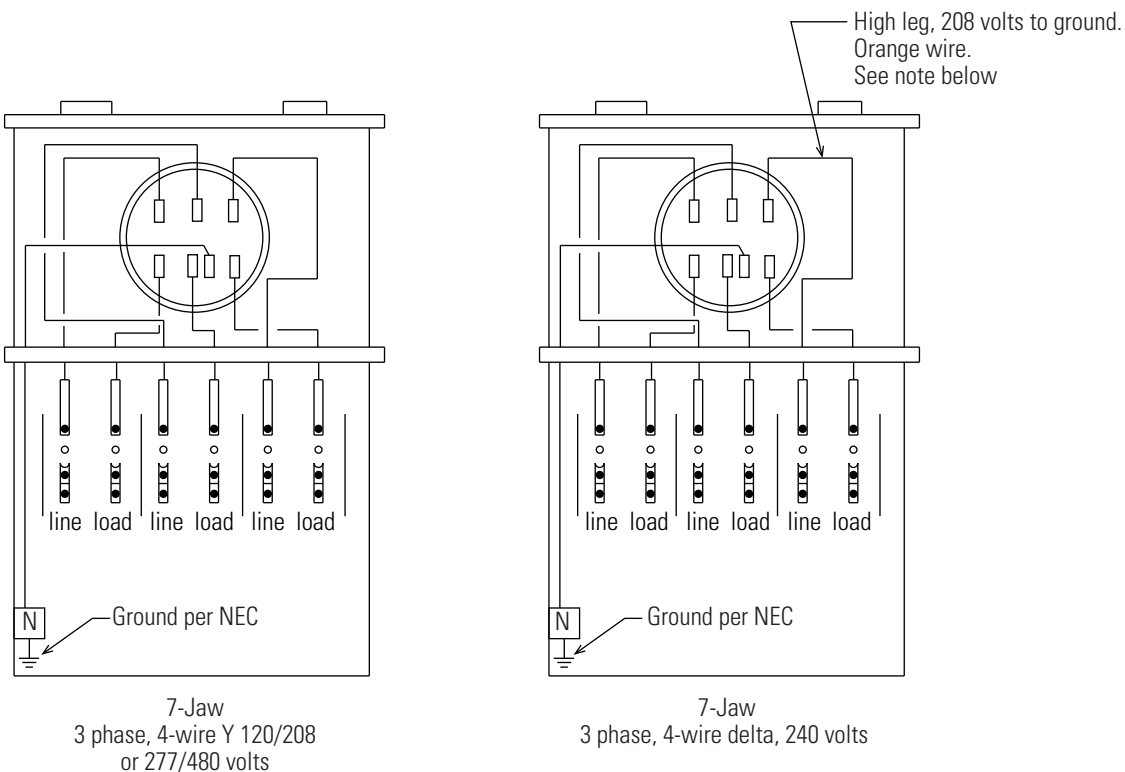


**Figure 4-18. Meter socket wiring, 4-jaw, single-phase, 3-wire, 120/240 volts, form 2S meter (commercial meter socket shown).**



Note: 5th jaw shall be installed at the 9-o'clock position.

**Figure 4-19. Meter socket wiring, 5-jaw, single-phase, 3-wire, 120/208 volts (Network), form 12S meter (commercial meter socket shown).**



Note:

The high leg (208 volts) for three-phase, 4-wire delta services shall be installed at the upper-right meter jaw. The high leg shall be clearly identified at the weatherhead to insure proper connection to the incoming service conductors.

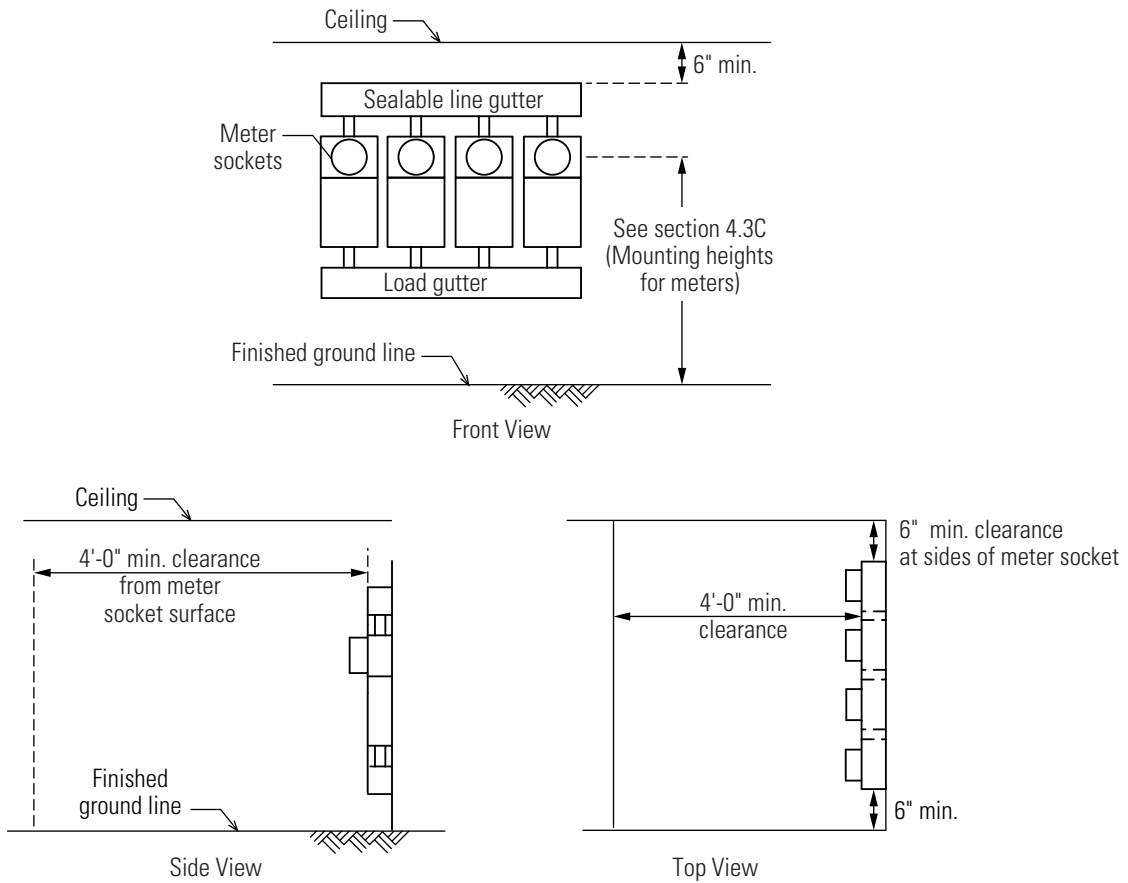
**Figure 4-20. Meter socket wiring, 7-jaw, form 16S meter.**

## C. Grouped Meter Installations

Grouped meters are two or more individually mounted meter sockets installed at a single location and typically supplied from a single service point. It is allowed for commercial and single phase residential services.

Initial design for the electric service shall incorporate all future installations. Space for subsequent metering installations shall be allocated and reserved. All meters serving the premises shall be centrally located, unless otherwise approved by the Company.

Line gutters shall be installed in close proximity to meter sockets (within approximately 4") for ease of inspection and sealing. Figure 4-21 shows an example of a grouped meter installation.



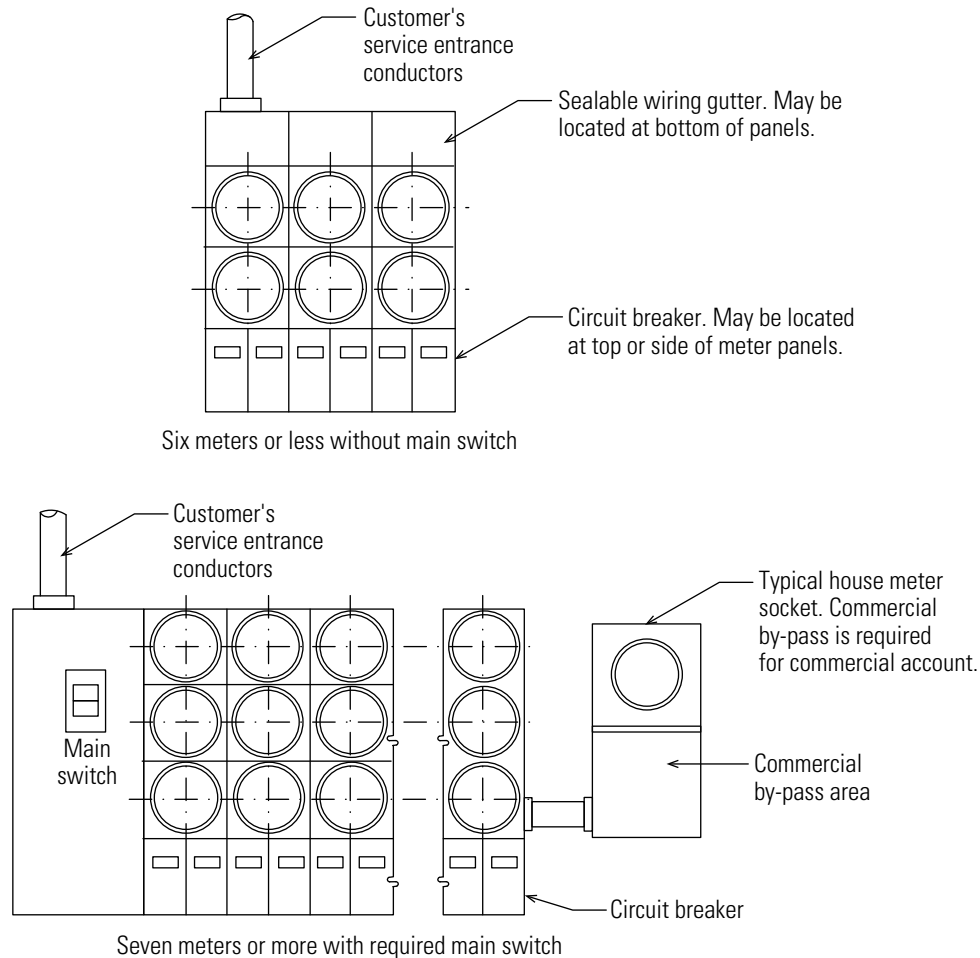
**Figure 4-21. Grouped meter installation.**

## D. Meter Centers and Switchboards

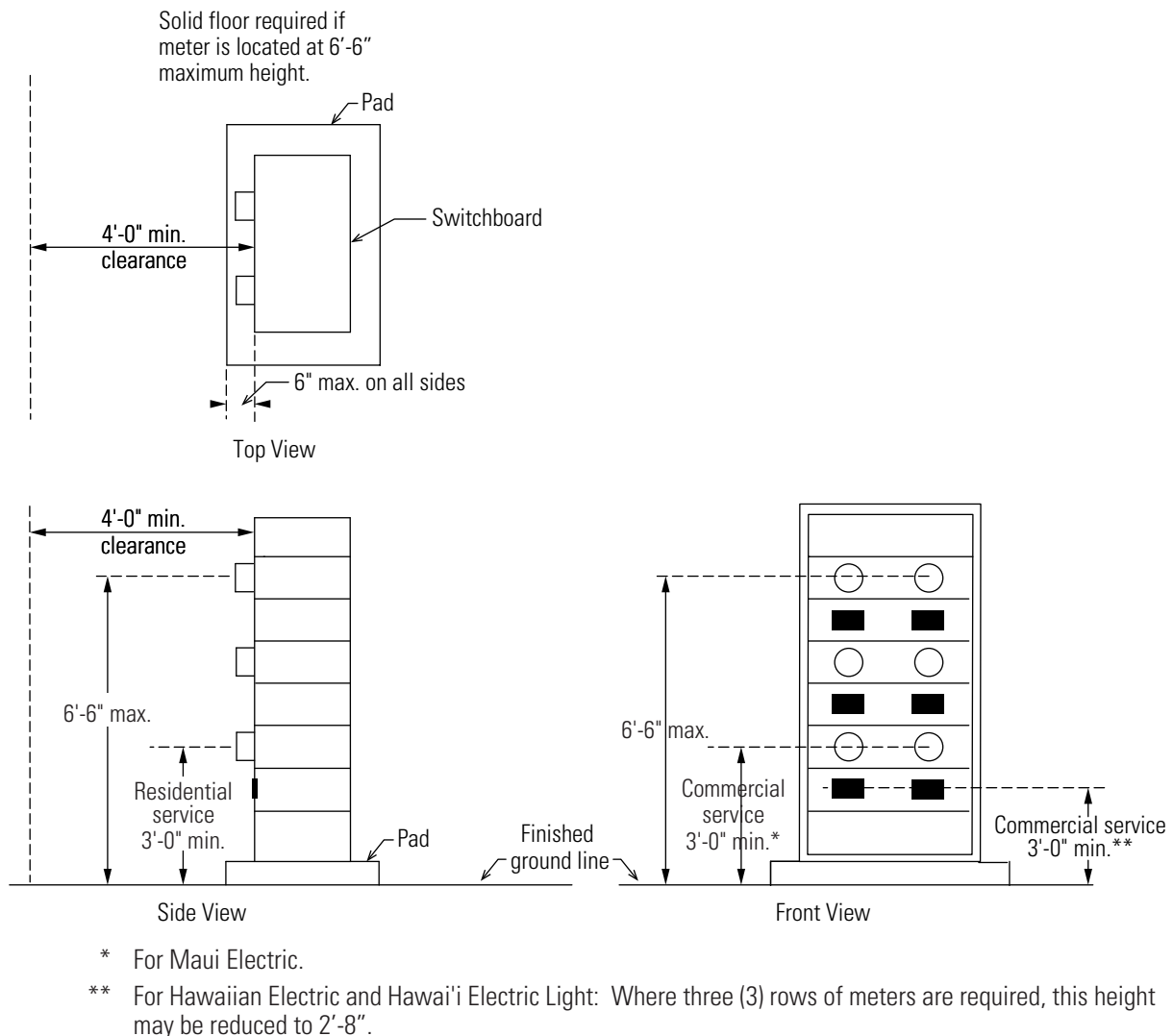
Meter centers (or meter banks) and metering switchboards are equipped with factory installed service terminations, metering equipment, and customer distribution sections. These types of service entrance equipment are installed primarily for metering multi-unit residential, commercial, and light industrial services.

Where switchboards are installed for residential services, meter sockets for house meters (such as for common area lighting, irrigation controls, etc.) shall be equipped with a commercial test-bypass facility.

The equipment shown below in Figure 4-22 is an example of a meter center. Figure 4-23 shows an example of a switchboard.



**Figure 4-22. Quick-stack meter centers with meter socket breaker provisions, for single-phase service cubicles.**



**Figure 4-23. Switchboards installed in a meter room, not accessible to public contact.**

## 4.7 Transformer-Rated Metering

Transformer rated metering is used when electrical services exceed the voltage and/or current ratings for self-contained metering (see section 4.6). In addition to the requirements described in this section, transformer rated services shall comply with the General requirements of section 4.3.

This section is divided into the following sub-sections:

- A) Current Transformer Cabinet Rated Metering (0 to 600 Volts)
  - 1) CT Cabinet with Type C and Z Brackets
  - 2) CT Cabinet with Bused Mounting Base (HECO Only)
- B) Secondary Voltage Switchboard Installations (0 to 600 Volts)
- C) Primary Voltage Switchgear Installations (Over 600 Volts)
- D) Primary Voltage Pole Mounted Installations (Over 600 Volts)

## A. Current Transformer Cabinet Metering (0 to 600 Volts)

Secondary voltage (0 to 600 volts) current transformers (CTs) are mounted within cabinets or enclosures for protection/safety and are utilized when the metered load exceeds or will exceed one of the following conditions:

- 200 amps (three-phase residential service)
- 320 continuous amps (single-phase residential service)
- 200 amps (single-phase or three-phase commercial service)

Customers who request CT metered service and have projected load currents below these requirements (but not less than 100 amps) will be charged for the equipment and labor to install this service. CT metered service will not be provided for loads under 100 amps.

The following installation requirements shall be followed for all CT cabinet installations:

- No taps are allowed within CT cabinets (whether it be the traditional or bus mounted type).
- CT cabinets shall be secured to a permanent wall with uni-struts. Wood may only be used for temporary services (less than one year).
- CT cabinets shall be installed on the line side or ahead of the main breaker/disconnect unless required by the NEC and/or approved by the Company.
- CT cabinet installations shall be limited to installations that require no more than three sets of 500 kcmil copper conductors per phase or 1200 amperes. A switchboard shall be used if the service requirements exceed either of these limits.
- Meter sockets shall be equipped with the appropriate number of jaws (see table 4-3) and shall have provisions to install a test switch.
- A single 1-1/4" conduit shall be installed between the meter socket and the CT cabinet. This conduit shall not exceed 10 feet in length. A maximum of one 90 degree bend is allowed. No LB's are allowed for this conduit.
- Remote metering is not allowed. Meters must be located on the same wall (cannot be located on the opposite side from the CT can).
- CT cabinets shall be installed so that it is level and securely mounted to a permanent or acceptable structure. Plywood backboards shall not be used.
- The CT cabinet shall be installed such that the top of the CT cabinet does not exceed 6 feet above finished grade. The bottom of the CT cabinet shall be at least 12 inches above the finished grade.
- Spare conduits shall only be installed up to the line side splice box. No spare conduits shall enter the CT cabinet.
- The Company will furnish and install the meter, current transformer(s), and test switch.
- CT cabinets using type C and Z brackets are not equivalent to bus mounted CT cabinets. The customer shall purchase the correct CT cabinet for the correct application and shall be responsible for correcting the issues if the incorrect CT cabinet is utilized.

Specific requirements for CT cabinet installations which use type C and Z brackets to mount metering CTs are detailed in section 4.7A(1). Requirements for CT cabinets which utilize a bused mounting base are detailed in section 4.7A(2).

### 1) CT Cabinet with Type C and Z Brackets

Traditional CT cabinet installations use type C and Z brackets to mount metering CTs inside the CT cabinet. These brackets offer some flexibility as they allow limited adjustment when mounting CTs.

Additional requirements for traditional CT cabinet installations are as follows:

- See Table 4-5 for cabinet size requirements for use with type C and Z brackets. The next larger cabinet size shall be used if the service conductor is larger than the table listing (cabinet size shall not exceed values in the table).
- CT cabinets shall be equipped with factory installed studs for type C and Z brackets.
- CT cabinets are recommended to be hinged, pad lockable, and shall open to a minimum of 90 degrees. Where applicable, clearances shall be increased to accommodate this recommendation
- CT cabinets 42 inches or wider shall have two-piece doors/covers with a 3 point latch. CT cabinets shall not have a center brace/bracket for two-piece doors/covers.
- CT cabinet doors/covers shall have two fixed solid handles and be sealable by the Company.
- The Customer shall be responsible for installing mounting brackets inside the CT cabinet as shown in Figure 4-24.
- Installation shall be coordinated with the Company to reduce installation issues as assistance may be required to pull service cables through the CTs.

The following are additional requirements that are specific to each service territory.

Requirements for the Hawaiian Electric service territory:

- Z brackets shall be centered and secured to the CT cabinet.
- Two full coil loops of slack shall be provided within the CT cabinet for the installation of CTs.
- Where required, sleeves shall be supplied for splicing conductors, The Company will not provide sleeves.
- During installation, connect the horizontal C brackets to the vertical Z brackets as shown in Figure 4-24. Do not tighten C brackets to allow for field adjustments by the Company.
- The Company will furnish and install wiring for the meter, test switch, and connections to the CTs.

Requirements for the Hawai'i Electric Light service territory:

- The Customer shall install Company provided CTs.
- During installation, connect the horizontal C brackets to the vertical Z brackets as shown in Figure 4-24. All brackets shall be tightened.

- The Customer shall provide and install wiring for the meter, test switch, and connections to the CTs per Hawai'i Electric Light meter standards. The Customer shall leave an adequate amount of slack as the Company will terminate these wires.
- The Customer shall also ensure proper installation of the test switch mounting plate to provide clearance for the test switch.
- See Hawai'i Electric Light's metering standards for additional requirements.

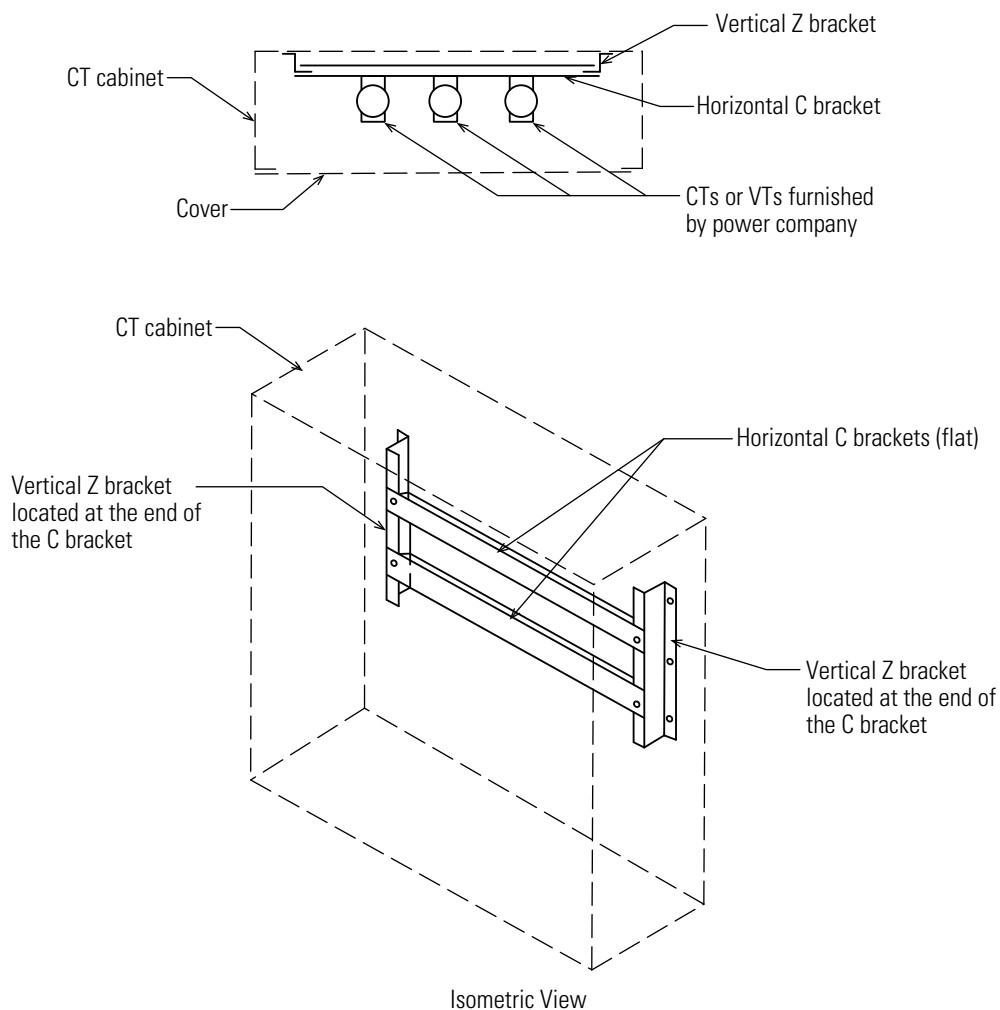
Requirements for Maui Electric service territory:

- In lieu of a C and Z bracket, the following are also accepted:
  - Uni-strut
  - CT Mounting Base: A CT mounting base may be used but must comply with EUSERC 318 and 329A. For services requiring PTs, please consult with the Company regarding CT can size requirements
- Contact Maui Electric for additional requirements.

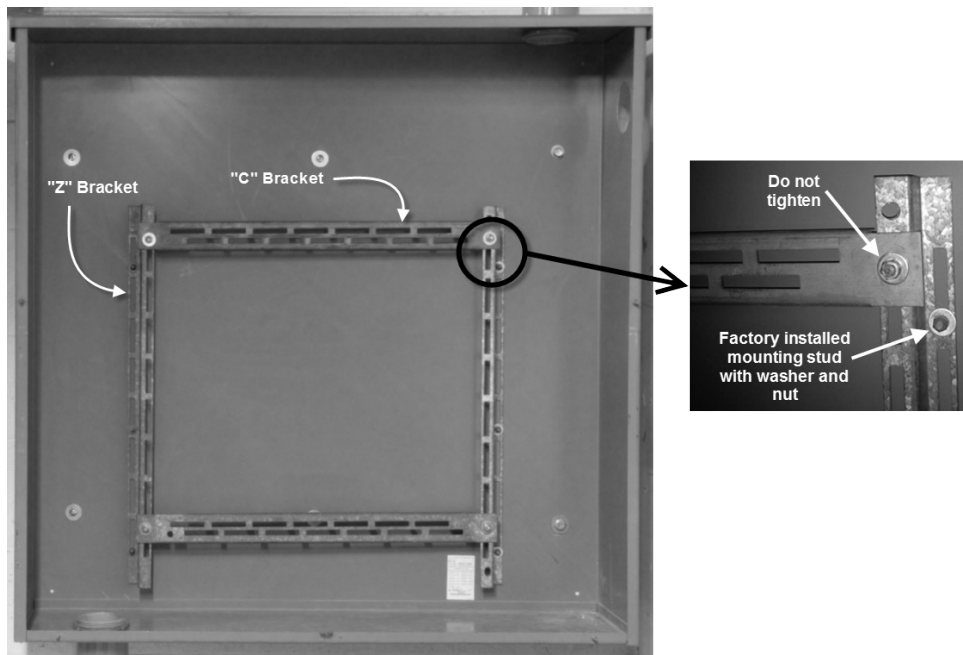
<b>Cabinet Size W" × H" × D"</b>	<b>Maximum Number and Size of Conductors</b>
30 × 30 × 11	One #3/0 copper per phase or smaller
36 × 36 × 11	One 500 kcmil copper per phase or smaller
42 × 42 × 11	Three 500 kcmil copper per phase or smaller
36 × 48 × 11	Three 500 kcmil copper per phase or smaller
48 × 48 × 11	Consult with the Company

**Table 4-5. Minimum sizes for instrument transformer cabinets using type c and z brackets**

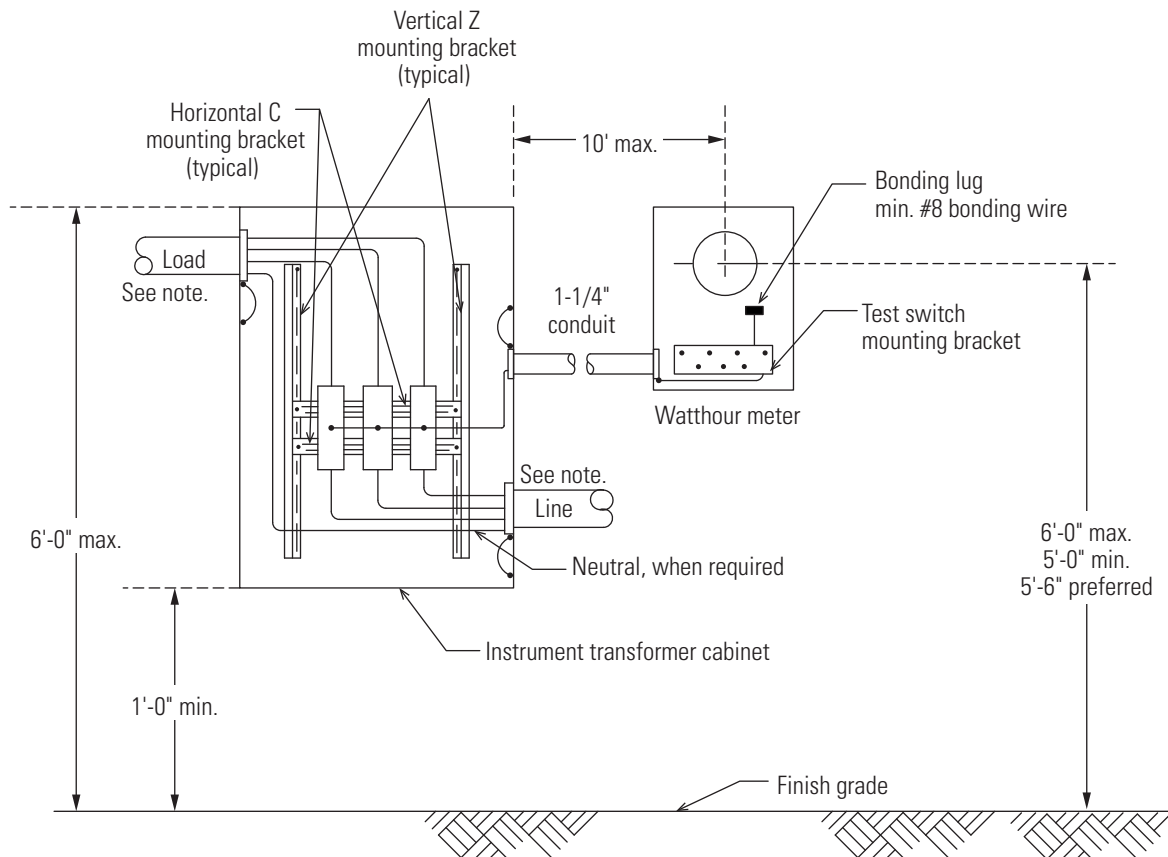




**Figure 4-24. C and Z bracket mounting inside a CT cabinet.**



**Figure 4-25. Example of Cooper B-Line CT Enclosure (Part number 424211 RTCT MS40) with installed type C and Z brackets (Universal CT Rack – Part number 415 H).**



Note: Line and load conduits shall be positioned at diagonally opposite corners of the CT cabinet.

**Figure 4-26. Example of a current transformer cabinet installation.**

## 2) CT Cabinet with Bused Mounting Base (HECO and MECO Only)

CT cabinets employing a bused mounting base differ from traditional CT cabinets described in the previous section. Bused mounting bases are live front electrical buses used to mount metering CTs. They are also equipped with lugs to allow the line and load conductors to be terminated directly to the base. Figure 4-27 shows an example of one such installation.

CT cabinets using a bused mounting base allow the customer and Company to easily install their respective equipment. Service conductors are installed independently from the metering CTs allowing for less coordination with the Company.

The requirements below shall be followed when using a bused mounting base:

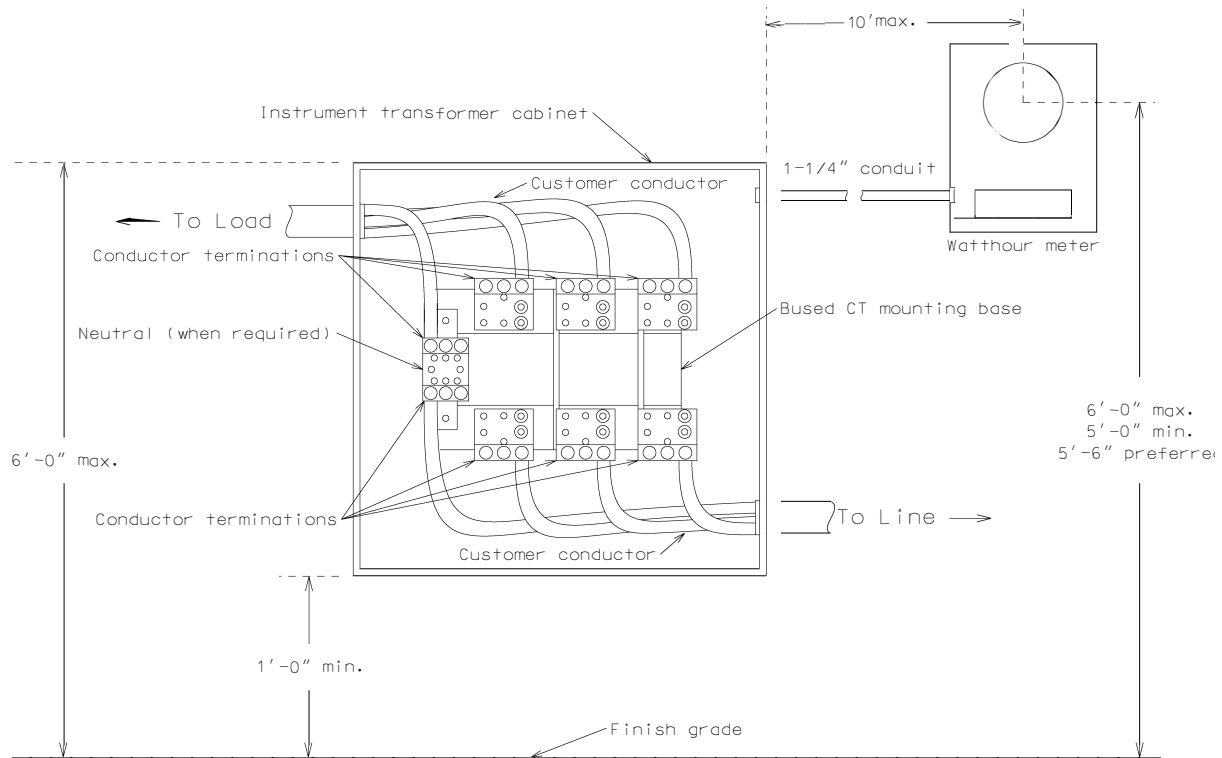
- CT cabinets shall have a hinged door with provisions for sealing and locking (with a padlock).
- CT cabinets shall be made of stainless steel.
- Bused mounting bases shall be purchased with the appropriate cabinet. See Table 4-6 for approved CT cabinets and Table 4-7 for approved CT bused mounting bases. The next larger cabinet size shall be used if the service conductor is larger than the table listing (cabinet size shall not exceed the values in the table).
- The bused mounting base shall be installed in the enclosure.
- All service conductors shall be terminated to the bused mounting base. Line/load conductors shall not protrude from the CT side of conductor termination lugs. The Company will install the CTs on the bus after the conditions of section 4.2C have been met.
- All clearances and minimum/maximum height requirements of CT cabinets shall be followed. See section 4.3 for more information.

Manufacture	Catalog Number	Height (Inches)	Width (Inches)	Depth (Inches)	Max Number and Size of Conductors
COOPER B-Line	303611 HRTCT	36	30	11	One #3/0 per phase
COOPER B-Line	304811 HRTCT	48	30	11	One 500 kcmil per phase
COOPER B-Line	363611 HRTCT	36	36	11	One 500 kcmil per phase
COOPER B-Line	364811 HRTCT	48	36	11	Three 500 kcmil per phase
COOPER B-Line	484814DD HRTCT	48	48	14	Consult with the Company

**Table 4-6. Approved CT enclosures.**

Manufacture	Catalog Number	# of C.T. Provisions	Max and Cont. Ampacity	Voltage	Service Type	Lug Wire Range
COOPER B-Line	6019 HAL	2	400	600	1 Ø or 3 Ø/3W	(3) 4 AWG - 600kcmil or (6) 1/0 - 250kcmil
COOPER B-Line	6067 HEEL	3	800	600	3 Ø 4W	(3) 4 AWG - 600kcmil or (6) 1/0 - 250kcmil

**Table 4-7. Approved CT bused mounting base.**



**Figure 4-27. Current transformer cabinet installation utilizing a bused mounting base. Consult with the Company prior to installation.**

## B) Secondary Voltage Switchboard Installations (0 to 600 Volts)

In addition to the requirements for EUSERC and those listed in section 4.3M (General Requirements for Switchboards and Switchgears), switchboard installations shall comply with the following:

- CT compartment doors shall comply with the EUSERC drawing 332. If a meter socket and blank panel are used, they shall be fastened together such that both panels operate as a single door. Doors shall swing open to a full 90 degrees (with the meter installed).
- Test switch opening shall be located on the side closest to the hinge of the door.

## C) Primary Voltage Switchgear Installations (Over 600 Volts)

Electrical service available in the area shall determine the customer's voltage and service type.

In addition to the requirements described below, primary voltage switchgear installations shall comply with the General requirements of section 4.3.

- Switchgears shall comply with EUSERC Drawing 400.
- For service voltages between 2400V – 15000V, switchgear enclosures shall comply with EUSERC Drawing 401.
- Meter socket panel shall be a single socket hinged meter panel per EUSERC Drawing 408. Test switch opening shall be located closest to the hinge side of the panel.

- Metering potential transformers shall be tapped on the line side of (before) the Company's current transformers.
- Switchgear shall have a PT disconnect with an interlock system and viewing window of the disconnect blades per EUSERC drawing 400.
- Mounting racks or supports for potential transformers shall be provided.
- PT fuse mounting clips shall accommodate current limiting fuses.
- Primary fuses for PTs and primary leads from the fuse holders to PT terminals shall be provided.
- Switchgear shall be furnished with 1 inch conduit for secondary wiring of instrument transformers. See EUSERC Drawing 401 for 2400V – 15000V.
- Self-shorting and non-shorting terminal blocks (6-point terminals) for instrument transformer secondary wiring shall be provided (Marathon 1600 Series). Consult the Company for specifications and requirements.
- Furnish switchgear with grounding knobs on line and load side of the bus at each current transformer location for safety grounds and insulating boots, covers, or an insulated bus at CT termination points shall be provided.
- The Company will furnish and install the meter(s) and test switch(es)
- The Customer's electrical contractor shall install Company supplied primary voltage potential and current transformers for metering. The polarity marks of the instrument transformers shall be installed towards the line side of the service.
- Switchgear ground bus shall have provisions for grounding lugs.
- Clearance to any door shall be 8'-0".

**Hawaiian Electric only:** The Company will supply and install the wiring for meter(s), test switch(es), and make the secondary connections to instrument transformers. The Company will supply the primary voltage instrument transformers for metering.

**Hawai'i Electric Light only:** The electrical contractor shall provide and install the wiring for meter(s) and test switch(es) per Hawai'i Electric Light's meter standards. The Company will terminate the wiring to meter(s), test switch(es), and make the secondary connections to the instrument transformers. The Customer shall also ensure proper installation of the test switch mounting plate to provide clearance for the test switch.

**Maui Electric only:** Customer shall contact Maui Electric for additional requirements.

## D) Primary Voltage Pole Mounted Metering Installations (Over 600 Volts)

Primary voltage pole mounted metering is installed on customer poles with the instrument transformers mounted on a set of crossarms. Primary metering equipment shall only be installed on customer owned poles. Primary metering is not allowed on Company poles (including "jointly owned" poles).

The Customer shall furnish, install, and maintain the pole, crossarms, crossarm braces, and meter sockets. All meter sockets used for pole mounted metering shall be stainless steel and have a NEMA 3R rating.

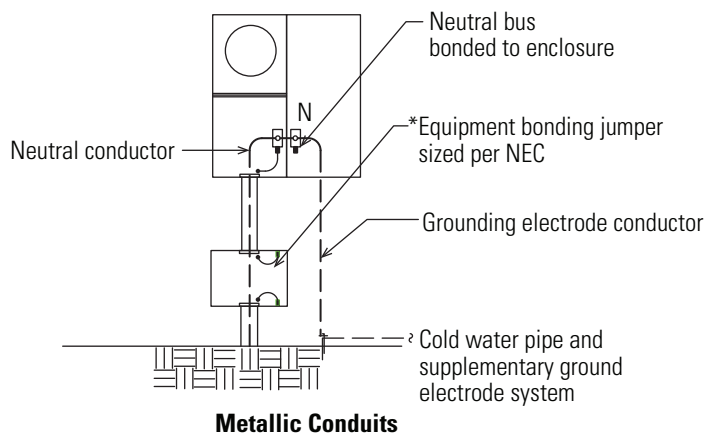
Where located in close proximity to streets or highways, the meter socket shall be mounted such that Company personnel will be facing oncoming traffic when reading the meter. Poles located in areas near vehicular traffic shall be protected with bollards or a curb.

Contact the Company's Customer Installations Department for additional requirements for outdoor pole-mounted metering.

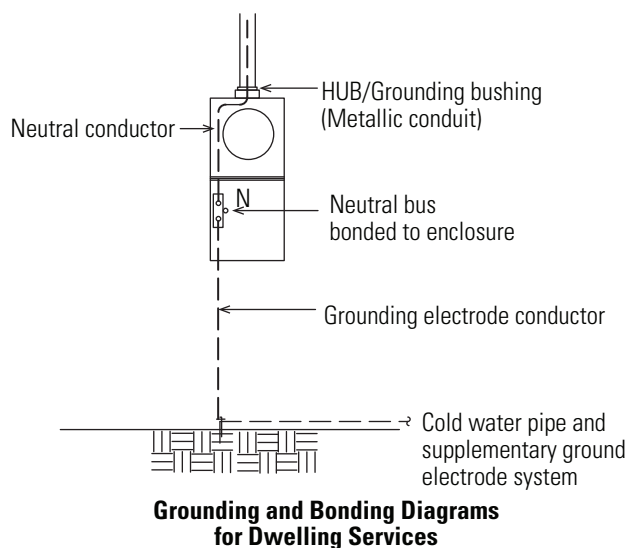
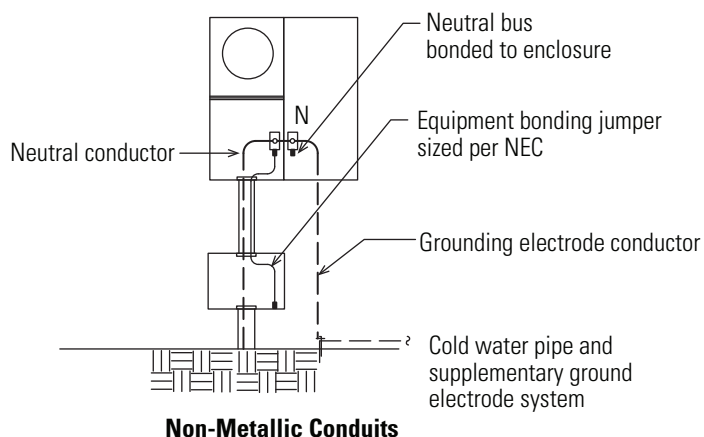
## 4.8 Typical Service Entrance Grounding and Bonding Diagrams

Grounding and bonding are required for the safety and electrical reliability of the service. Customers shall ground and bond metering equipment installations in accordance with the current applicable version of the NEC. In addition, all grounding and bonding conductors shall be sized in accordance with the applicable NEC requirements. Bonding and grounding conductors shall not be pulled from or tapped to the Company's distribution service transformer.

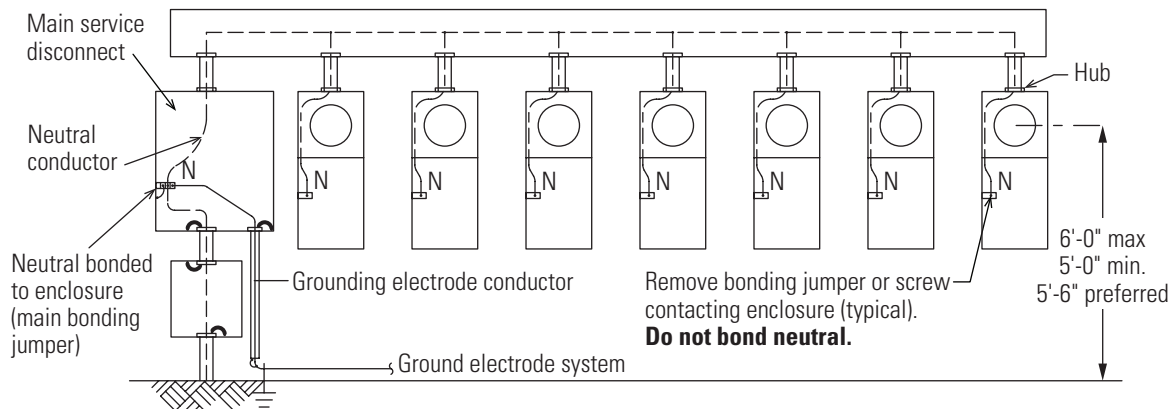
As an alternative to individual bonding jumpers, a continuous bonding jumper may be used to bond the service entrance equipment enclosures. Figures 4-28 through 4-33 show typical grounding and bonding practices, however, refer to the applicable version of the NEC or your local City and County Building Department/Electrical Code Branch for guidance and direction on acceptable grounding and bonding methods.



\*As an alternative, a continuous bonding jumper can be used to bond service enclosures and conduits



**Figure 4-28. Example of grounding bonding for typical overhead and underground services**

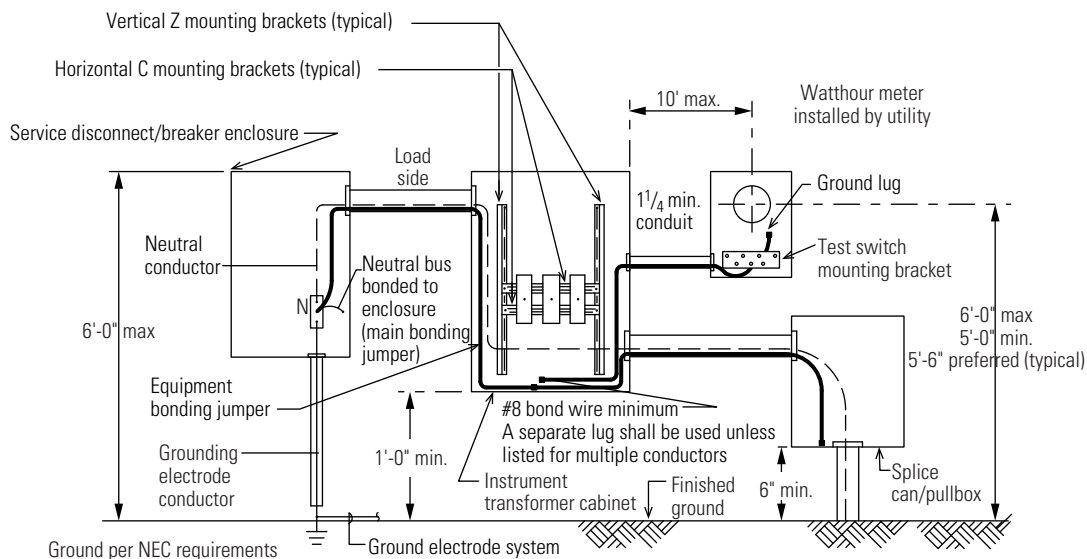


Main disconnect switch required for seven or more breakers per NEC 230.71.

Size all grounding and bonding conductors in accordance with NEC.

**Figure 4-29. Example of grounding and bonding for grouped meter installation with main breaker ahead, for seven or more meters, with metallic conduits.**

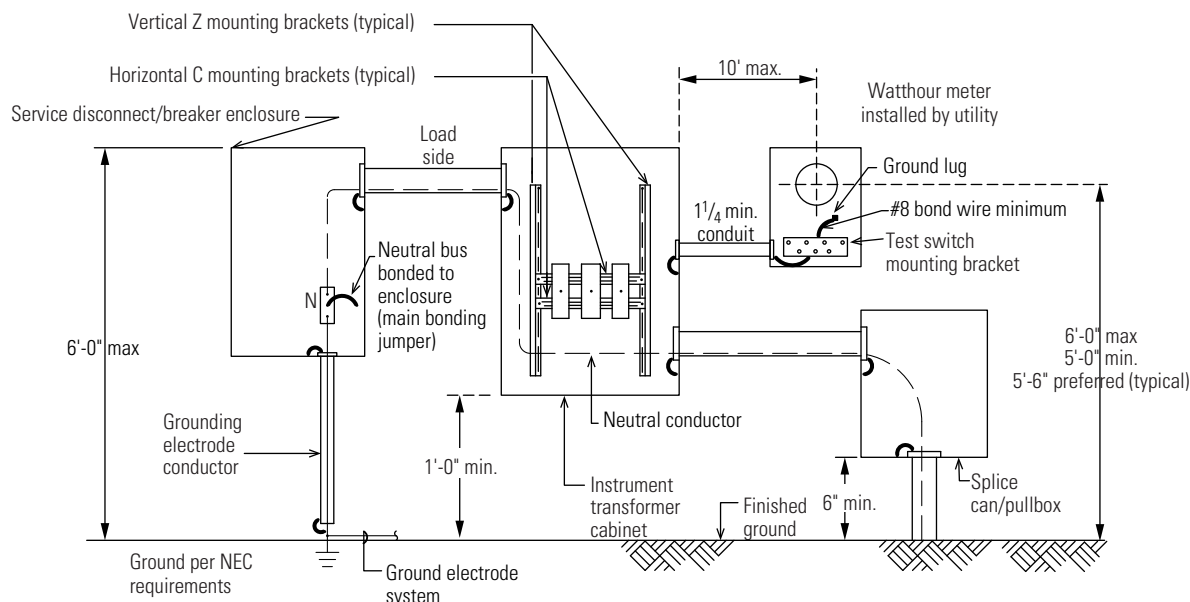
**Note:** Main service disconnecting means is required for seven or more breakers per NEC 230.71.



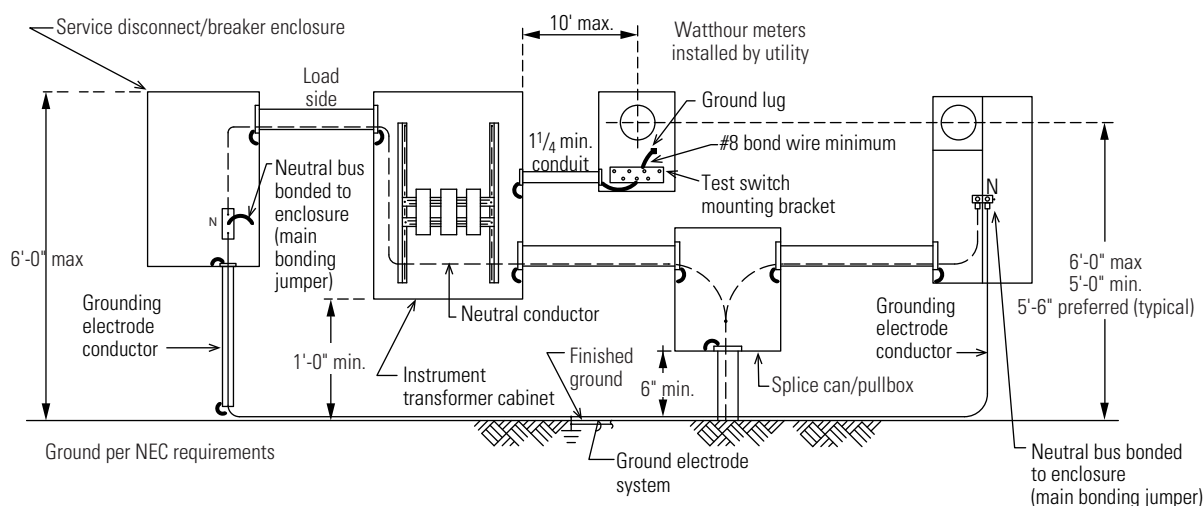
Size all grounding and bonding conductors in accordance with NEC.

**Figure 4-30. Example of grounding and bonding for CT Rated metering installation with non-metallic conduits.**

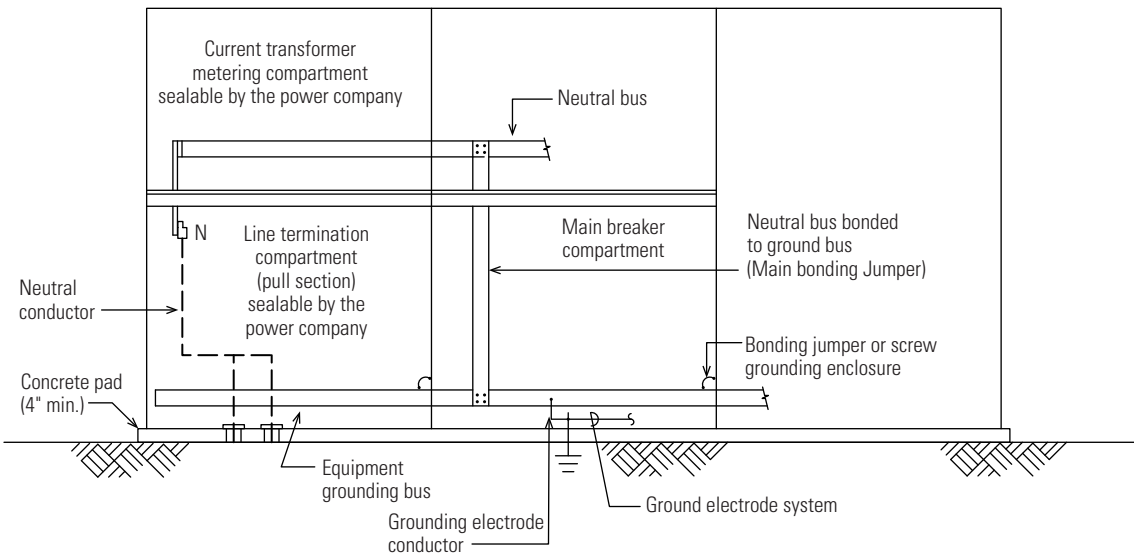




**Figure 4-31. Example of grounding and bonding for CT Rated metering installation with metallic conduits.**



**Figure 4-32. Example of grounding and bonding for CT rated and self-contained metering installation with metallic conduits.**



**Figure 4-33. Example of grounding and bonding for metering switchboard installation with non-metallic conduits.**

**Note:** Ground rods shall not be installed in Company sealable compartments. In addition, the grounding electrode conductor connection to the grounding system/supplemental ground rod shall not be made in Company sealable sections.

## 4.9 Specialized Metering

### A. Pulse Metering Output (KYZ Output)

Pulse outputs or KYZ outputs are dry contact signals produced by the Company's meter that indicate Wh (and VARh if applicable) consumption. This type of output is usually provided for managing electricity usage through a customer-owned Energy Management System (EMS). KYZ outputs can be provided in a three wire (form "C" contacts) or a two-wire (form "A" contacts) format. As the meter registers consumption, dry contacts toggle back and forth. The change in relay state indicates pulses from the meter, where this rate of toggle is proportional to the customer's energy usage being registered.

Customers shall be responsible for the Company's costs to provide KYZ pulses. This includes the cost for a meter capable of providing KYZ pulses, an isolation relay board to protect the revenue meter, and the labor to install this equipment. In the future, customers may be assessed an additional monthly maintenance fee for this service.

In addition to the Company's costs, customers shall be responsible to install any additional infrastructure associated with this work. This includes conduit, wiring, and junction boxes. These requirements may vary according to the customer's service entrance equipment.

For CT switchboard installations, the isolation relay may be installed on the metering compartment door. Customers shall be responsible to install the conduit and wires to the hinge side of the Company's CT compartment.

For meter socket installations, customers shall also provide and install a 12"W x 12"H x 6"D junction box adjacent to the meter socket to house the isolation relay along with a

¾" conduit to the meter socket. The customer shall preinstall the isolation relay board into the junction box prior to the Company inspection of the metering equipment installation. Where the service is via a self-contained meter socket, single phase 120 or 277 volt power along with a breaker to control the source shall be provided at the junction box. For these installations, the size of the junction box shall be increased as necessary.

Work to connect conduit to Company sealed compartments shall be coordinated with the Company. In addition, the Company will make all connections to the isolation relay.

The recommended maximum distance for pulses is 250ft. Where the distance to the customer's EMS is longer, the customer shall be responsible to install equipment to extend this distance.

The Company will coordinate the pulse weight value (Wh/Pulse) with the customer. The company reserves the right to modify this pulse value where necessary due to changes in metering equipment (which includes meters, instrument transformers, isolation relay boards, etc.) and will coordinate such modifications with the customer.

The Company shall not be held responsible for faulty pulse information supplied to the customer due to equipment malfunction, lost pulses, etc.

## B. Totalized Metering of Coincident Demand

Totalized metering of coincident demand combines simultaneous demand and energy registration of individually metered service points supplying a single location. The Company may totalize the service where the expected demand or load cannot be supplied at a single service point or where installations require more than one distribution feeder to serve a single location (such as where redundant service is required). Totalized metering is accomplished through analysis of interval data (load profile recorded in a meter's mass memory) which is acquired via a dedicated analog phone line connection to the individual meters for each feeder.

Customers shall provide and maintain separate dedicated analog\* phone service to each meter and be responsible for all related costs. This includes the installation of all necessary conduits and wiring to facilitate the service. Meters shall be protected from phone line transient voltages or currents by installing and terminating the phone line to a surge suppressor (Technicom, Inc., TSS-200 Telephone Line Surge Suppressor or equivalent). All installations shall be in accordance to the latest version of the NEC. Phone surge suppressors shall be clearly labeled with the assigned phone number.

- \* Modems for revenue meters are not compatible with phone services that are digitally converted to analog signals (such as for VoIP and ISDN). Modems are also not compatible with services that utilize a call routing system (such as call answering services, PBX, etc.)

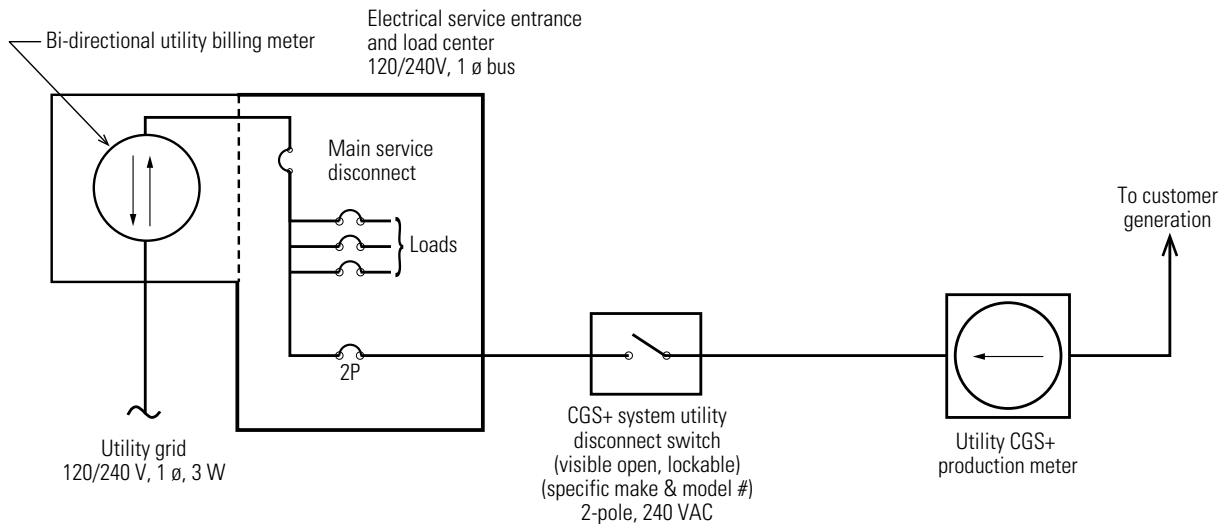
For CT cabinet installations, in addition to the requirements above, customers shall also furnish and install a 6"W x 6"H x 4"D junction box adjacent to the meter socket, to house the surge suppressor. A ¾ inch (minimum) conduit shall be installed to connect the meter socket and junction box.

For switchboard and switchgear installations, customers shall route the wiring and surge suppressors to the inside of the Company's meter compartment door. Leave 6'-0" of wiring

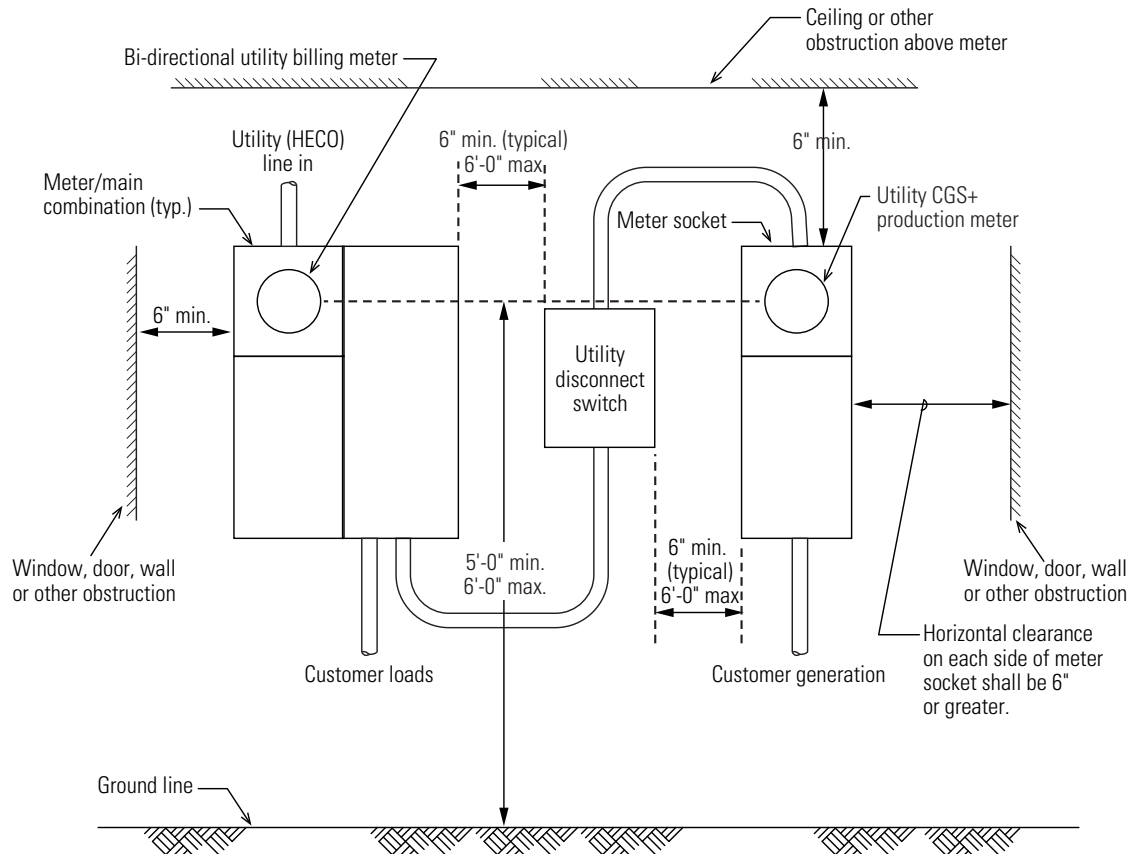
slack neatly coiled inside the meter compartment. Consult with the Company to coordinate the location for the conduit entry into the equipment. Work to connect conduit and pull wiring into Company sealed compartments shall be coordinated with the Company. For energized services, consult with the Company for phone line routing and installation details.

## 4.10 CGS+ Metering

Customers seeking interconnection under the Customer Grid Supply Plus (CGS+) program will be required to provide, install, and maintain a utility disconnect switch and an additional “Production” meter socket. The disconnect switch and production metering equipment is installed on the load side of the billing meter, and shall be installed in accordance with applicable local, state, and national codes and requirements. Additionally, the Company’s minimum requirements for CGS+ metering installations are outlined in the illustrations below. The customer shall be responsible to consult with a qualified electrical contractor or licensed electrical engineer to perform a detailed analysis and evaluate to ensure that the equipment and its installation meets all of the requirements.



**Figure 4-34. Typical CGS+ single line diagram.**



Notes for CGS+ metering:

1. All requirements from the applicable version of the NEC, and this manual shall be followed for both the billing and CGS+ meter installation. This includes all clearance and meter height requirements.
2. Meter sockets shall meet the requirements for residential meter sockets in this manual.
3. Where not up to standard, the equipment for the billing meter shall be upgraded to meet the latest requirements of this manual. This includes relocating meter sockets to company approved locations and upgrading all clearances, bonding and grounding.
4. The socket for the billing meter shall be physically installed closest to the front of the house / structure.
5. Both meter sockets shall be permanently labeled per Chapter 1, Section 1.10.
6. There shall only be one connection between the neutral and ground. This connection shall be made at the socket for the billing meter.
7. Utility disconnect switch shall be designed/installed per the applicable version of the National Electric Code.
8. 24-hour access is required.

**Figure 4-35. Typical CGS+ meter socket installation detail.**



CHAPTER  
**5**

**Other Requirements**

## 5.1 Switching and Protection

### A. Service Connection Configurations

#### **Automatic Transfer Equipment – Commercial Service 0 to 600V**

Equipment may be installed to automatically transfer the customer's load from a de-energized preferred service to an energized alternate service, and to return to the preferred service either by automatic open transition return, automatic close transition return, or by manual closed transition return performed by power company workers.

The customer shall submit to the company, a one-line diagram of the proposed automatic transfer configuration. Approval must be obtained from the Company prior to ordering of the transfer equipment.

The requirements for either of these optional methods of operation are:

#### **Automatic Transfer with Automatic Open Transition Return**

Transfer equipment must automatically transfer the customer's load from a de-energized preferred service to an energized alternate service after an adjustable time period set by the utility, from zero to thirty seconds following interruption of the preferred service.

When the preferred service is restored, the equipment must make an automatic-open transition return to the preferred service after an adjustable time period set by the utility, from one to ten minutes following restoration of preferred service. However, if during this time period the alternate service is interrupted, the equipment may make an automatic open transition return to the preferred service, without waiting for the completion of the time delay period, if the preferred service is energized.

The protective and controlling equipment in the preferred and alternate services must be designed to prevent paralleling the services during automatic transfer in either direction.

The transfer equipment should have a Normal-Closed Transition selector switch as defined in this section, and have suitable interlocks so the customer can not parallel both services but the utility can parallel both services when necessary to allow a manual closed transition transfer in either direction. This switch must be sealed with a lock, as specified by the utility and elsewhere in this manual.

#### **Automatic Transfer with Automatic Close Transition Return**

Transfer equipment must automatically transfer the customer's load from a de-energized preferred service to an energized alternate service after an adjustable time period set by the utility, from zero to thirty seconds following interruption of the preferred service.

When the preferred service is restored, the equipment must make an automatic close transition return to the preferred service after an adjustable time period set by the utility, from one to ten minutes following restoration of preferred service. However, if during this time period the alternate service is interrupted, the equipment may make an automatic open transition return to the preferred service, without waiting for the completion of the time delay period, if the preferred service is energized.



The automatic close transition return operation must include the closing of the preferred service, followed by the instantaneous (no time delay) opening of the alternate service.

The transfer equipment should have a Normal-Closed Transition selector switch as defined in this section, and have suitable interlocks so that the customer can not parallel both services but the utility can parallel both services when necessary to allow a manual closed transition transfer in either direction. This switch must be sealed with a lock as specified by the utility, and elsewhere in this manual.

### **Automatic Transfer with Manual Closed Transition Return by the Power Company**

Transfer equipment must automatically transfer the customer's load from a de-energized preferred service to an energized alternate service after an adjustable time period set by the utility, from zero to thirty seconds following interruption of the preferred service.

The customer must notify the utility's load dispatcher as soon as practical whenever the equipment automatically transfers to the alternate service.

The utility will manually make a closed transition transfer of the customer's load from the alternate service to the preferred service as soon as feasible after the preferred service is restored. However, if the alternate service is interrupted, the equipment may make an automatic open transition return to the preferred service if the preferred service is energized.

The protective and controlling equipment in the preferred and alternate services must be interlocked to prevent paralleling the services during automatic transfer in either direction.

The transfer equipment should have a Normal-Closed Transition selector switch as defined in this section, and have suitable interlocks so that the customer can not parallel both services but the power company can parallel both services when necessary to allow a manual closed transition transfer in either direction. This switch must be sealed with a lock as specified by the utility, and elsewhere in this manual.

### **Additional Requirements**

In addition to the requirements described above, automatic transfer equipment must comply with the following requirements:

- Install automatic transfer equipment in compliance with the applicable requirements in the manufacturer's manual.
- The transfer equipment must have provisions for locking or blocking open, either service, and must have targets to indicate whether each service is Open or Closed, if this can not be determined by a visible air gap. This requirement is in addition to the requirements as stated under the Disconnecting Equipment paragraph in this section: Protective and Controlling Equipment Commercial Service 2 kV to 15 kV.
- The transfer equipment must have provisions for changing either service to be preferred, so the preferred feeder can be changed by the utility.
- The transfer equipment must be accessible to power company workers at any time.
- The utility reserves the right to transfer the customer's load to the alternate service, and to block the automatic features temporarily to facilitate work or maintenance on the utility's system.

- The customer must obtain permission from the utility's load dispatcher before manually transferring to the alternate service.
- The customer must operate his equipment so it will not produce any adverse condition on the utility's system in conformance with the utility's tariffs.
- The customer must install bus fault protection to provide automatic transfer blocking of his facilities in the event of a bus fault.
- The utility reserves the right to determine if automatic open or close transition return is applicable to the given installation.
- All operational testing must be performed by the customer and witnessed by the utility's Test Division before the equipment is placed in service.

### **Automatic Transfer Equipment – Commercial Service 2 kV to 15 kV**

Equipment may be installed to automatically transfer the customer's load from a de-energized preferred service to an energized alternate service, and to return to the preferred service either by automatic open transition return or by manual closed transition return performed by power company workers. Automatic closed transition return is not allowed. The manual closed transition return method may not be available at all locations on the utility's system, and this option is offered subject to approval by the utility.

The customer shall submit to the company, a one-line diagram of the proposed automatic transfer configuration. Approval must be obtained from the Company prior to ordering of the transfer equipment.

The requirements for either of these optional methods of operation are:

### **Automatic Transfer with Automatic Open Transition Return**

Transfer equipment must automatically transfer the customer's load from a de-energized preferred service to an energized alternate service after an adjustable time period set by the utility, from zero to thirty seconds following interruption of the preferred service.

When the preferred service is restored, the equipment must make an automatic open transition return to the preferred service, after an adjustable time period set by the utility, from one to ten minutes following restoration of preferred service. However, if during this time period the alternate service is interrupted, the equipment may make an automatic open transition return to the preferred service, without waiting for the completion of the time delay period, if the preferred service is energized.

The protective and controlling equipment in the preferred and alternate services must be designed to prevent paralleling the services during automatic transfer in either direction.

The transfer equipment should have a Normal-Closed Transition selector switch as defined in this section and suitable interlocks so that the customer can not parallel both services but the utility can parallel both services when necessary to allow a manual closed transition transfer in either direction. This switch must be sealed with a lock as specified by the utility and elsewhere in this manual.

### **Automatic Transfer with Manual Closed Transition Return by the Power Company**

Transfer equipment must automatically transfer the customer's load from a de-energized preferred service to an energized alternate service after an adjustable time period set by the utility, from zero to thirty seconds following interruption of the preferred service.

The customer must notify the utility's load dispatcher as soon as practical whenever the equipment automatically transfers to the alternate service. The phone numbers to call are: HECO (808) 543-7466, HELCO (808) 969-6666, MECO (808) 871-7777.

The utility will manually make a closed transition transfer of the customer's load from the alternate service to the preferred service as soon as feasible after the preferred service is restored. However, if the alternate service is interrupted, the equipment may make an automatic open transition return to the preferred service if the preferred service is energized.

The protective and controlling equipment in the preferred and alternate services must be interlocked to prevent paralleling the services during automatic transfer in either direction.

The transfer equipment should have a Normal-Closed Transition selector switch as defined in this section and suitable interlocks so that the customer can not parallel both services but the utility can parallel both services when necessary to allow a manual closed transition transfer in either direction. This switch must be sealed with a lock as specified by the utility and elsewhere in this manual.

### **Automatic Transfer Policy for Critical Loads**

Customers may install their own automatic transfer equipment in place of utility's primary automatic transfer equipment.

Primary customers with critical loads (see definition below) are required to provide the following as a condition of service where necessary.

- Adequate vault space for the customer's or utility's primary automatic transfer equipment.
- Pay for the purchase and installation of primary automatic transfer equipment dedicated to serve their load.

Secondary customers that fit the critical load definitions are required to provide the following as a condition of service where necessary:

- Adequate vault space for the utility's primary automatic transfer equipment.

### **What is a critical load?**

Critical loads include:

- Hospitals, vital military installations, communication facilities (television, common control program stations, civil defense, police, fire), civil defense control centers, major police stations, refineries, airports, vital navigational aids (VORTAC, OMEGA, LORAN, etc.), vital gas utility pumping stations, heavy industry, major shopping centers, large auditoriums, large movie theaters, stadiums, other facilities that regularly have large numbers of people present and/or total demand of 500 kVA or more.

- Any residential building, office building, hotel, retirement home, or other commercial structure that is equipped with an elevator or electric stairway, and is more than four stories high, and/or total demand of 1000 kVA or more

### **Additional Requirements**

In addition to meeting the requirements of the above, automatic transfer equipment must comply with the following:

- The transfer equipment must have provisions for locking or blocking open, either service, and must have targets to indicate whether each service is Open or Closed if this can not be determined by a visible air gap. This requirement is in addition to the requirements as stated under the Disconnecting Equipment paragraph in this section: Protective and Controlling Equipment Commercial Service 2 kV to 15 kV.
- The transfer equipment must have provisions for changing either service to be preferred, so that the preferred feeder can be changed by the utility.
- The transfer equipment must be accessible to electric power company workers at all times.
- The utility reserves the right to transfer the customer's load to the alternate service and to block the automatic features temporarily to facilitate work or maintenance on the utility's system.
- The customer must obtain permission from the utility's load dispatcher before manually transferring to the alternate service.
- The customer must operate his equipment so that it will not produce any adverse condition on the power company's system in conformance with the utility's tariffs.
- It is highly recommended that the customer install bus fault protection to provide automatic transfer blocking of his facilities in the event of a bus fault.

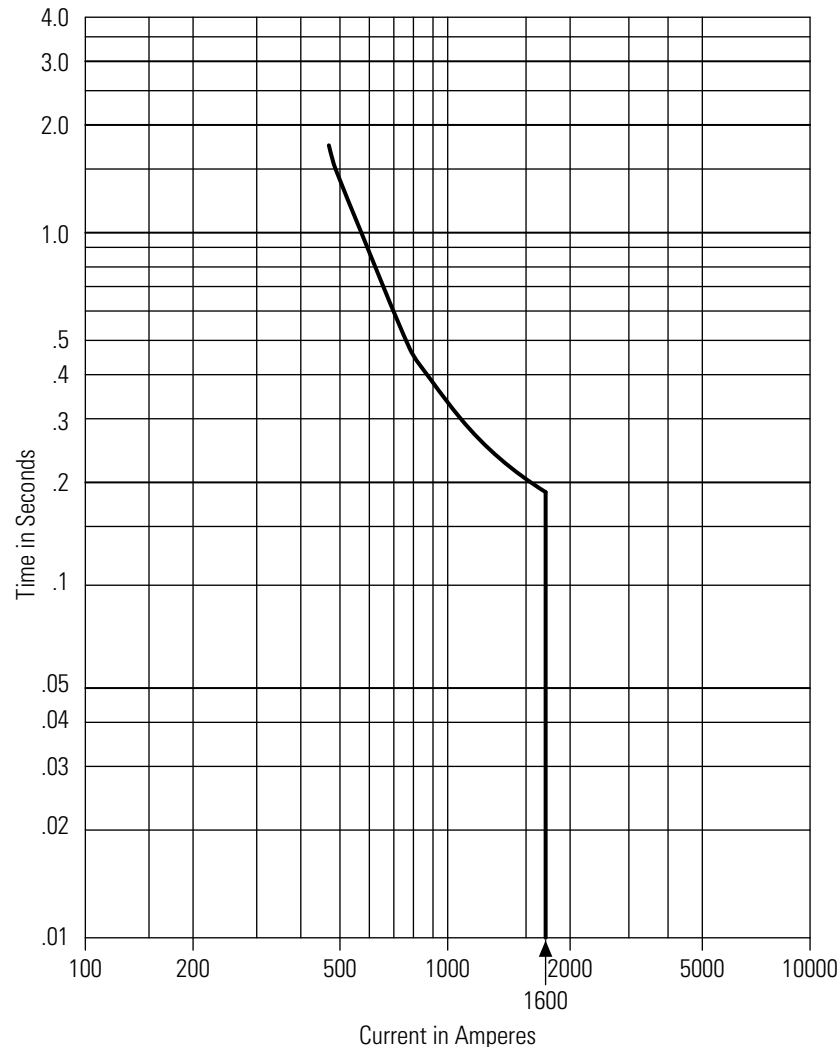
## **B. Protective and Controlling Equipment – Commercial Service 2 kV to 15 kV**

### **Services Which Can Not Be Fused By 100-Ampere Fuses Or Less**

For these services, the customer must provide primary circuit breakers or equivalent between his equipment and the utility's source. The protective and controlling equipment must conform to the following requirements:

- The protective and controlling equipment must be installed as close as feasible to the power company's primary service termination.
- The total clearing time for opening the circuit to the customer's equipment must not be slower than the time plotted on the curve as indicated in Figure 5-1.
- The equipment must have a current rating capable of safely interrupting and closing into the maximum primary fault current available as specified by the utility. All equipment is to be rated for nominal 15 kV class operation with a minimum BIL of 95 kV, except for auxiliary power or potential transformers which must be rated for operation at the nominal voltage as specified by the utility.

- Provision must be made by the customer to safely disconnect and remove the protective and controlling equipment for maintenance without assistance from the utility. There must be a visible air gap to give positive indication that service has been disconnected from the customer.
- The protective equipment must be equipped with phase(s) and ground relays.



**Figure 5-1. Time-current curve for a fuse protecting 2 kV to 15 kV services.**

### **Services Which Can Be Fused By 100-Ampere Fuses Or Less**

#### **Location**

The protective and controlling equipment must be installed as close as feasible to the utility's primary service termination.

#### **Time-Current Characteristics**

The total clearing time at corresponding current values for opening the circuit to the customer's equipment must not be slower than the maximum time plotted on the standard NEMA curve for 100 ampere Type N fuses.

## Current and Voltage Rating

The fuses must have a current rating capable of safely interrupting the maximum primary fault current available as determined by the utility. The fuses must be rated for operation at the nominal voltage as specified by the utility.

## Type of Fuses

The fuses must be of a type designed for the specific application and location, such as outdoor or indoor.

## Stocking and Replacement

Stocking and replacement of fuses must be the responsibility of the customer.

## Fused Service from Overhead Source

When services fused by 100 ampere fuses or less are connected to the utility's overhead lines, the utility will normally fuse the services to the customer with 100 ampere NEMA Type N fuses. At many locations, a 40 ampere fuse will be the largest size the customer can install that will coordinate with the utility's fuse. Consequently, when the customer installs fuses of a size from 40 to 100 amperes inclusive, any fault condition which causes the customer's fuses to blow, may also blow or damage the utility's fuses. This may require the utility to replace its fuses before the customer's service can be restored.

## Two Services

When fuses are installed in each of two services to the customer, switching from one service to the other must be by open transition.

## Future Growth

When the customer chooses to install fuses initially, and his load then increases and is no longer fusible by 100 ampere fuses, it will be the customer's responsibility to design, furnish, and install protective and controlling equipment as specified.

# C. Service Connection Configurations – Commercial Service 2 kV to 15 kV

## Definitions and Symbols

<b>Interlock</b>	As used here: An electrical or mechanical switch-blocking arrangement which prevents two services from being paralleled.
<b>Open Transition</b>	Transferring customer's load from one service to another by opening the first service before closing the second service.
<b>Closed Transition</b>	Transferring a customer's load by closing the second service before the first service is opened.
<b>Normal-Closed Transition Switch</b>	A control switch which, in the normal position makes the interlock feature effective, and in the closed-transition position bypasses the interlock to permit the utility to parallel the two services.
<b>NO</b>	Normally open
<b>NC</b>	Normally closed

**Table 5-1. Defintions for system protection and control circuits.**

<div><div>Power company</div><div>Customer</div></div>	The division line between the customer and power company in general defines the portion of the installation for which the customer is responsible for ownership and maintenance.
	3-Phase overhead line
	3-Single conductor primary cables
	Primary cable termination
	Circuit breaker or equivalent with disconnecting means
	Disconnect switch, non-load break
	Disconnect switch, load break
	Fused disconnect switch or fuse removable with hotstick
	Transformer

Table 5-2. Symbols.

Overhead or Underground, Single Source, Single Load

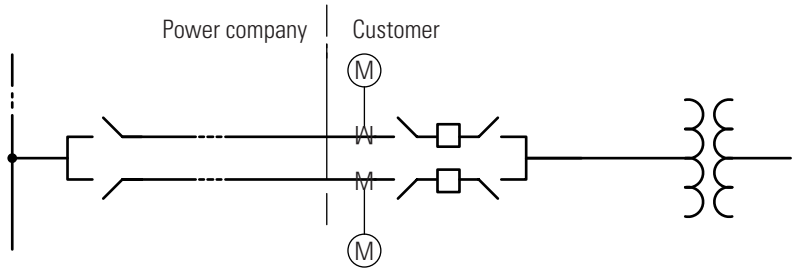


Figure 5-2. Protective and controlling equipment for services which cannot be fused by 100 ampere fuses or less. Two metering points.

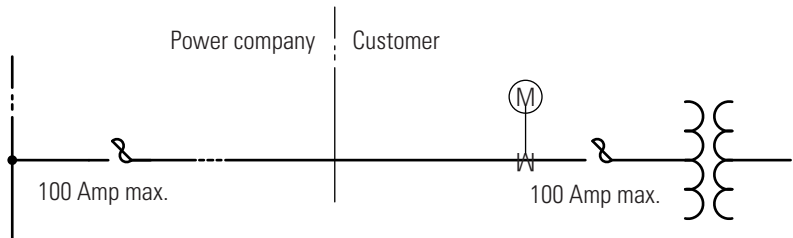


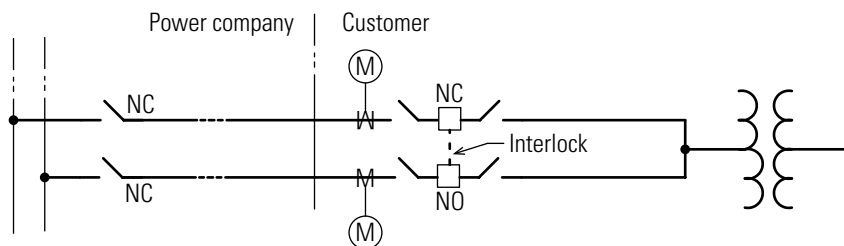
Figure 5-3. Protective and controlling equipment for services which can be fused by 100 ampere fuses or less.

For overhead primary services, the utility will, at its expense, furnish and install a single span of service conductors from its pole or other aerial support to the customer's first permanent support, provided such support is of a type and at a location approved by the utility. Further extensions of power company lines for service outside the customer's property will be made in accordance with the utility's tariff.

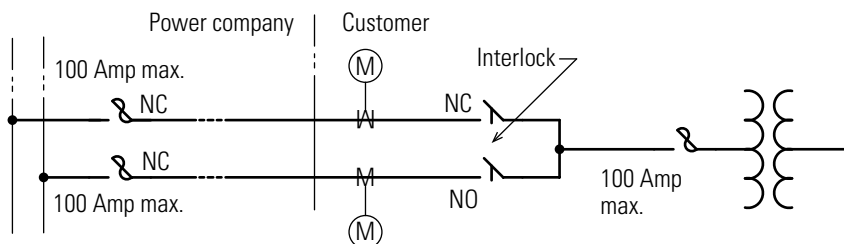
The location of the primary metering point will normally be the first permanent support inside the customer's property at which the utility terminates the source. The instrument transformers will be mounted on this structure by the utility on facilities provided by the customer.

When the customer's first point of permanent support is not a feasible metering point, or if the customer will be metered on the secondary side of his transformer, the metering will be located at a utility-approved location other than the first permanent support.

### Overhead, Dual Source, Single Load

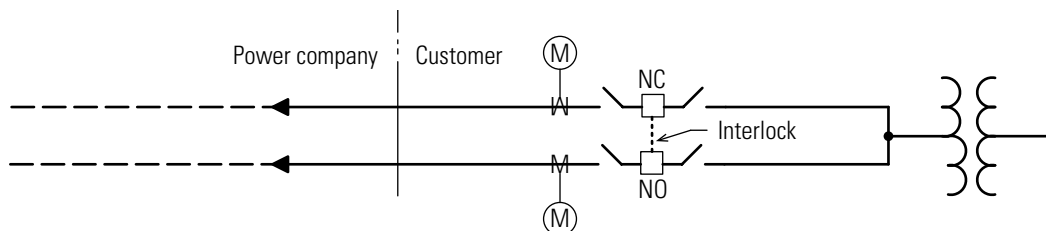


**Figure 5-4. Protective and controlling equipment for services which can not be fused by 100 ampere fuses or less.**



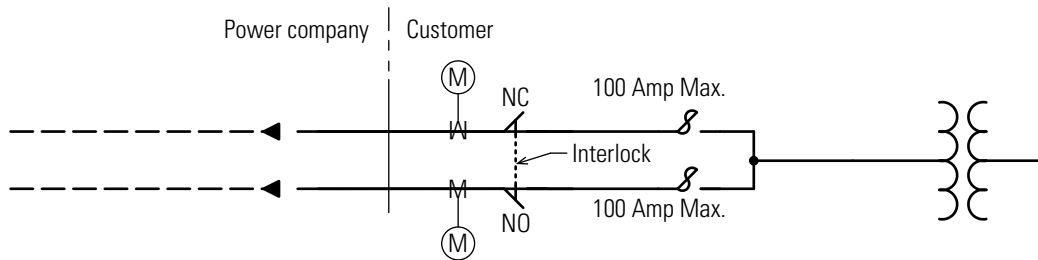
**Figure 5-5. Protective and controlling equipment for services which can be fused by 100 ampere fuses or less.**

### Underground, Dual Source, Single Load



**Figure 5-6. Protective and controlling equipment for services which can not be fused by 100 ampere fuses or less.**

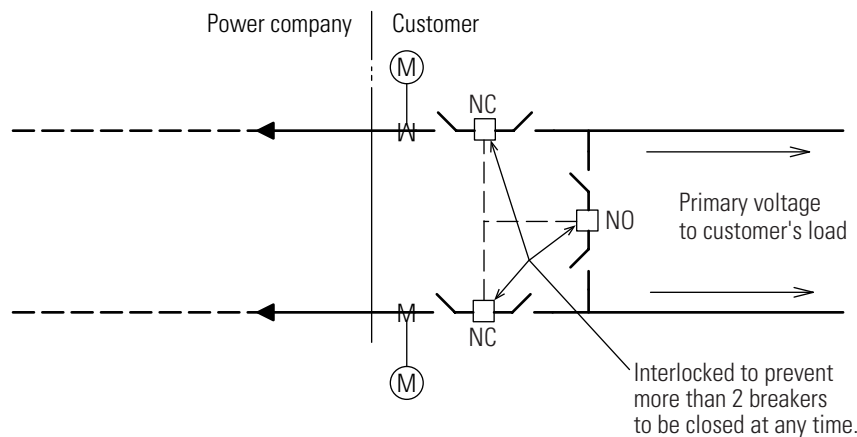




**Figure 5-7. Protective and controlling equipment for services which can be fused by 100 ampere fuses or less.**

The preferred fuse location is on the load side of disconnecting switches but it will be acceptable if fuses are installed on the source side of switches.

### Underground, Dual Source, Dual Load



**Figure 5-8. Parallel services. Two metering points.**

The tie breakers shown in Figure 5-8 must be as close as practical to the incoming main breakers. If provision is made for manual closed transition switching by power company personnel, locate it as close as practical to the incoming main breakers. Any additional circuit breakers or switches must be installed or interlocked so that it will not be possible to parallel the power company's two continuously energized services.

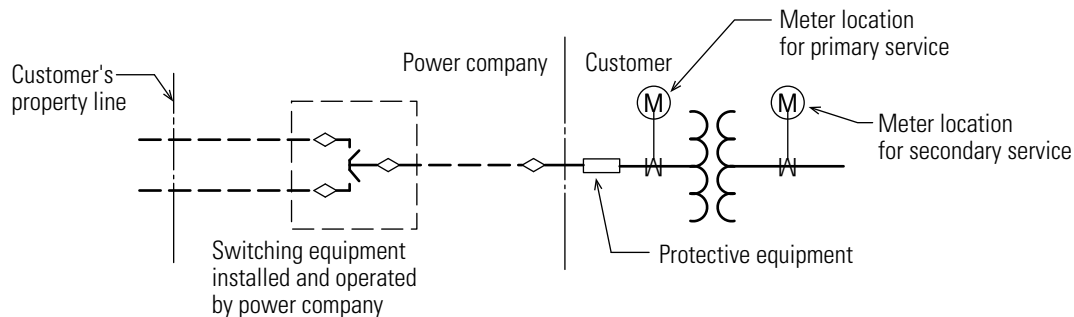
The tie breaker shown in Figure 5-8 will not be satisfactory for paralleling the two services unless the breaker trip elements can be blocked to prevent possible tripping on parallel current flow during a switching operation.

The customer must install a single-phase indicating maximum demand ammeter in one phase of each service, to enable the utility to determine the demand load on each service. The ammeters must be installed on the load side of the utility's revenue metering equipment. The ammeters must be single-range with a 5-ampere full-scale rating. The ammeters may be switchboard type similar to Lincoln Type AD-2, or socket mounting type similar to Lincoln Type ADS manufactured by the Sangamo Electric Company. The customer may install indicating demand watt-hour meters in each service in lieu of the ammeters specified above.

Metering requirements for this type of service must be obtained from the utility.

The customer must obtain the approval of the utility to use fuse protection instead of circuit breakers.

## 5.2 Utility-Owned Switchgear (Non-Metering Equipment)



**Figure 5-9. Service connection configuration, with utility owned switchgear.**

For installations for which the advantages of a primary rate are desired but the nature of load does not warrant the cost of customer-owned switchgear, the customer may opt for utility-owned switchgear.

The switching equipment will be installed by the power company at the customer's expense on a concrete pad constructed by the customer on the customer's premises at a location and with accessibility as specified by the power company. See section 3.10 for construction details and requirements for switchgear pads. The equipment will be locked with a power company lock and switching will be performed by the power company personnel only. The power company will maintain the switching equipment. No protective equipment will be provided or permitted to be installed within the switching equipment. The distance from the switching equipment to the customer's protective equipment shall not exceed 75 feet.

This option is available only to customers having a maximum demand up to 1000 kVA. If this option is taken and the demand exceeds 1000 kVA, the customer shall be required, if requested by the power company, to revise the equipment to meet requirements as specified in Figure 5-7.

A terminating pull-section must be provided by the customer in the area of his protective equipment, in accordance with the requirements of this manual.

Metering must be on the secondary side of the transformer, in accordance with applicable rate schedules.

## 5.3 Customer Generators

The utility allows parallel operation of customer generators on its electrical system, only with specific agreement with the customer.

An emergency or standby source may be utilized for times when normal service can not be provided. Notify the utility prior to installation of emergency or standby sources of electric service. This applies to all permanent or portable emergency or standby sources designed to energize the customer's electrical system.

**General requirements for customer generators include:**

- A positive acting, UL-listed double-throw switch or transfer device is required. The switch and its configuration must be approved by the utility prior to purchase. The switch or transfer device is necessary for opening all ungrounded conductors from the utility's normal supply prior to the transfer to the emergency power source. The double-throw switch or transfer device must be designed, constructed, and installed so the customer's emergency power source does not feed back into the utility's distribution system.
- Upon receiving appropriate approvals, submit the building plans to the utility for review. The plans must include service equipment location, service elevations, and one-line diagrams. Electrical connections must not be made to the service entrance conductors or other equipment until the utility has approved the plans.
- Emergency generators must not be installed in locations where metering facilities are subject to noise levels in excess of 85 db. Refer to the meter section of this manual for acceptable meter locations.
- As prescribed by the National Electrical Code, place a sign at the service entrance equipment indicating the type and location of the on-site emergency standby power source.
- Conductors intended for the emergency or standby power source must not be installed in the same conduits or raceways as the utility's service entrance conductors.
- The customer provides the utility with a construction and installation schedule, as soon as possible.

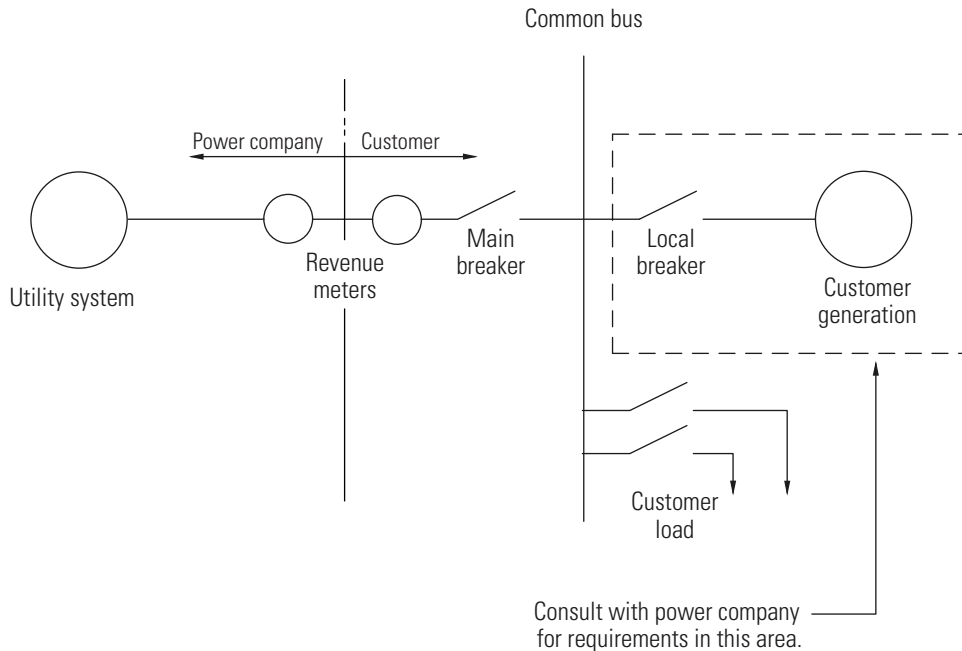
**A. Design and Operating Guidelines**

This section covers general service and metering requirements which apply to generating systems of 500 kW or less, and operating at less than 600 volts, 60 Hertz. Consult with the power company for other generating systems.

When the customer plans to operate generators in parallel with the utility's system, the customer must apply to the utility for permission, and to discuss the detailed requirements that apply to parallel operations. As part of this procedure, the customer submits single-line diagrams showing the control, protection, and metering functions. Typical functions to be included are listed below. "Typical" is interpreted as possible functions. The specific functions actually implemented will be determined by the utility. Typical functions include:

- Synchronizing controls
- Voltage and frequency controls
- Over-voltage trip
- Under-voltage trip
- Current unbalance detection and trip
- Over-current trip
- Interlocking of main breaker
- Ground current detection

- Over-frequency trip
- Under-frequency trip
- Energy measurement
- Demand measurement
- VARh measurement (when Schedule P applies)



**Figure 5-10. Functional diagram of a customer generation installation.**

## 5.4 Residential Customer Emergency Generators

Be extremely cautious when using a portable generator during a power outage, or at any other time. Never plug a portable generator into a home's electrical system and attempt to backfeed power into the home's electrical panel. This is very dangerous to occupants, neighbors, and to power company workers. Electricity can back-feed not only into your own panel, but also out into the company's power system. Once backfeed reaches primary lines, it can reach in excess of 12,000 volts.

In addition to this safety hazard, you can destroy your generator. Power company crews routinely use ground clamps for their safety. If your generator tries to feed into this ground, the amperage drawn on your generator will greatly exceed its design limits. Furthermore, if the utility re-energizes power while your generator is connected to the system, the sudden reversal of power flow can destroy your generator.

Opening the home's main breaker does not adequately protect against these risks. The only safe way to use a portable generator is to plug individual appliances directly into the generator. This is how it was designed to be used. If you have special needs for back-up power during outages, consult a licensed electrician to discuss your options.

## 5.5 Street Lighting

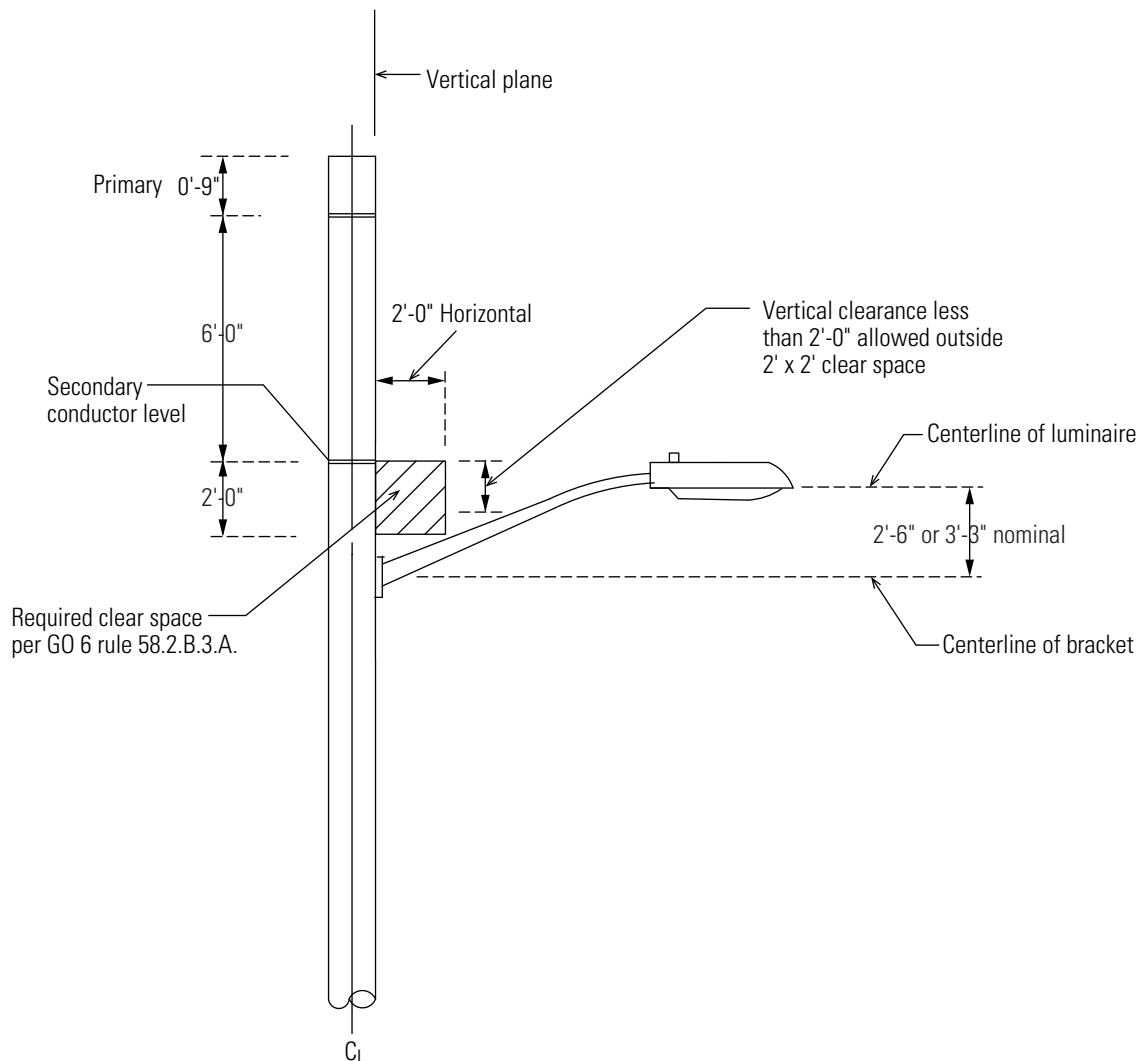
### A. Street Lighting From an Overhead Electrical Source

The customer installs and maintains conductors, conduits, separable connectors, fuse holders, and fuses between the luminaries and the utility's overhead secondary lines or service drop.

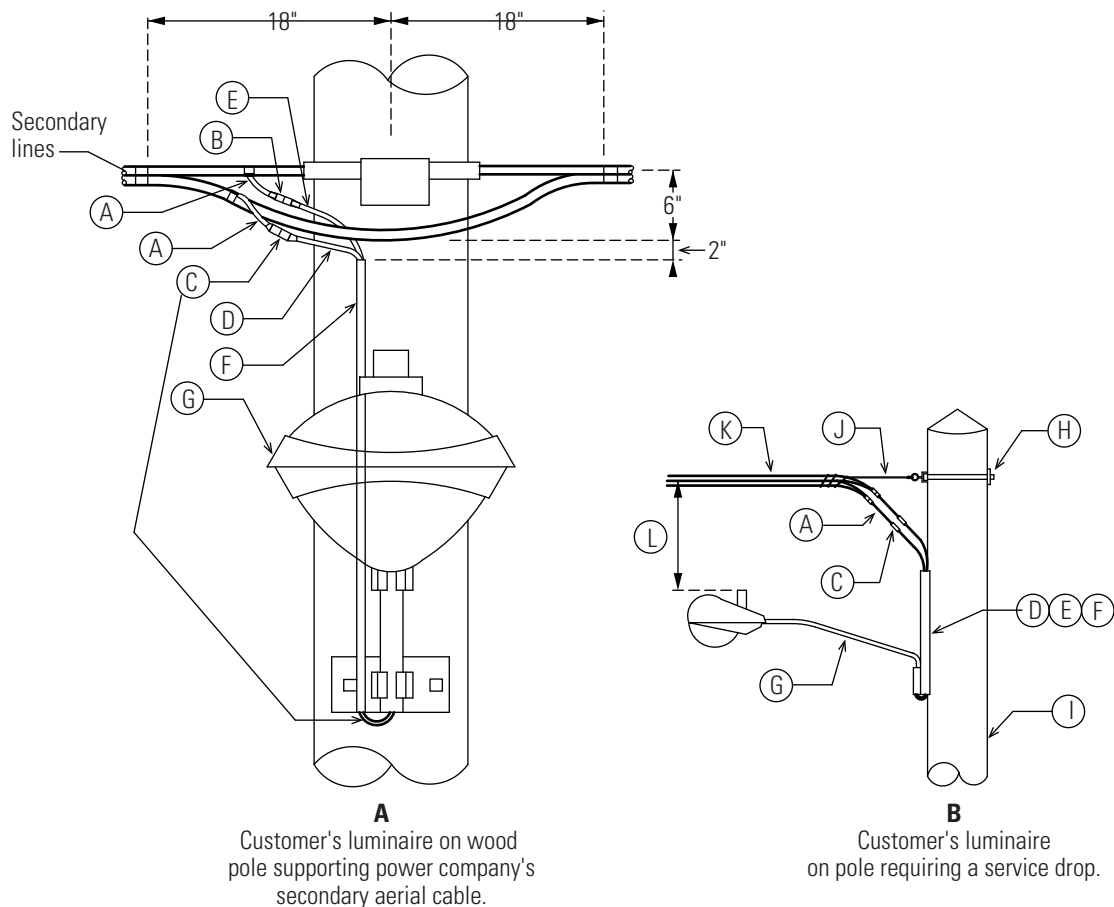
All parts of street light service drop, street lamps, and their supporting fixtures (including rods, braces and guys) must not be less than 1 foot above, or 2 feet below the level of messenger or conductors supported by messengers.

For street lighting systems in new subdivisions and roadway extensions, the customer must submit a set of drawings of his street lighting plans to the utility.

Height requirements for pole-mounted street light meter sockets are: 5' minimum, 6' maximum, with preferred mounting height of 5'-6" similar to outdoor meters accessible to pedestrian traffic, as shown in the Metering chapter of this manual.



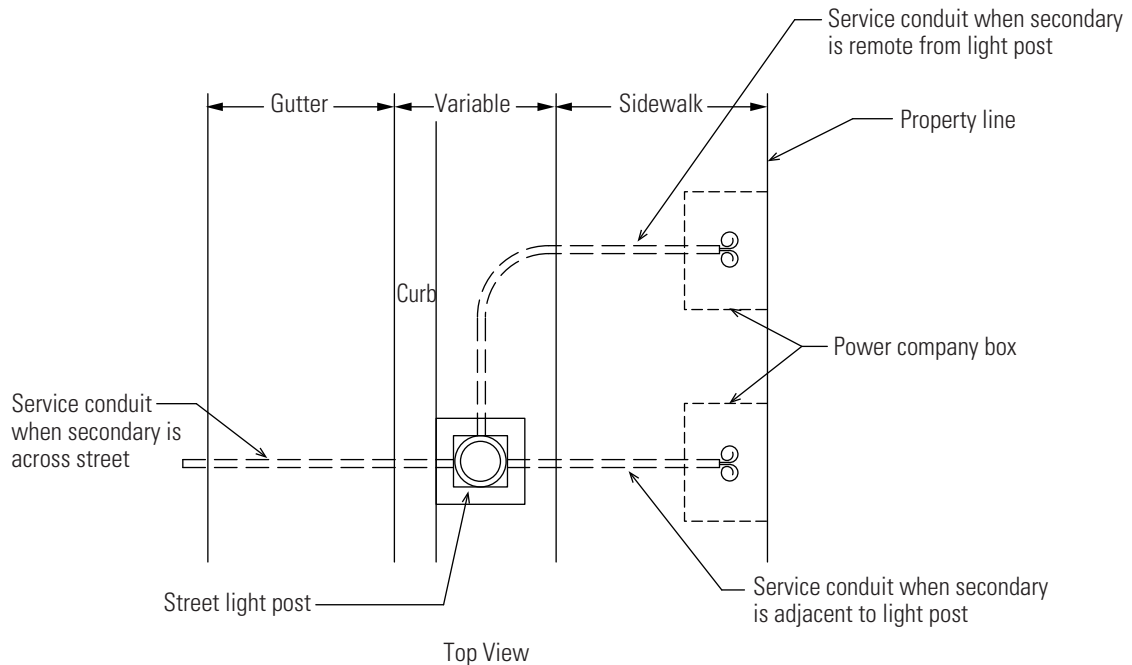
**Figure 5-11. Street lighting from an overhead electrical source.**



- A. No. 8 AWG 7-strand aluminum wire, RHW, of sufficient length to splice to the power company's lines. Coil the wire at the pole, pending splicing by utility.
- B. Line without fuse protection, insulated separable connector, suitable for No. 8 AWG stranded aluminum wire on line side, No. 12 copper wire on load side.
- C. In-line fuse holder and fuse suitable for No. 8 AWG stranded aluminum wire on line side and No. 12 AWG copper on load side.
- D. No. 12 AWG RHW black, single conductor stranded wire.
- E. No. 12 AWG RHW white, single conductor stranded wire
- F. 3/4" PVC Schedule 80 conduit.
- G. Luminaires and bracket.
- H. Aluminum service drop anchor bolt, assembly furnished and installed by customer.
- I. Wood pole by customer.
- J. Preformed grip by customer.
- K. Aluminum service drop by customer.
- L. 12" minimum clearance between the light fixture and the utility service conductor. If not possible when service drop passes over luminaires, the utility will select a splicing point which will provide a passage to the right or left of luminaires to provide a 12" clearance.

**Figure 5-12. Street lighting from an overhead electrical source, details.**

## B. Street Lighting From an Underground Electrical Source



### Notes:

1. The customer provides and installs utility-approved No.8 AWG type RHW-USE copper or aluminium conductors, white neutral, black underground line in 1-inch diameter minimum rigid galvanized steel or ABS or PVC plastic conduit from fuses in post base to a point 6 inches from power company secondary conductors. Allow sufficient length for splice and coil at trench end of conduit. The ABS or PVC plastic conduit may be either type DB for direct buried, or type EB for encasement in a minimum of 3 inches of concrete.
2. The customer shall consult the Company to determine the point of connection to the company's secondary conductors.
3. When splices cannot be made during installation of the company's secondary conductors, run the street light conductors to nearest service tail.

**Figure 5-15. Service conduit for street lighting.**

Underground street light requirements for Maui Electric (MECO) will be addressed according to the company's standards. Please contact MECO's engineering department at (808) 871-2390 for assistance.

GENERAL

OVERHEAD

UNDERGROUND

METERING

OTHER

IPP & FIT



## CHAPTER

**6**

# HECO IPP and FIT Requirements Connected at 46 kV and 138 kV

## 6.1 Introduction

This chapter describes metering requirements for Hawaiian Electric Company's Independent Power Producer (IPP) and Feed in Tariff (FIT) Tier 3 customers that sell electric energy to the Company at 46kv or 138kv. The information in this chapter does not apply to facilities constructed within the HELCO and MECO service territories.

This chapter is divided into the following sections:

- General Requirements for the IPP
- Indoor metering requirements
- Outdoor metering requirements
- Junction Box Layout

## 6.2 General Requirements for IPPs

### A. Review of Drawings by the Company

All drawings that involve the revenue meter (hence forth to be called "meter") and its related components shall be submitted to the Company for review and comment. This includes, but is not limited to, the one-line diagram, plan view, elevation details, and manufacturer's equipment drawings and specifications. Details such as the point of interconnection, metering point, ductline (and distance) between the meter and instrument transformers, estimated maximum demand/generation, working clearances, equipment clearances, and equipment elevation heights shall be reflected.

Three (3) copies of each drawing shall be submitted via the IPP's point of contact with the Company. These drawings shall be submitted separately from reviews by other HECO departments/divisions (in the case where other reviews by the Company are required). One copy will be returned to the IPP with the Company's comments. Where the Company has no major comments, the drawings will be returned with a "stamp of acceptance". All comments by the Company shall be satisfactorily addressed prior to the start of construction.

A minimum of three (3) weeks should be allowed for the Company's review for all drawing submittals.

### B. Metering Point Locations

The location of the metering point for IPP and FIT Tier 3 services shall be adjacent to and on the IPP's side of the point of interconnection (POI). The meter shall be located as close as practical to the POI and no line or transformer losses will be credited back to the POI. With the exception of lightning arresters and insulator strains, no taps or other equipment will be allowed between the metering point and the POI.

Where it is determined to be beneficial, the Company may decide to allow the metering point to be located on the Company side of the POI. A possible example of this situation is where the point of interconnection is immediately adjacent to a Company substation.

### C. Meter Location

All meters and their associated equipment shall be readily accessible at all times (24 hours a day) by Company personnel. The revenue meter shall be installed in a location that has been pre-approved by the Company.

Where possible, the meter should be located such that the length of wire that is required to be pulled from the instrument transformers to the meter will not exceed 100 feet. This distance shall be indicated on the drawings that are submitted to the Company for review. Where the meter is to be install outdoors (not within a control house), the meter location requirements set forth in section 6.4C shall be followed.

### D. Meter Clearances

All meter sockets shall be installed such that the elevation of the meter will be at 5'-6" (center-line) from finished grade. In addition, at least 4'-0" of working clearance shall be provided fronting all enclosures which will contain meter wiring (meter sockets, junction boxes, splice cans, and pull boxes). See Chapter 4, Section 4.3B (Clearance Around Metering Equipment) for additional clarification.

Where not specifically addressed in this section or in the purchase power agreement, all other working and equipment clearances shall follow the requirements set forth in Chapter 4 of this manual. Where clarification is required, the Company shall be consulted.

### E. Meter Sockets

All meter sockets shall be 13 jaw, ringed type and designed to comply with ANSI C12.7.

### F. Metering Conduits for the CT/PT Wiring

Three (3) 2" schedule 80 PVC conduits shall be installed for the CT/PT wiring between the CT/PT structure and the metering cabinet. These ducts shall be encased with a 3" minimum concrete jacket. One conduit will be used for the CT wiring, one for the PT wiring, and one conduit will be used as a spare. At the CT/PT structure, conduits shall be secured at 3'-0" minimum intervals. Where installed underground, conduits shall be installed at least 3'-0" below finished grade and per the Company's latest revision of specification CS7001 (Construction of Underground Facilities) and it's accompanying Engineering standards. Ducts shall also be inspected and tested with a mandrel per these requirements.

It is preferable that the duct run from the terminals of the CT's and PT's be continuous to the meter socket/cabinet (have no junction boxes, splice cans, or pull boxes). Where a junction/splice/pull box is required by design or is requested by the IPP, prior approval shall be obtained from the Company. Under no circumstances shall the duct line for the CT/PT wiring run through any handholes or manholes or beneath bus structure foundations or concrete equipment pads.

A pulling tension calculation shall be performed by the IPP's consultant to confirm that there will be no problems in pulling the CT/PT wiring thru the duct line. This calculation shall be based on pulling four (4) strands of #10 solid copper THHN/THHW wire into the 2" conduit.

Flex conduits are not allowed for CT/PT wiring except for between the LB's at the top of the CT/PT structure to the individual CT's and PT's. Liquid tight type flex tubing with liquid type connectors shall be used to connect LB's to the secondary boxes at the base of the CT's and PT's. These tubings shall not exceed 3'-0" in length.

## **G. Grounding and Bonding**

Wires used for grounding and bonding may be solid or stranded but must be made of copper. Aluminum or copper clad wiring is not acceptable. Where not entirely installed within an enclosure, all grounding/bonding wires shall be covered in conduit/piping. In addition, duct seal or removable foam shall be used to plug conduits after these wires have been pulled so that nothing can accidentally drop into these pipes. When the bonding/grounding wires have an insulated jacket, its color shall be green.

All grounding connections to the substation ground grid shall be by Cadweld or DMC Power's Swage tool.

## **H. Revenue Metering CTs, PTs and the CT/PT Structure**

All installations will be metered with 3 individual PT and 3 individual CT units (combo units will not be used).

HECO Revenue metering CT's and PT's shall be installed closest to the point of interconnection. Customer equipment (other than lightning arresters and insulator strains) shall NOT be connected on the line side of the CT's and PT's.

Revenue metering PT's and CT's shall be dedicated solely for revenue metering purposes. No equipment other than HECO's revenue meters shall be connected to the CT/PT secondary wiring.

It is preferred that the CT/PT units be mounted on a single structure to minimize the number of bends for the CT/PT secondary wiring. Where the use of a junction box is approved by the Company to be installed on the CT/PT structure, it shall conform to the requirements of section 6.5 of this chapter.

All clearances for the CT's and PT's shall conform to the 2002 NESC requirements.

## **I. Splice Cans**

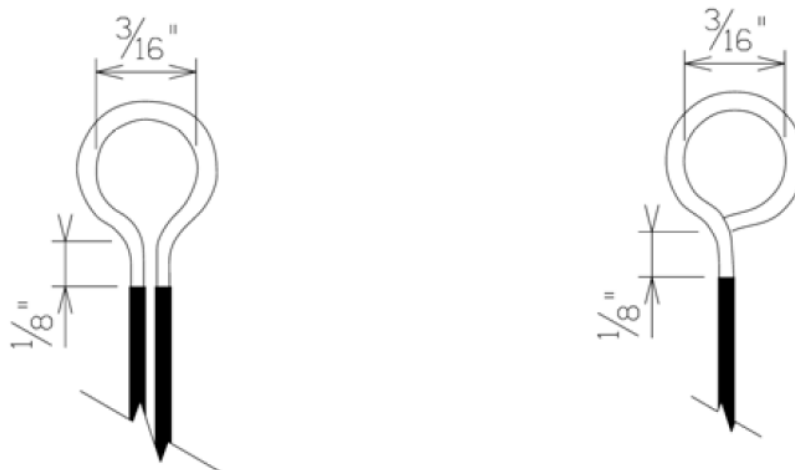
Where junction/splice/pull boxes are required by design or are requested by the IPP, prior approval shall be obtained from the Company. Where approved, these splice/junction/pull boxes shall be 24"H x 20"Wx8"D, be rated NEMA 3R stainless steel, have a three point latch, be pad lockable, and follow the layout/additional requirements documented in section 6.5.

Raceways of any size are not approved for 46kv or 138kv metering.

## **J. Meter CT/PT Wiring**

The Company is normally responsible to purchase and install the wiring for the secondary side of the metering instrument transformers. The following requirements are for cases where the IPP will purchase and install this wiring either because they are required to do so by the Purchase Power Agreement (PPA) or they elect to do so for their convenience:

- All wiring shall be #10 solid copper THHN/THHW. No aluminum wiring is allowed for metering applications.
- Wiring shall all be continuous (no splices) between the CTs/PTs and all terminal blocks.
- All CT and PT wiring shall be color coded. A-phase potential wires shall be red, B-phase potential wires shall be green, and C-phase potential wires shall be blue. The color for the CT wiring shall be the same except that it shall also have a white tracer. Neutral wires for the PTs shall be white and common (return) wires for the CTs shall be black. Ground wires shall be solid green or bare.
- Separate neutral or common wires shall not be pulled to/from each CT and PT unit. One continuous wire shall be used to tie the neutrals of the PTs (white in color) and one continuous wire shall be used to tie the commons of the CTs (black in color).
- Where feasible, slack shall be provided for all wires (potential, current, neutral, and common) and be neatly installed in the secondary boxes in the bases of the instrument transformers.
- Wiring shall not be kinked. Wiring that becomes kinked during the installation shall be replaced.
- Wiring terminations to the terminal blocks shall be made as shown in Figure 6-1 below:



**Figure 6-1. Termination details for secondary CT/PT wiring.**

## K. Labeling

Meter sockets shall be labeled “A METER” or “B METER” in 3/8” high phenolic labeling as shown in the figures in section 6.3A and 6.4A of this chapter. Where there is more than one metering point per premise (location), additional labeling to identify the meters shall be provided.

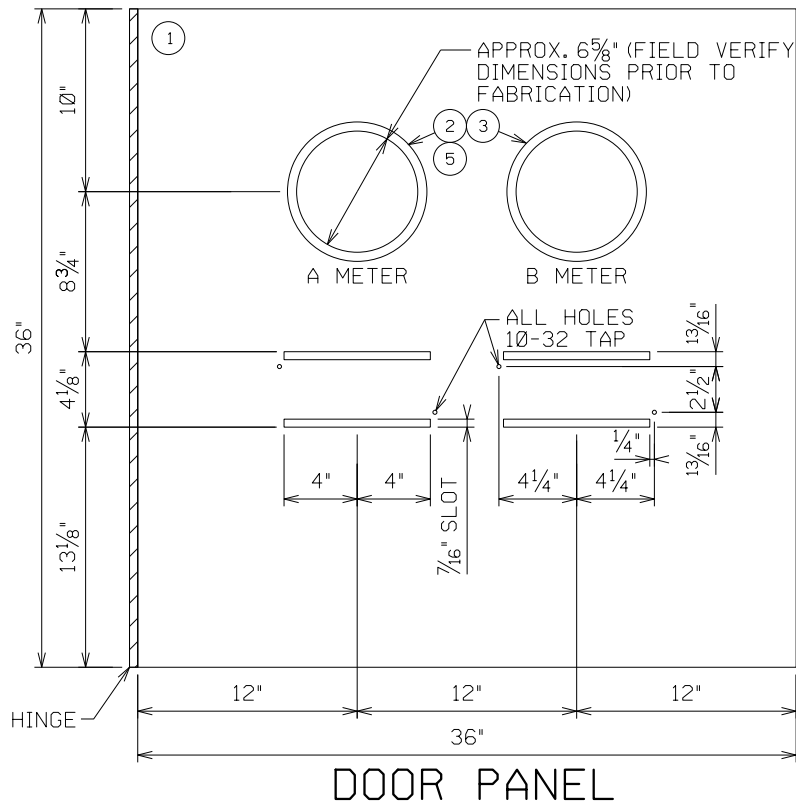
## 6.3 Meter Cabinet Requirements for Indoor Metering

This section was created to provide an alternate meter installation design for indoor applications where space is a premium (such as within a control house). Where space is not a premium, the layout provided in section 6.4A may be used.

This design consists of a modified 11 gauge, 36"H x 36"W x 12"D, 304 stainless steel hinged box which is equipped with a 33" x 33" 304 stainless steel subpanel (back panel). The door panel of the box shall be modified per section 6.3A for the mounting of the meters and test switches. The back panel shall have holes predrilled and have the ground bus, isolation relays, and terminal blocks preinstalled per section 6.3B.

### A. Door Panel Layout

The door panel of the 36"H x 36"W x 12"D stainless steel box shall be modified as shown in Figure 6-2 below. All items on the Material List shall be preinstalled. Where material substitutions are requested, they shall be approved by the Company prior to purchase.



MATERIAL LIST			
ITEM	QTY	DESCRIPTION	PART NUMBER:
1	1	NEMA 1 CT CAN, SINGLE SWING DOOR, 36WX36HX12D, 11 GAUGE	P.O.
2	2	METER INTERFACE, COOPER B-LINE	10013 CT-B
3	2	CAST ALUMINUM METERING, COOPER B-LINE	25114
4	2	TEST SWITCH, 10 POLE, TIN PLATED WITH BLACK FIBERGLASS COVER, THE DURHAM COMPANY	1-2411F-06
5	2	CROSS BAR KIT FOR METERING	

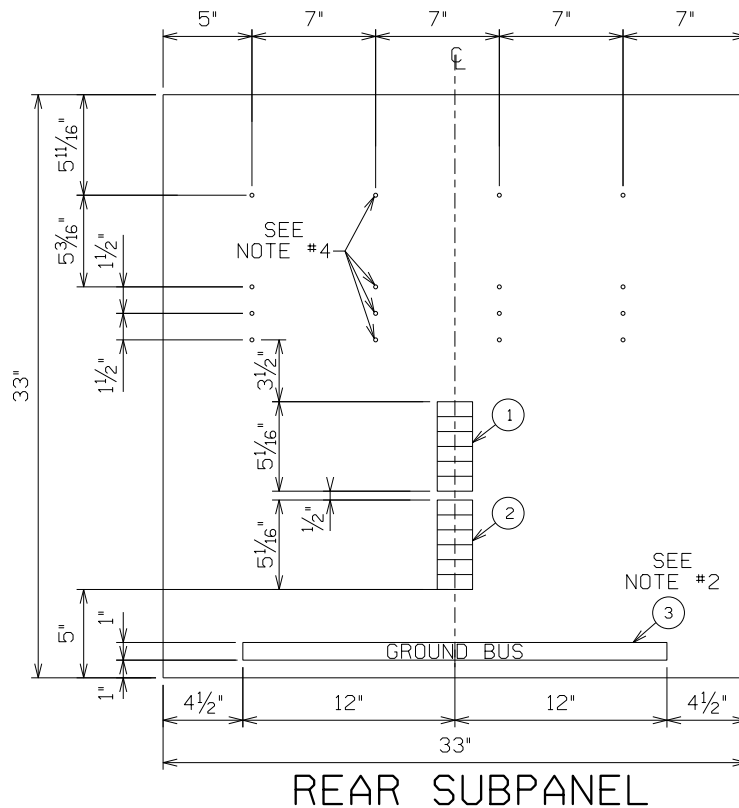
Notes for Figure 6-2:

- 1. The meter cabinet shall be designed using a 36"H x 36"Wx12"D hinged box constructed of 11 gauge (minimum) 304 or 316 stainless steel and shall be equipped with a 33" x 33" stainless steel back panel.
- 2. The door panel shall be predrilled and precut per Figure 6-2. It shall also be able to support a 25-pound load applied at the unsupported end when fully opened with maximum sag of 1/8".
- 3. The back panel shall be pre-drilled and have the terminal blocks, isolation relays, and a ground bus pre-installed as shown in 6-3.
- 4. The meter cabinet shall have a three point latch and be pad lockable. The hinge shall permit the door panel to open to 120 degrees (designed with an allowance for 11" protruding meters) and be equipped with a mechanism to secure the panel in that position.
- 5. All wiring (including ground wires and pulse wires) shall enter the meter cabinet via ductlines/piping.
- 6. Meter sockets shall be 13-jaw, designed for back connection and come equipped with sealing rings.
- 7. 7/16" slotted openings shall be cut and 10-32 holes tapped for two 10 pole test switches. The slotted openings shall be smooth to prevent damage to the meter wire insulation.
- 8. Each meter socket shall be reinforced with a brace. These braces can be purchased from Universal Welding.
- 9. Two (2) 10 pole test switches shall be provided and pre-installed (Durham Company type 1-2411F-06). For FIT Tier 3 customers, the Company will provide these test switches in accordance with Rule 14 Section A2 of the Tariff.
- 10. The cabinet shall be grounded to the ground grid with a #1/0 (minimum) copper wire. The door panel shall be bonded to the cabinet with a #6 equivalent copper braid which shall have enough slack for the panel to open to its maximum position. The door panel shall not rely on the hinge for bonding.
- 11. Meter sockets shall be labeled "A Meter" and "B-Meter" in 3/8" high phenolic labeling.
- 12. The meter cabinet shall be labeled with "DO NOT CUT SEALS" in 1/2" high phenolic lettering.

**Figure 6-2. Door panel layout and material list for indoor metering.**

## B. Back Panel Layout

The 33" x 33" back panel for the stainless steel cabinet shall be modified as shown in the detail below. The panel shall have the terminal blocks, ground bus, and isolation relays pre-installed as shown.



MATERIAL LIST			
ITEM	QTY	DESCRIPTION	MIMS / STOCK CODE
1	1	TERMINAL BLOCK, 6-POINT W/O COVER, MARATHON 1600 SERIES	1606 STD
2	1	TERMINAL BLOCK, 6-POINT W/O COVER, W. SHORTING SCREWS MARATHON 1600 SERIES	1606 SC
3	1	GND. BAR, COPPER, 24" L x 1" H x 3/8" D	-
4	4	SSI (SOLID STATE INSTRUMENTS) ISOLATION RELAY	RPR-2PS

### Notes:

1. The ground bus shall be connected to the substation's ground grid via a #6 minimum copper wire.
2. The 24"L x 1"W x 3/8"D copper ground bus shall be installed such that it is raised off of the backboard by 1" so that it is accessible from the back. The bus shall be predrilled and tapped with one row of holes evenly spaced 2" apart and supplied with brass screws and lock washers which are small enough to accommodate forks for #8-#12 wires.
3. Sixteen (16) 8-32 tapped holes shall be drilled into the subpanel as shown for the installation of SSI isolation relays.
4. Four (4) Solid State Instruments model RPR-2PS isolation relays shall be supplied and installed. These relays shall be installed along the top of the panel using the top two rows of tapped holes. Phenolic labeling (installed on the subpanel) shall be used to identify each relay (KWH-Del, KWH-Rec, KVARH-Del, KVARH-Rec).

**Figure 6-3. Back panel layout and material list for indoor metering.**



## 6.4 Meter Cabinet Requirements for Outdoor Metering

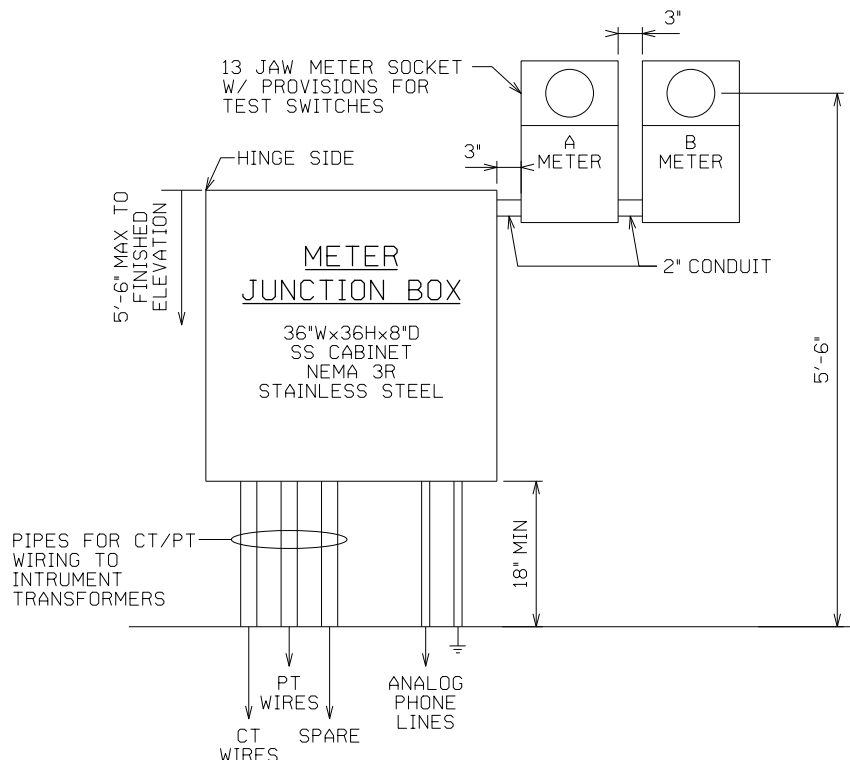
This section describes the requirements for meter installations for outdoor applications and is divided into the following sections:

- Meter Equipment Layout – Equipment layout for two/three pole structures or on the wall of a building (front access design)
- Guidelines for meter pedestals
- Location Diagram and Requirements for outdoor metering

### A. Meter Equipment Layout (Wall Mounted or Two/Three Pole Structure)

The design for outdoor 46kv/138kv IPP metering shall consist of a 36”H x 36”W x 8”D hinged NEMA 3R (304 or 316) stainless steel (11 Gauge) junction box and two NEMA 3R stainless steel 13 jaw meter sockets (equipped with provisions for test switches). This equipment shall be installed as shown in Figure 6-4 below.

This equipment may be mounted on either the interior or exterior of a permanent building/structure or on a free standing structure consisting of stainless steel posts and unistrut.



#### Notes:

1. The location of this equipment shall follow the requirements for meter locations presented in section 6.4C and be coordinated with the Company.
2. The 36" x 36" x 8" junction box shall have a hinged door that is equipped with a three point latch and is pad lockable. The door shall open to 120 degrees (minimum) and have a mechanism to lock it in that position.
3. The junction box shall come equipped with a 33" x 33" preinstalled stainless steel back panel. The panel shall be predrilled and have terminal blocks, isolation relays, and a ground bus installed per section 6.3B.

4. The meter sockets shall be UL listed. IPP customers shall provide and install a Durham Company type 1-2411F-00 test switch in each meter socket. For FIT Tier 3 customers, the Company will provide these test switches in accordance with Rule 14 Section A2 of the Tariff.
5. All wiring shall enter/exit the junction box and meter sockets via ductlines/piping (including ground wires and phone lines). The piping for the incoming CT/PT wiring shall enter the junction box from the bottom, opposite from the meters (as shown in Figure 6-4 above). Duct seal or removable foam shall be used to plug all conduits after the wiring has been installed so that nothing can accidentally fall into these pipes.
6. Where the meter equipment is installed on a free standing structure, it shall be mounted on stainless steel poles/piping/unistrut and the design of the structure shall be approved (stamped) by a licensed structural engineer.
7. All equipment shall be bonded together with a #6 (minimum) copper wire and be grounded to the substation's ground mat per the 2002 NESC. The door panel shall be bonded to the junction box with a #6 equivalent copper braided wire and shall have enough slack to allow the door to open to its maximum position.
8. Bonding/grounding wires that are exterior to enclosures shall be encased in conduit. Exposed bonding/grounding wires are not acceptable.
9. This layout may be used for indoor or outdoor applications.

**Figure 6-4. Meter equipment layout for outdoor metering.**

## B. Guidelines for Meter Pedestals

Where meter pedestals are used for 46kv or 138kv metering, the following requirements shall be followed:

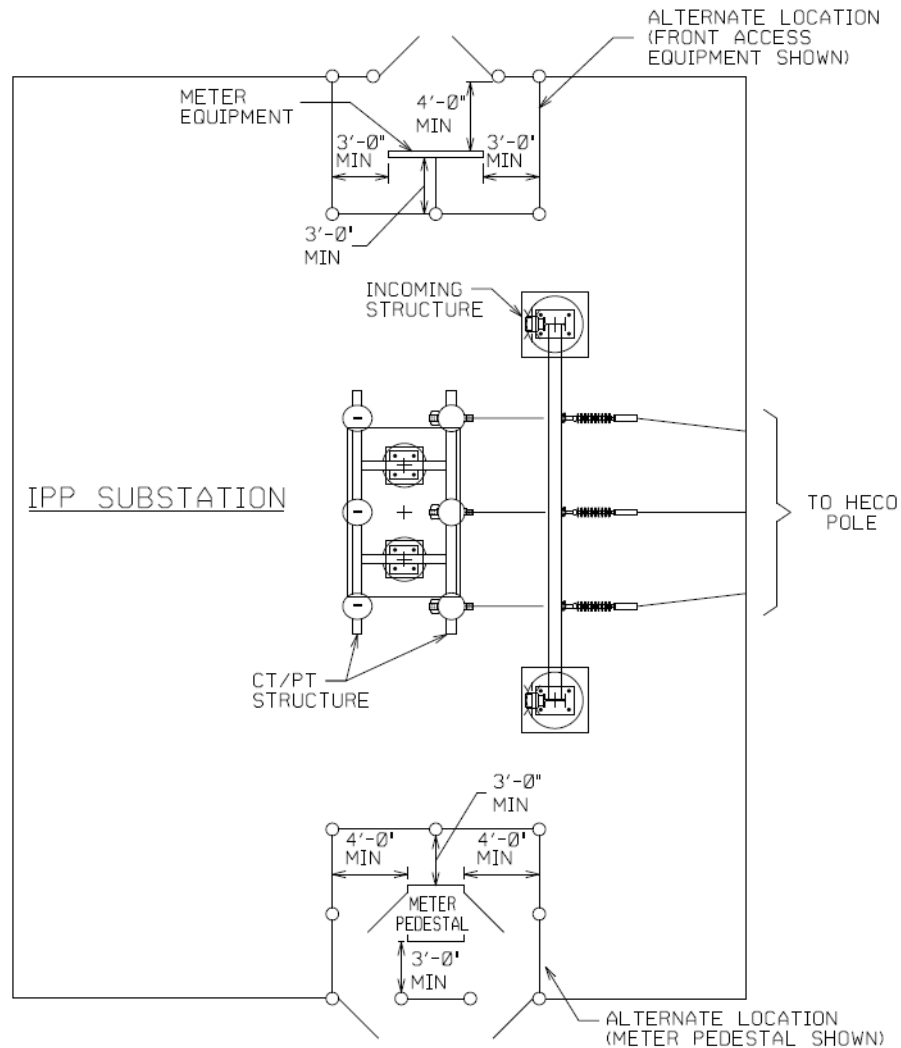
- The pedestal shall be constructed of 304 or 316 stainless steel and be NEMA 3R rated.
- The pedestal shall be accessible from both the front and rear and be securely mounted to the pad.
- The location of the pedestal shall follow the requirements in section 6.4C and be coordinated with the Company.
- The pedestal shall come equipped with a stainless steel backboard that is at least 36" wide and be tall enough such that the revenue meters will be mounted at 5'-6" above finished elevation.
- The doors for the pedestal shall have a three point latch and be pad-lockable. They shall also be able to open to 120 degrees and have a mechanism to secure it in that position. A minimum of four feet (4'-0") of working clearance shall be provided fronting all doors of the pedestal. The other sides of the pedestal shall have a minimum of three feet (3'-0") frontal clearance.
- The pedestal shall be designed with an allowance for 11" protruding meters.
- The doors of the pedestal shall open such that egress to the entrance gate will not be blocked (see Figure 6-5).
- The pedestal shall be equipped with two (2) 13 jaw back connected meter sockets, two (2) Durham 10 pole test switches (IPP customers only), one (1) 24" x 1"H x 3/8"D copper ground bus, two (2) six point terminal blocks (one shorting and one non-shorting), and four (4) isolation relays. The part numbers for this equipment are identical to those listed in Figures 6-2 and 6-3.
- Manufacture's drawings shall be submitted to the Meter Division for review and comment prior to purchase/order. Included in these drawings shall be layouts of the

panel’s front and rear views. The layout for the front view shall show the locations of the meters and test switches. The layout for the rear view shall show the locations of the terminal blocks, isolation relay boards, ground bus, and phone equipment. All dimensions shall be identified . Layouts for the front and rear views shall be similar to Figures 6-2 and 6-3 (respectively).

- The surface of the pedestal’s pad shall be 4” above finished grade. The detail for the pad shall be approved (stamped) by a licensed structural engineer and submitted with the pedestal’s drawings to the Company for review.
- The pedestal shall be grounded to the ground grid per the 2002 NESC. This grounding connection shall be made to an interior grounding pad. The doors shall be bonded to the pedestal with a #4 minimum equivalent copper braid which shall have enough slack to allow the doors to open to their maximum position.
- The pedestal shall have phenolic labeling with 1/2” high lettering on both doors that read “HECO Metering Compartment” and “DO NOT CUT SEALS”.

C. Meter Location Requirements

Where meters are located outdoors on a two/three pole structure or within a meter pedestal, the metering equipment shall be installed along the fence of the substation as shown in the detail below.



## Notes:

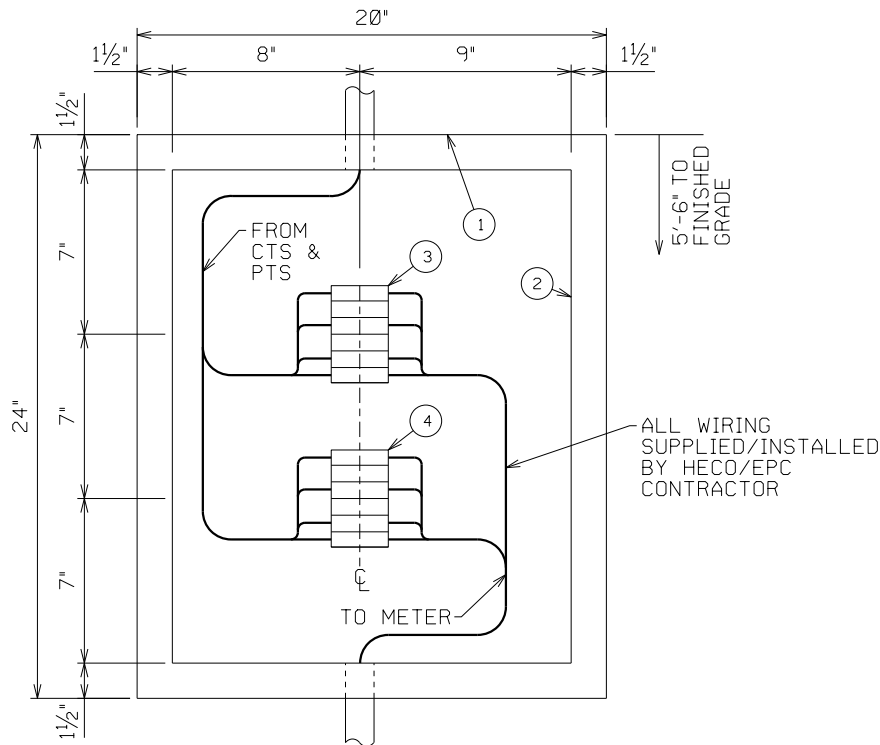
1. All revenue meter locations shall be approved by the Company. Meters shall not be located such that Company personnel would have to pass near or under the substation bus, switchgear, transformer, or other energized equipment to access the meter.
2. It is acceptable to locate metering equipment inside a control house, or on the outside of the control house. However, there shall be 24hr access to the equipment and the wiring distance from the meter to the CTs and PTs shall be kept to a minimum. These types of locations shall be approved by the Company.
3. The preference is to locate the meter equipment along the fence line of the substation and near the CT/PT structure. Metering equipment that is located outdoors should be surrounded by a grounded fence where access can be gained without entry via the IPP substation.
4. Meters located along the substation fence shall be accessible from the exterior of the substation via 4ft wide (minimum) man-gates. These man-gates shall be reasonably accessible by a vehicle. If necessary, a path shall be paved to the metering equipment.
5. Fencing shall be installed such that it provides at least 4'-0" of working clearance fronting all meters and accessible openings. This clearance shall be measured from the face of the enclosures. There should be at least 3'-0" of clearance fronting all other sides.
6. The man-gates and at least every other fence post and the fence fabric that surrounds the metering equipment shall have a grounding connection to the ground mat.

- 7. Bollards shall be installed to protect the frontal clearances of metering equipment or their gates from vehicular traffic. Where required, bollards shall be installed per Chapter 4 (section 4.3J) and when installed nearby or within a substation, grounded in accordance with the 2002 NESC. If necessary, the substation's ground mat shall be expanded to include these bollards.
- 8. Where the revenue meter is installed away from the substation (e.g. to meter a transmission line tie between the customer and the Company), the metering equipment shall either be installed in a pad-lockable enclosure or a meter pedestal. Where exposed to vehicular traffic, all operational clearances shall be protected by bollards as described in Chapter 4 of this manual.

Figure 6-5. Recommended outdoor meter location.

6.5 Junction Box Layout

Where the use of a junction (splice) box is approved by the Company, it shall conform to the detail and notes listed in this section.



JUNCTION BOX

MATERIAL LIST			
ITEM	QTY	DESCRIPTION	MIMS / STOCK CODE
1	1	CABINET, NEMA 3R, TYPE 304 STAINLESS STEEL, 24"x20"x8" PADLOCKABLE WITH 3" POINT LATCH	AS REQUIRED
2	1	BACK PANEL FOR CABINET, TYPE 304 STAINLESS STEEL, 27"x21"	AS REQUIRED
3	1	TERMINAL BLOCK, 6-POINT W/O COVER, MARATHON 1600 SERIES	1606 STD
4	1	TERMINAL BLOCK, 6-POINT W/O COVER, W/ SHORTING SCREWS, MARATHON 1600 SERIES	1606 SC

## Notes:

1. This junction box shall only be installed for installations where the CT/PT wiring run is long (over 100 feet) and/or its installation is pre-approved by the Company.
2. The junction box shall be 24"H x 20"W x 8"D, be rated NEMA 3R stainless steel (304 or 316), and have a hinged door with a pad-lockable three point latch. The door shall open to 120 degrees (minimum) and have a mechanism to secure it in that position.
3. The junction box shall come equipped with a 21"H x 17"W stainless steel backboard. Terminal blocks shall be installed onto the backboard per the detail above.
4. Where approved, the junction box shall be installed on the CT/PT mounting structure such that wires from the CT's and PT's enter via the top of the box while wires to the meter socket exit via the bottom.
5. The top of the junction box shall be mounted at 5'-6" above finished grade and its door shall be labeled with "HECO Meter Wiring" and "Do not cut seals" in ½" high phenolic labeling.
6. All wiring (including ground wires) shall enter the junction box via duct-lines/piping. The junction box shall be grounded to the substation ground grid per the 2002 NESC. The door shall be bonded to the junction box with a #6 minimum copper braid which shall have enough slack for the door to open to its maximum position.

**Figure 6-6. Layout and material list for junction boxes.**



