



ELECTRIC SERVICE MANUAL 2022

Marshfield Utilities
Rules for Electric Service Installations
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MISSION AND VISION STATEMENTS

FOR

MARSHFIELD UTILITIES

A MUNICIPALLY-OWNED, CUSTOMER-ORIENTED UTILITY

Mission: A forward looking stakeholder-focused organization providing reliable and safe services to our customers while providing value and enhancing quality of life in the community.

Vision: Be a prominent cornerstone of the community that provides value added services with innovative solutions while ensuring environmental stewardship.

INTRODUCTION

This electric service manual is published to provide a convenient resource to our customers and their architects, engineers, contractors, and employees concerned with electrical installations in the Marshfield Utilities (MU) electric service area. MU's objective is to cooperate with and assist customers to obtain safe and energy efficient electric service.

PURPOSE

The information in this manual is intended to reflect the municipal electric codes of Marshfield, the Wisconsin Administrative Code, and any other regulations which may apply. MU reserves the right to revise and reissue this manual from time-to-time to reflect changes in the art, legal requirements, or when other circumstances make it advisable.

These rules are intended for standard equipment installations. To avoid misunderstanding and unnecessary expenses, the customers or their representatives should consult with MU at the address and telephone numbers listed in Section 1 of this manual during the planning stage about electric service availability and MU's Rates and Rules. Early and timely notification will prevent unnecessary delay and expense.

MU may refuse or discontinue electric service if a customer does not comply with these rules. It is necessary for the customer to obtain an electrical inspection from the Marshfield City Electrical Inspector or other inspection agency and/or approval from MU, prior to receiving initial electrical service. Electrical service may be discontinued, without prior notice, if a dangerous condition exists on the customer's premises.



If you are doing any digging, including installation of ground rods, in Wisconsin, **State Statute 182.0175** requires you to notify Diggers Hotline of your intent to work, and to allow a minimum of 3 working days prior notice before digging. **If you dig without calling Diggers Hotline and damage underground facilities, not only will you be responsible for the damage, but you could also be subject to a substantial fines.** Our employees have been instructed to report any digging without locates to local law enforcement.

Diggers Hotline is open 24 hours a day, 7 days a week, and 365 days a year!
24 hour online portal access is also available at: <https://www.diggershotline.com/>

If you should need to notify Diggers Hotline of your intent to dig, call:

Toll Free (800) 242-8511 (Dial 811)
Hearing Impaired (TDD) (800) 542-2289

All calls to Diggers Hotline are recorded and kept on file for six years, as mandated by Wisconsin State Statute.

SECTION 1

MARSHFIELD UTILITIES

ELECTRIC SERVICE AREA AND OFFICES

MU provides electric service to the City of Marshfield and surrounding rural area.
MU's electric service territory is depicted in Figure 1-1.

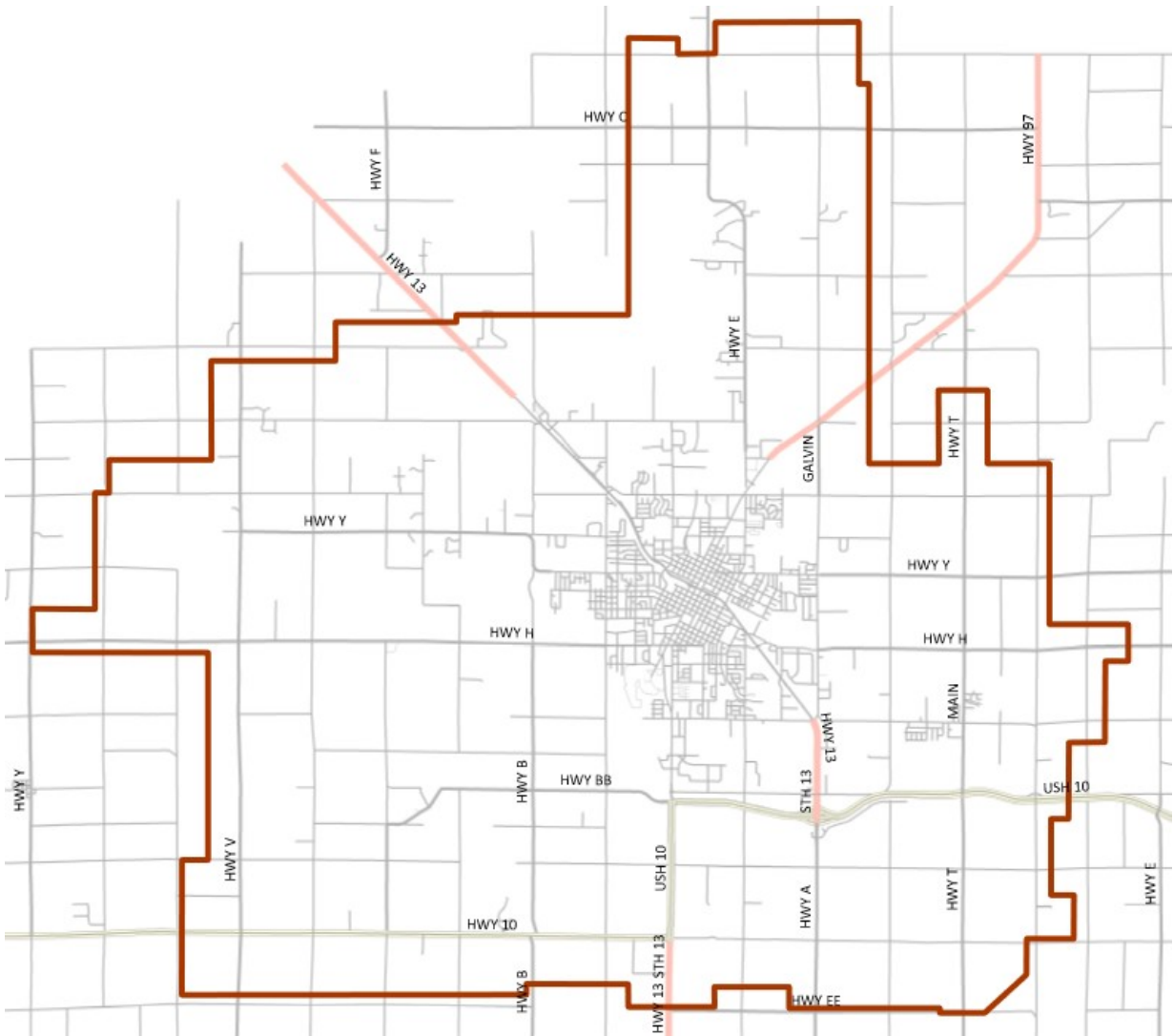


Figure 1-1
Marshfield Electric Service Territory

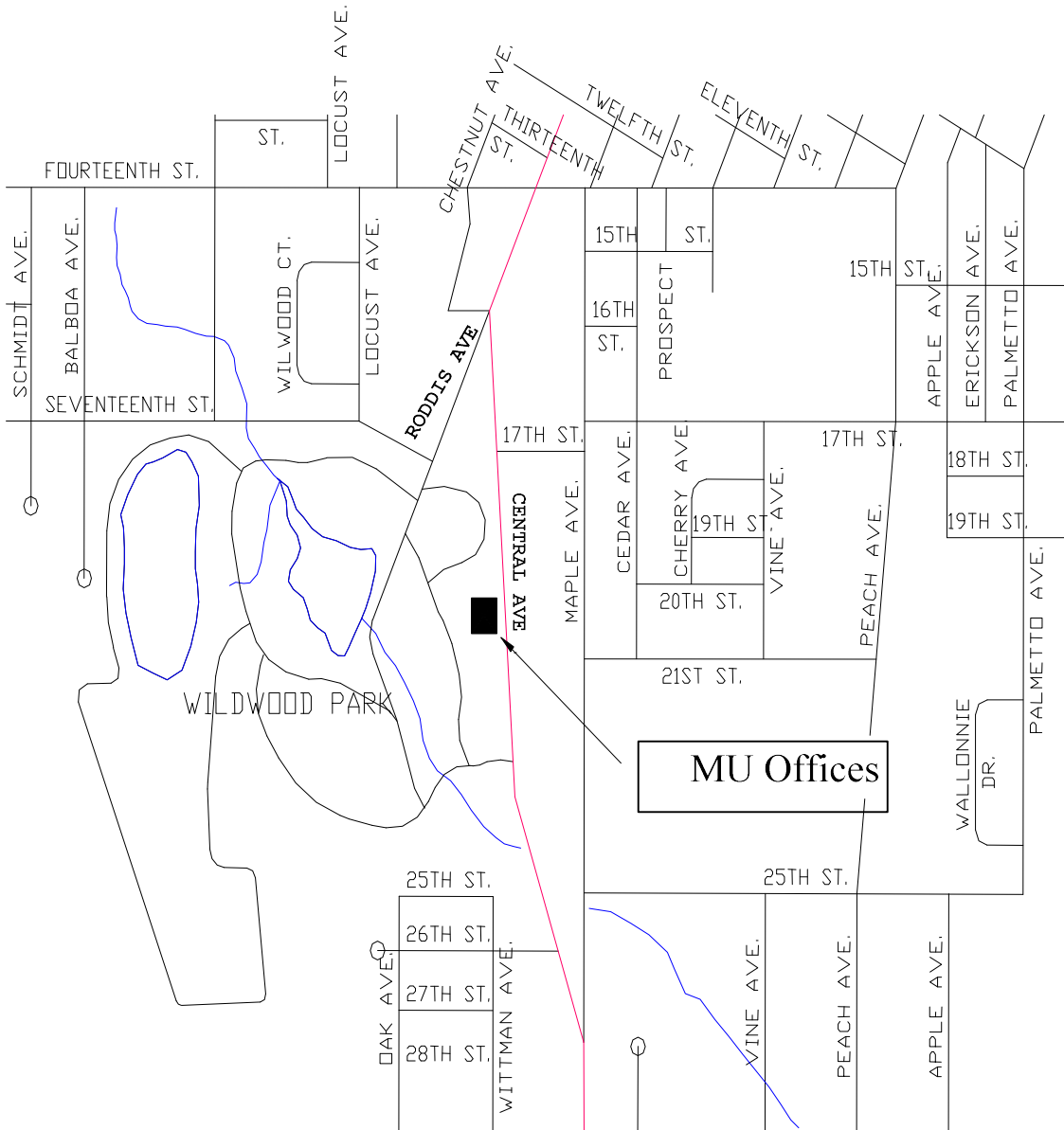


Figure 1-2
MU LOCAL OFFICE LOCATION
2000 South Central Avenue
Marshfield, Wisconsin 54449

MARSHFIELD UTILITIES
P. O. BOX 670
2000 SOUTH CENTRAL AVENUE
MARSHFIELD, WI 54449

CONTACT NUMBERS

OFFICE 7:00 A.M. TO 4:00 P.M..... 715.387.1195
OUTAGE REPORTING AFTER HOURS 715.384.8515

<u>MU TITLE</u>	<u>EXTENSION</u>
Administrative Coordinator (Kelly).....	2141
Electric Comm. & Gas Manager (Tony).....	2140
Electric Operating Supervisor (Derrek)	2144
Electrical Engineer (Alex S)	2147
Utility Engineer (Cody)	2143
General Manager (Nick K)	2101
Meter Technician (Allan)	2151
Customer Service Manager (Joe)	2120
Power Systems Supervisor (Erik R)	2146

DIGGER'S HOTLINE..... 800.242.8511
CITY ELECTRICAL INSPECTOR 715.486.2018

Go to our website at www.marshfieldutilities.org for the following:

- Utility Commission contact information
- These service rules in PDF format
- Provide us with comments or complaints
- Other Utility information

Utility Commission Approval of These Service Rules: May, 9, 2022

SECTION 2

Procedure to Obtain Electric Service

2.0 To obtain electric service from MU, the following steps shall be followed.

2.1 Permanent Service

During the design phase of a project that will require a new or change in existing electrical service, visit our website or call our customer accounts team. In order to provide an accurate estimate, MU needs the following information:

1. service address,
2. service type
3. (single or three phase and voltage desired)
4. billing information (completed on MU Website)
5. service size,
6. service class (residential, commercial, industrial)
 - a. AIC Rating required for all non-residential projects
7. expected project timeline,
8. load calculations,
9. copy of the certified survey or plot plan of the property where the service will be required,
10. A map with dimensions, including building foot plan, desired service location, nearest road, nearest MU Electric Distribution facility, and wetland, if any.

Before any work begins, customer billing information, the proper city, village, township, county, and state permits shall be obtained.

*Note: To avoid any unnecessary delay in service hookup, provide customer billing information as soon as possible.

2.2 Temporary Service

MU will work with the customer to determine the location of the temporary service if one is needed. Temporary service will include a hook-up fee and may require a line extension fee. Temporary service shall not utilize the permanent meter socket.

2.3 Line Extension

After a review of the proposed project, MU will notify the customer if a line extension contract is required and if any additional charges will be required to cover the cost to extend electrical service facilities. When this occurs, a contribution is necessary before the line extension can be scheduled for installation. MU shall utilize the most direct, engineering feasible route to determine additional charges.

2.4 Easements and Right-of-Way

When easements are required, they must be obtained before construction will be scheduled. The customer requesting service shall obtain permission from those landowners as required. MU will provide the easement document. Any costs involved with obtaining the easement will be the responsibility of the customer requesting the line extension.

2.5 Site Preparation (Grading, Tree, Stump, and Brush Removal)

The customer is responsible for the initial clearing of the right-of-way required for line construction on the customer's property. For overhead lines, trees and brush should be trimmed back 10 feet, plus a 4 year growth cycle distance on both sides of the line. MU may provide any required tree trimming if requested to do so, with the cost being added to the service extension cost. For underground projects, the grade in the construction area must be within 3 inches of final grade. Also, any trees, brush, and stumps shall be cleared back to make a path of at least 10 feet in width. Any equipment re-installations required because of grade changes will be done at the customer's expense.

2.6 Inspection

Refer to "6.1 Code Compliance and Inspection"

2.7 Scheduling of the Job

Prior to MU scheduling construction on a line extension, the following items, if applicable, are required:

1. Payment made and contract with MU executed.
2. Easements signed.
3. Site clearing/grading completed within 3-4 inches of final grade.
4. Service entrance location determined.
5. Approved sanitary permit.

2.8 Service Extensions – Special Requirements

Multi-family, commercial, and industrial line extensions have special requirements.

This Service Manual will provide many of the details necessary to obtain service. A short summary of those needs follows below:

1. Standard service voltages available from MU are:

- 120/240 volt, three wire, single phase
- 120/208 volt, four wire, three phase
- 120/240 volt, four wire, three phase*
- 277/480 volt, four wire, three phase

*This service voltage is limited to existing customers only or at MU discretion.

Service voltages other than 120/240-volt single phase must be approved by MU before installation. In areas where a given standard customer distribution voltage already exists, new customers must accept service at that voltage. MU primary service voltage is 7620/13200 volts and is available to customers who qualify.

MU will provide one delivery point to the site or premise. If the customer requires service at a voltage other than offered by MU, the customer must furnish and maintain the additional equipment to provide this voltage.

2. Metering

Consult Section 4 for all of MU metering options and approved metering equipment. Generally, MU uses 200 and 320 amp single-phase plug-in meters and current transformer enclosures for services of 400 amp and greater.

3. Early Notification of MU

On larger jobs, it is essential for the customer to get MU involved as soon as possible in the design process. A number of issues must be resolved before the service can be installed. Routing of the service, ordering the material, and obtaining the necessary easements and permits all require time.

Large jobs may require large transformers or special cable and terminal equipment with lead times exceeding 6 months. If the extension of service involves the installation or upgrading of transmission lines, American Transmission Company (ATC) would need to be contacted.

4. Transformers

Service will be provided by pole-mounted or pad-mounted transformers. If you are to be served from a pad-mounted transformer, it is essential to consider all the necessary clearance and protection requirements. Clearance and protection requirements are detailed in sections 3 and 5.

5. Facility Protection

MU requires that certain precautions be taken for the physical protection of metering facilities, service cables, and transformers. Many of these requirements are to meet various electrical safety codes and the remainder are to ensure access to electrical facilities for any necessary repairs or replacements. Consult section 3 for these requirements.

6. Service Conductors

The customer is responsible for the installation and ownership of all electric infrastructure beyond the MU Meter including the service mast or meter pedestal.

7. Trouble Calls

During regular work hours, MU is available to respond to customer trouble calls normally at no cost to the customer. MU will not compensate customers or electricians unless MU specifically directs the customer to contact an electrician and the trouble is later found to be on MU's system.

Outside of regular work hours, the customer will be instructed to call an electrician if the problem appears to be customer equipment. If the electrician finds that the trouble is on MU's system, MU will compensate the electrician by an amount to be determined each year by MU.

SECTION 3

Service Entrance Requirements

MU will, in all cases, designate where MU service will terminate on the customer's building or structure. MU will consult with and consider the customer's preferences before making this determination.

3.1 Service Requirements

Only properly credentialed electricians following all code requirements, and practicing electrical safety will be allowed to wire on the MU system. MU will not inspect customer wiring or provide electrical code interpretations. By law, this is allowed to be done only by State-Certified Electrical Inspectors. The City of Marshfield Electrical Inspector is State-Certified and can be contacted at the phone number listed in section 1.0.

Basic items for completing the service entrance to the customer's main disconnect switch for a single family residential building include:

1. The minimum service and meter socket/pedestal size is 200 amperes for underground service and 100 amperes for overhead service. Service entrance conductors and main disconnects may be 100 amperes on underground services if the National Electric Code load calculation allows.
2. Table 3-1 shows the minimum conductor sizes for residential use only for 120/240 volt single-phase 3-wire service entrances: (Conductor sizing from NEC 310.15 and applies for wire/cable types THW, THWN, THHN and USE).

Table 3-1 Service Entrance Size Requirements For a 120/240 3-wire (single phase) Residential Dwelling Unit		
<u>Service Size</u>	<u>Service Entrance Conductors</u>	
<u>Amperes</u>	<u>Copper</u>	<u>Aluminum</u>
100	#4	#2
150	#1	2/0
200	2/0	4/0
400	400	600 *

Note: * Larger than 500 kcmil will not be accepted for overhead service entrances

3. Conduit sizing for entrances must be:
 - A minimum size of 2 inch HDPE bore duct or 2½ inch Schedule 40 Electrical PVC for underground services. Schedule 80 PVC is required for all risers and above grade installations. Risers should extend approximately 3 inches above ground level.
 - On overhead masts that extend above the roof, rigid metal conduit is required to the weatherhead. The mast may not extend over 5 feet above the roofline without permission from MU. For 200 ampere or less services, the minimum rigid metal conduit size is 2 inch. All overhead masts should be back-guyed if the service drop attachment point is more than 36 inches above the roof. MU may also require back guying or bracing on service wire lengths over 100 feet. No couplings are allowed in the service mast above the roofline. The top section of conduit must be a full section of conduit and be securely anchored to the building just above any coupling. No portion of the mast pipe, except the portion extending through the eave/overhang, should be covered.
4. The main disconnect must be located within 8 feet of where the service entrance raceways or service entrance cable enters the structure.
5. All aluminum connections must be made with aluminum rated connectors. The conductor and connector must be properly brushed, treated, and dressed with approved corrosion inhibitors.
6. Only metering conductors may be installed in pedestals or meter sockets.
7. In rural areas, meters shall be turned toward the road or driveway whenever practical for ease of reading.
8. All services of the same class/voltage must be served from a common service entrance mast. This can be a single mast or parallel mast depending on load. If services of different characteristics are utilized and the meter sockets cannot be connected with a common bus due to mechanical limitations, dual mast may be allowed if located close together. For example, with a combination of a 400-ampere service and a 200-ampere service or a combination of a three phase and a single-phase service, dual masts may be allowed if located close together. Contact MU before installing dual mast. MU must approve all dual mast installations.
9. The maximum mast wire size is 500 kcmil, regardless of service type.
10. All overhead service attachments should have a reinforced insulated attachment (screw knob, service clevis, etc.) point provided. Back guying, if required, of overhead mast should be 36 inches above the roof line measured to the attachment point.
11. All nuts, bolts, lugs, etc. located within meter sockets and meter pedestals are to be torque per the manufacturer's specifications.

3.1.1 Grounding

- 1 Two ground rods are to be installed at least 6 feet apart, and if present on the premises the following are to be bonded to the grounding system:
 - Metal underground water pipe system
 - Concrete enclosed electrode
 - Ground rings
 - Metal frame of building
 - Communication grounding electrode
 - Cable TV grounding electrode

If you have an ufer ground (rebar incased in concrete) ground rods are not required. Ground rods are only required when you need to supplement a water service or where no other electrodes are available.

Other grounding configurations are described in NEC Article 250 and Safety and Professional Services SPS 316.250 (1) (2).

- 2) Ground rods and grounding electrode conductors shall not be located in front of the meter pedestal, wire troughs, or within 2 feet of the underground cable route. Good wiring practice is to install the ground rods outside the drip line.
- 3) Grounding electrode conductors shall not be run in or through the overhead meter socket or underground meter pedestal. On current transformer (CT) cabinets, the grounding electrode conductor may be run into the CT cabinet if enclosed in a separate conduit and terminated on the neutral strip or run directly into the main disconnect.
- 4) NEC 250 and the Wisconsin Electrical Code Chapter SPS 316.250 both provide details on specific grounding issues. Specific references include:

NEC 250 Part V	Bonding
NEC 250 Part VI	Equipment Grounding & Equipment Grounding Conductor
NEC 250 Part VII	Methods of Equipment Grounding
NEC 250.102(C)	Size-Supply Side Bonding Jumper
NEC 250.94	Bonding for Other Systems
NEC 820 Part IV	Grounding Methods
NEC 250.104	Bonding of Piping Systems and Exposed Structural Steel
NEC 250.50	Grounding Electrode System
NEC 250.52	Grounding Electrodes
SPS 316.250	Two-Ground Rod Requirement
NEC 250.62; 64	Grounding Electrode Conductor Material; Installation
NEC 250.66, table	Size of Alternating-Current Grounding Electrode Conductor
NEC 810.21	Bonding Conductors and Grounding Electrode

Conductors—

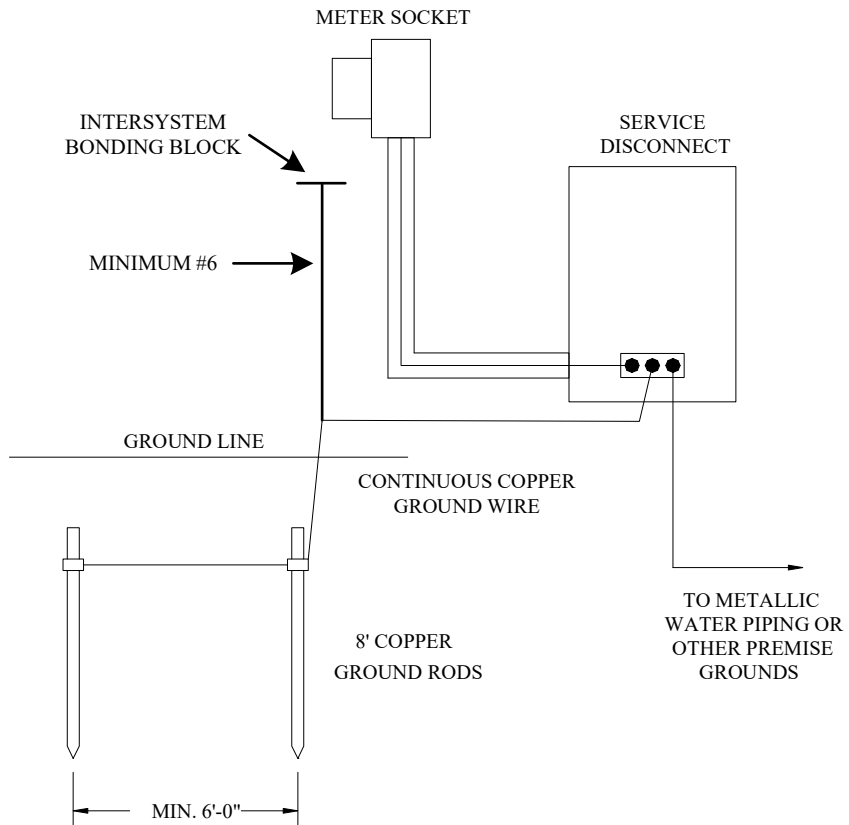
Receiving Stations
 NEC 800 Part IV Grounding Methods (Communication Circuits)

- 5) In a building with 10 feet or more of metallic water pipe in contact with the earth, the water pipe must be bonded to the neutral bar in the main distribution panel or first disconnecting means. The bond to the water pipe must be within 5 feet of where the water line enters the building, and the bond must be on the supply side of the water meter. Also note that the metallic water piping must be bonded even if there is no earth contact.
 The bond to the water pipe shall not be made within 1 foot of either side of the water meter.
- 6) Service Entrance Ground Conductor Requirements
 Table 3-2 shows the required grounding electrode conductor sizes for various service entrance conductor arrangements. The table is based on NEC 250.66. This table should be used in conjunction with table 3-1. The grounding conductor must be a minimum of #4 copper for a 200 ampere service.
- 7) All grounding conductors, (green and bare conductors) must be bonded to the neutral in the main distribution panel or first disconnecting means. Equipment grounding conductors and grounding electrode conductors are not permitted in the meter socket or other entrance equipment unless the main disconnect is located in the meter socket/pedestal.

Table 3-2 NEC 250.66			
Grounding Electrode Conductor for Alternating Current Systems			
And			
Equipment Bonding Jumper on Supply Side of Service			
SIZE OF LARGEST SERVICE-ENTRANCE CONDUCTOR OR EQUIVALENT AREA FOR PARALLEL CONDUCTORS		SIZE OF GROUNDING ELECTRODE CONDUCTOR	
<i>Copper</i>	<i>Aluminum or Copper-Clad Aluminum</i>	<i>Copper</i>	<i>Aluminum or Copper-Clad Aluminum</i>
#2 or smaller	1/0 or smaller	#8	#6
#1 or 1/0	2/0 or 3/0	#6	#4
2/0 or 3/0	4/0 or 250 Kcmil	#4	#2
Over 3/0 through 350 Kcmil	Over 250 Kcmil through 500 Kcmil	#2	1/0
Over 350 Kcmil through 600 Kcmil	Over 500 Kcmil through 900 Kcmil	1/0	3/0
Over 600 Kcmil through 1100 Kcmil	Over 900 Kcmil through 1750 Kcmil	2/0	4/0
Over 1100 Kcmil ¹	Over 1750 Kcmil ¹	3/0	250 Kcmil

¹ Equipment bonding jumper for this category shall be not less than 12-1/2% of the area of the phase conductors of the same materials.
 Note: 1. Where multiple sets of service-entrance conductors are used as permitted in 230.40, Exception No. 2, the equivalent size of the largest service-entrance conductor shall be determined by the largest sum of the areas of the corresponding conductors of each set.

2. Where there are no service-entrance conductors, the grounding electrode conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.
^a This table also applies to the derived conductors of separately derived AC systems.



**Figure 3-1
Overhead Service**

Note: *Ground rods are only required if they are supplementing a water service that was utilized as a grounding electrode or if it is the primary and sole grounding electrode.

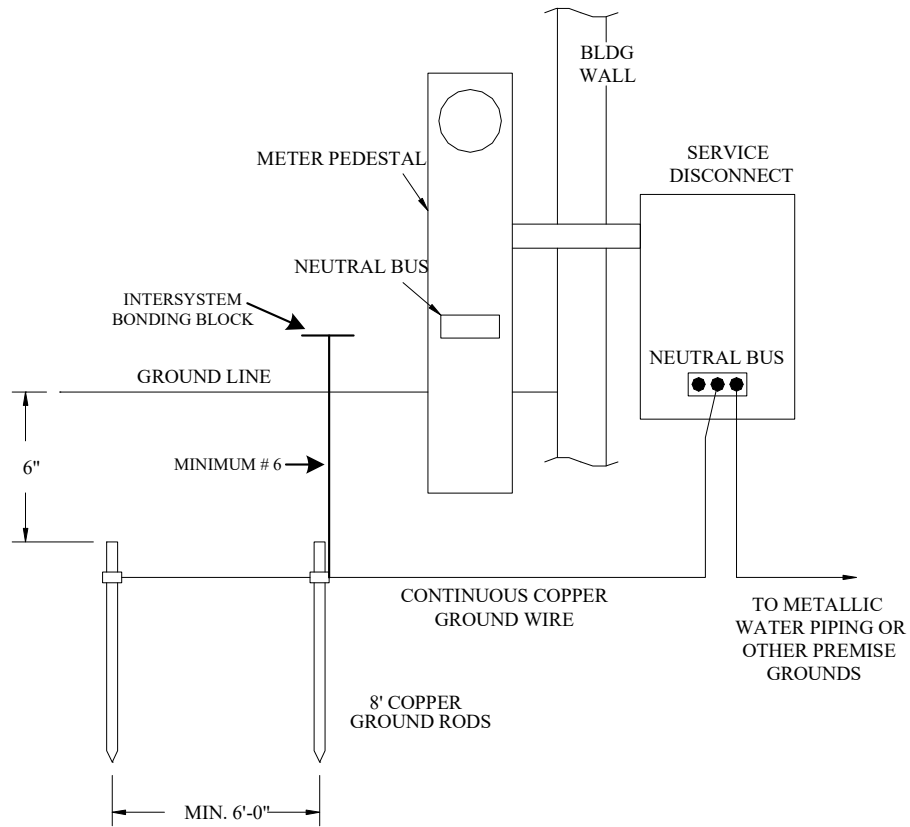


Figure 3-2
Underground Single-Family Without Service Disconnect in Meter Pedestal
 Note: *When two ground rods are applicable

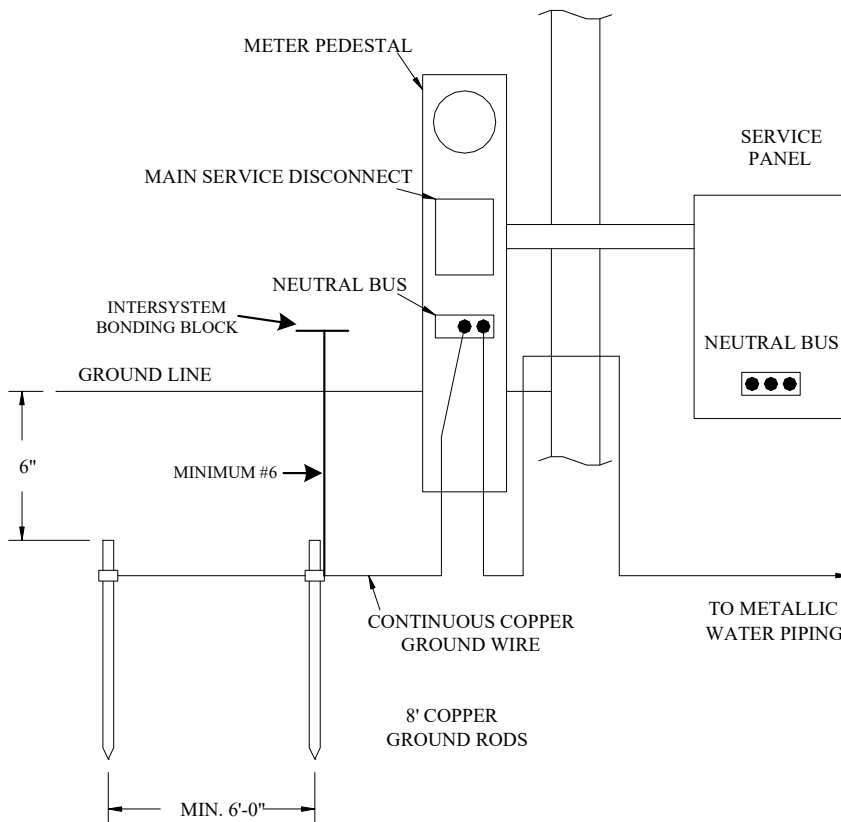
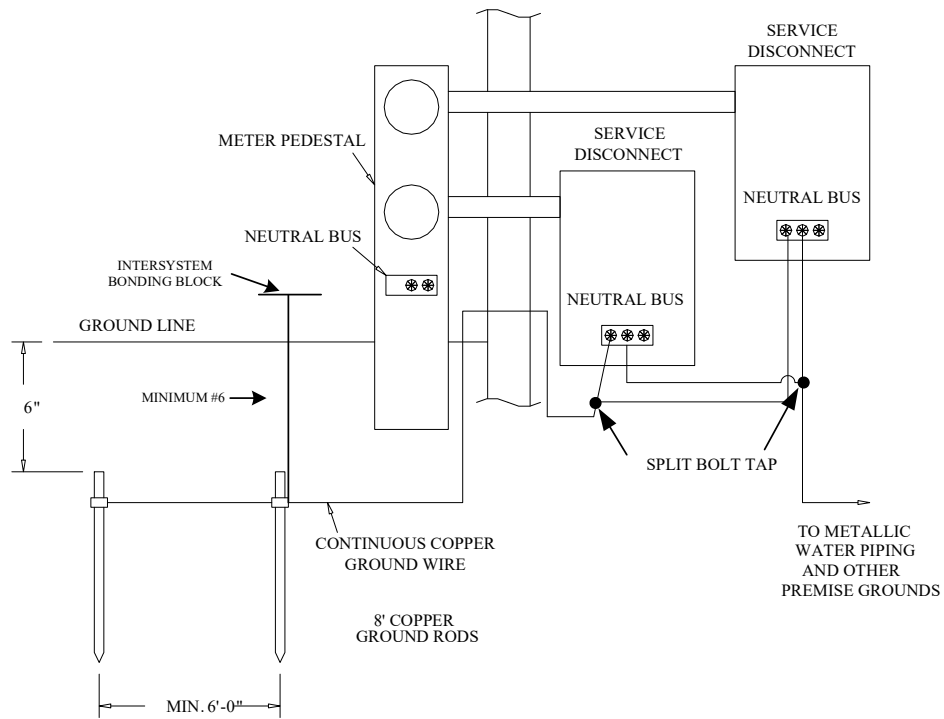


Figure 3-3
Underground Single-Family With Service Disconnect in Meter Pedestal
 Note: *When two ground rods are applicable

The service disconnect shall be located in the meter pedestal if the raceways containing service conductors or cables, or service entrance cable not contained within a raceway extends longer than 8 feet into a building to the service disconnect. [SPS 316.230 (3) (b)] A service disconnect with overcurrent protection is required on all self-contained metering installations where the conductors go underground after leaving the meter socket, the over current disconnect maybe eliminated if the conductors are installed in conduit, a red caution tape is installed in the trench 1 foot below grade, and the conduit route is parallel with and within 2 feet of the building wall. Transformer rated installations with multiple services originating from one transformer will be evaluated at time of design to determine if a disconnect is required.



NOTE: Wires to ground rods and to waterline are un-spliced. Both un-spliced wires can originate from one panel. Then, run two wires out of the other panel and "tap" to these un-spliced wires.

Figure 3-4
Underground-Two Family Residential
 Note: *When two ground rods are applicable

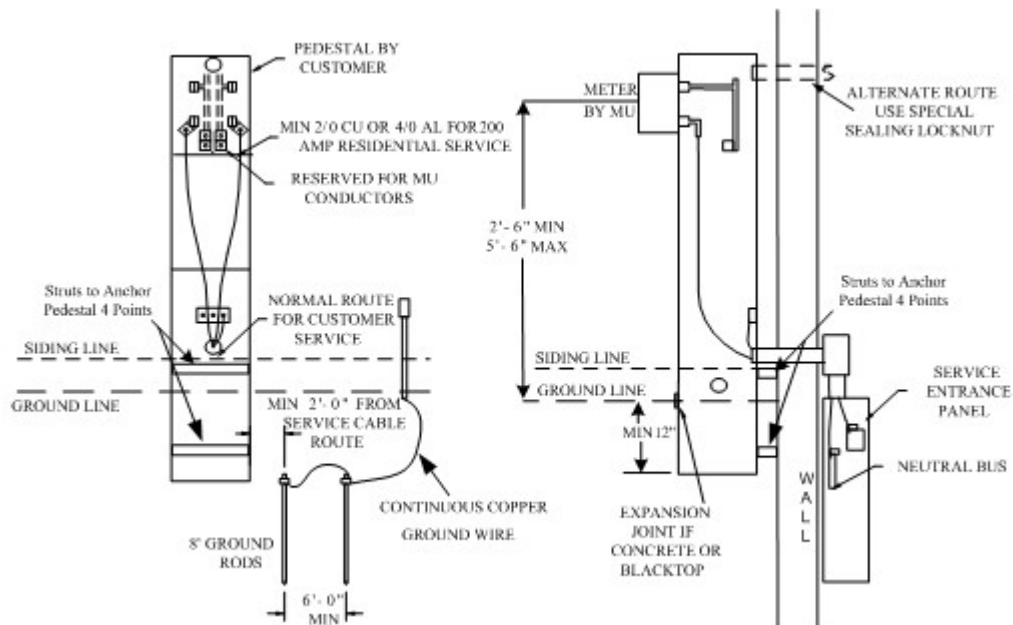


Figure 3-5

200 Ampere Single Phase Underground Service

Note: *When two ground rods are applicable

The main disconnect must be located within 8 feet of where the services entrance cable or raceway enter the building. Figure 3-5 depicts the main entrance in the traditional location. Also consult the previous sections of this chapter for proper sizing of the grounding conductor. All new and upgraded underground services shall be installed to the existing foundation wall by means of two (2) horizontally or vertically installed pieces of unistrut with four points of contact and secured at the top of the meter pedestal per manufacture requirements. Treated Lumber will not be accepted.

3.1.3 200 Ampere Single Phase Underground Service with Main Breaker

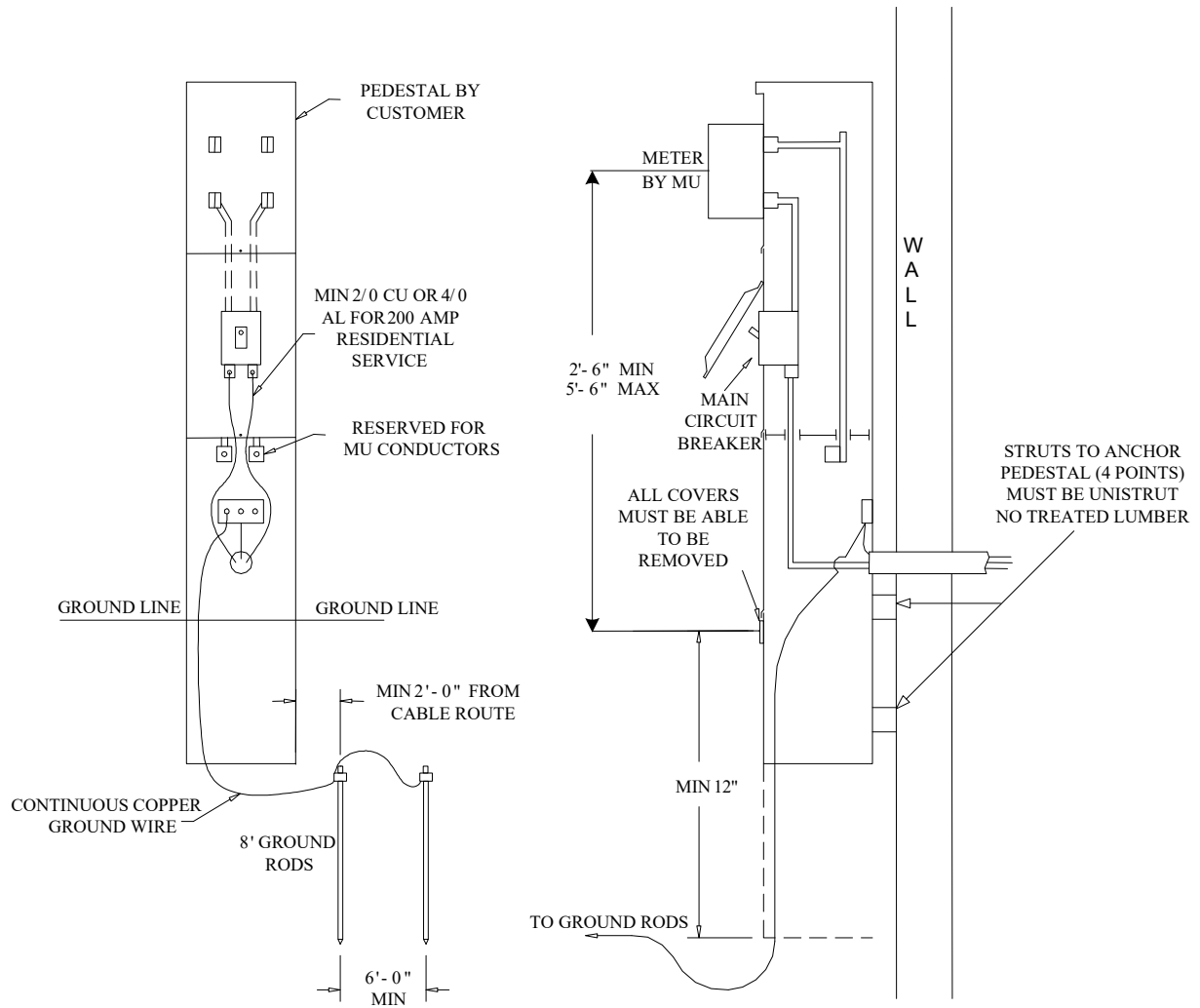


Figure 3-6
200 Ampere Single Phase Underground Service with Main Breaker

Note: *When two ground rods are applicable

Figure 3-6 is applicable for underground service where the main breaker is an important part of the outdoor underground service pedestal. See also Section 3.1 - Figures 3-2 and 3-4 for the more common underground service with an indoor main breaker(s). If this equipment is freestanding, see figure 3-11.

3.1.4 100-200 Ampere Single-phase Overhead Service

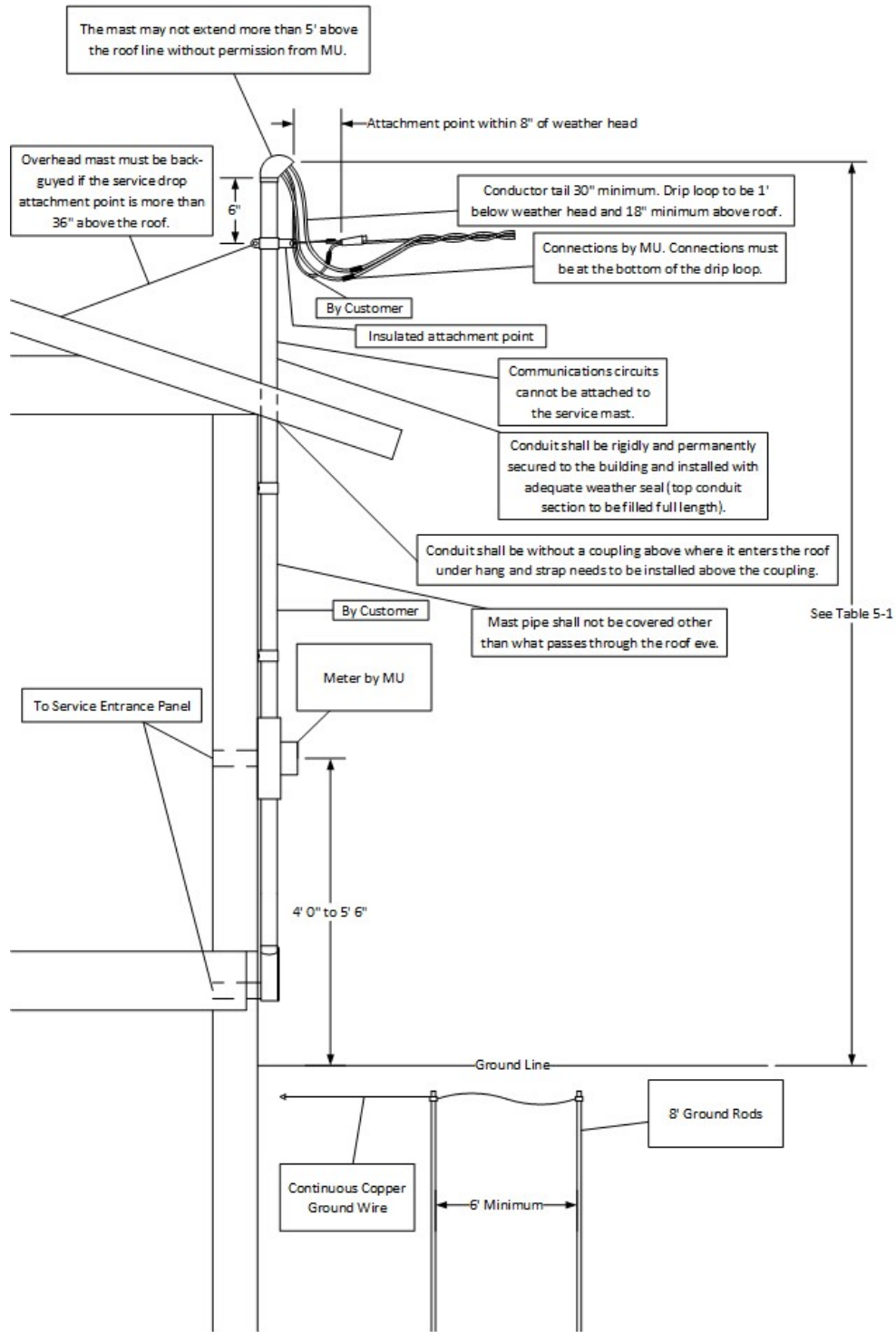
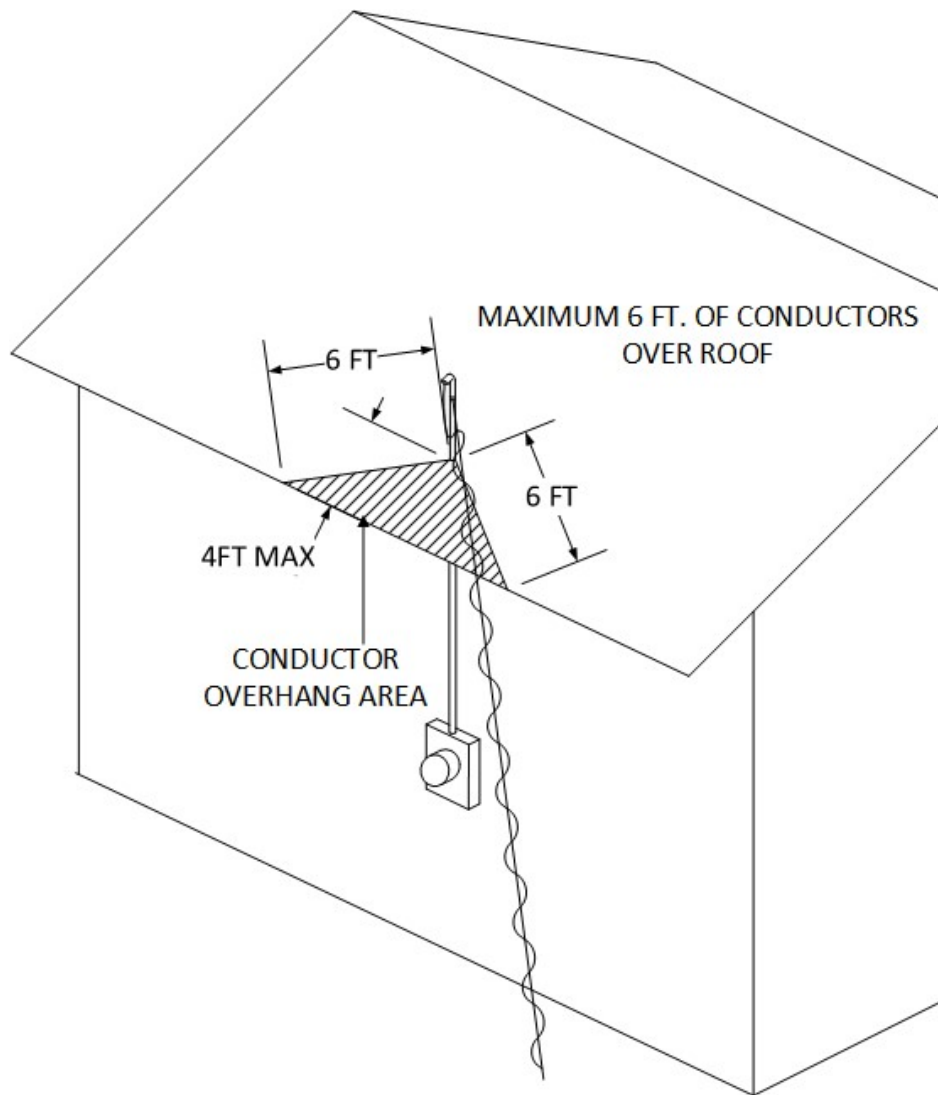


Figure 3-7 (a)
100-200 Ampere Single-Phase Overhead Service

Note: *Schedule 80 PVC if mast terminates below roof and Rigid if conduit is utilized as an attachment



ROOF MUST HAVE A 4/12 PITCH TO USE CLEARANCES IN
NEC 230.24 (A) EXCEPTION NO. 3

Figure 3-7 (b)

100-200 Ampere Single Phase Overhead Service

Figures 3-7 (a) and 3-7 (b) Shows a typical overhead single-phase 120/240-volt 3-wire service arrangement. See Table 3-3 for overhead line clearances and separations.

Table 3-3 Service Drop Clearance Requirements (Minimum Clearance at Maximum Load and Temperature)	
1.	In general, service conductors must maintain 8 feet over roofs. (NEC 230.24 (A))
2.	Where the voltage between conductors does not exceed 300 volts, a reduction in clearance above only the overhanging portions of the roof to not less than 18 inches shall be permitted if (1) not more than 6 feet of overhead service conductors, 4 feet horizontally, pass above the roof overhang, and (2) they are terminated at a through-the-roof raceway or approved support. (NEC 230.24 (A) Exception #3)
3.	Where the voltage between conductors does not exceed 300 volts and the roof has a slope of 4 inches in 12 inches or greater, a reduction in clearance to 3 feet shall be permitted. (NEC 230.24 (A) Exception #2)
4.	The drip loop and service conductor must have at least a 3 feet separation in any direction from windows, doors, porches or similar structures. An exception is granted for a window that does not open or the top edge of a window.
5.	The drip loop and service conductor shall have a separation of at least 12 inch to any communication circuits.
6.	Communication, telephone, cable TV, and customer-owned cables shall not be attached to the service mast. (NEC 230.28)
7.	Raceways containing service conductors or cables, or service entrance cable not contained within a raceway, may not extend longer than 8 feet into a building to the service disconnect or the first service disconnect of a group disconnects as permitted by NEC230.71
8.	The customer's neutral conductor shall be identified by white tape, white insulation, white paint, or other techniques permitted by NEC Article 200.
9.	An overhead service may be attached to a customer-owned pole or post provided that the pole or post is treated with a wood preservative, is back-guyed, and the pole/post has a minimum of a 5 inch diameter top.
10.	The customer is responsible to provide and install an insulated attachment point either located on the service mast or a screw knob that will support MU's service conductors.
11.	No portion of the service mast pipe, except the portion extending through the roof eve/overhang, should be covered.

3.1.5 Temporary Service

Temporary Service Requirements Include:

1. MU shall specify the location of temporary service pole(s) or meter pedestal to avoid clearance problems. The temporary service pole or meter pedestal will need to be clear of the route for permanent service.
2. Meter sockets shall be rated 100 or 200 ampere, be UL approved, of ringless design, and have bypass horns or a manual lever bypass.
3. The distribution panel must be weatherproof or protected from the elements, have ground fault protection with proper protective covers on all outlets, and be installed so as to comply with all electrical codes.
4. For residential temporary services, entrance conductor shall be a minimum of #4 copper or #2 aluminum for 100-ampere service and 2/0 copper or 4/0 aluminum for 200-ampere service. For commercial temporary services, entrance conductors shall be #3 copper or #1 aluminum for 100-ampere service and 3/0 copper or 4/0 aluminum for 200-ampere service. The customer must provide protection for cable and conductors that is acceptable to the local electrical inspector and/or MU.
5. Two ground rods are required in addition to a bond to metallic water piping, if present, for grounding. The grounding electrode conductor should be terminated in the distribution panel and not run through or terminate in the meter socket.
6. The temporary service pole shall be at least 5 inches in diameter at the top. Three 2" x 4" will meet this requirement. Bracing and stakes shall also be of 2" x 4" construction.
7. Only MU will make connections to MU system.
8. Junk, unserviceable, or inadequate capacity equipment such as 60-ampere meter sockets and/or indoor 60-ampere fuse panels are not acceptable for temporary service. If MU must make return trips because of clearance problems, or unsafe or otherwise inappropriate equipment, MU will apply additional charges.
9. Temporary services are for short-term use. If a temporary service is expected to be used longer than 90 days, it shall be installed as a permanent service.
10. Temporary service may be allowed on utility poles on a case-by-case basis with Utility permission.
11. Temporary services shall not utilize the permanent meter socket mounted on the house to provide a route into the house. The permanent meter socket must be kept unused until the permanent service conductors are installed.

Note: The NEC requirements are the same for temporary service as for permanent service.

Figures 3-8 (a), (b), (c) and (d) on this and the following pages show temporary overhead and underground service arrangements that MU would accept.

Note: *When two ground rods are applicable

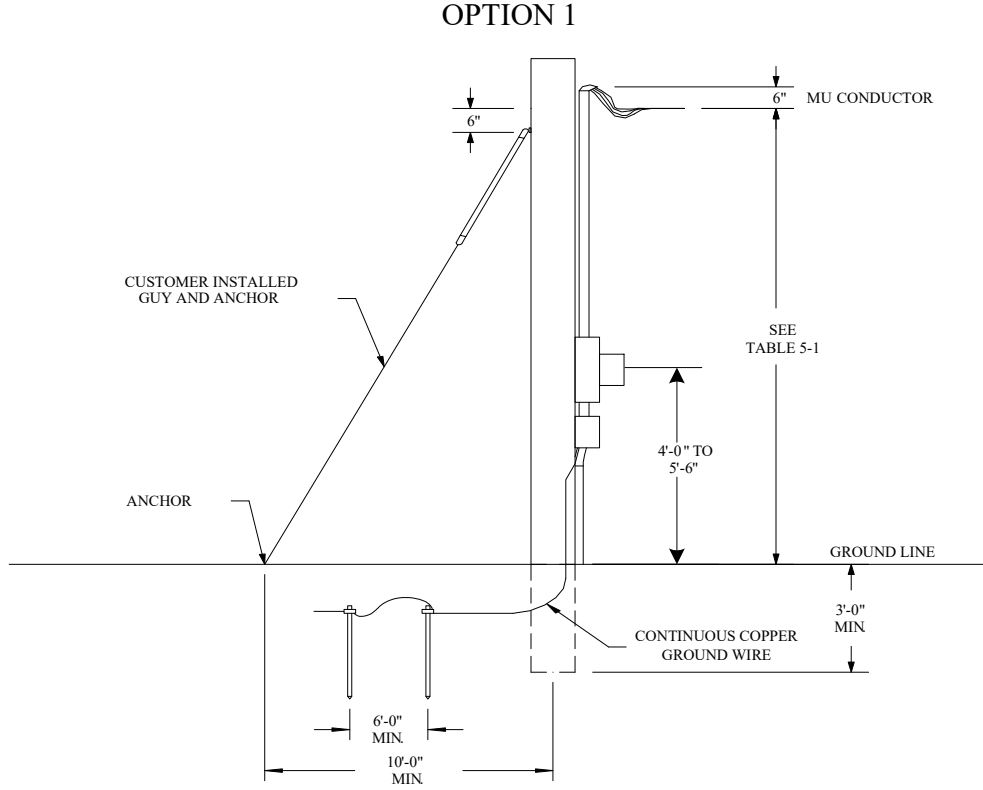


Figure 3-8 (a)
Temporary Overhead Service Options
OPTION 2

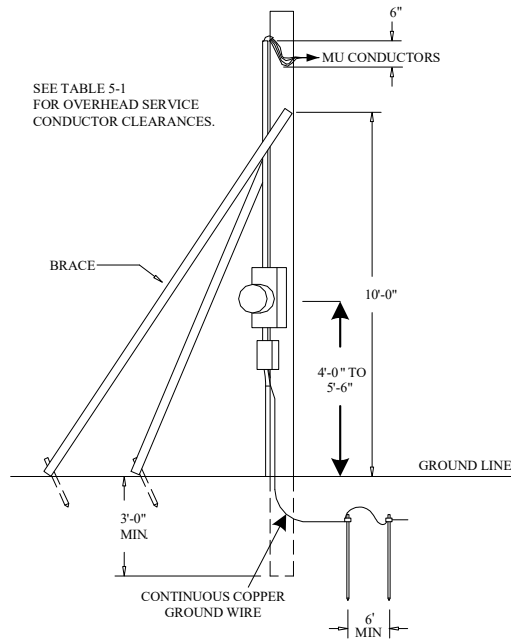


Figure 3-8 (b)
Temporary Overhead Service Options
OPTION 3

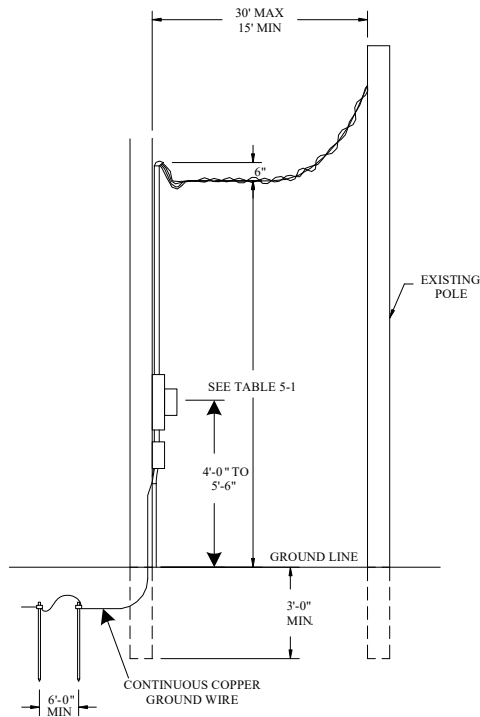


Figure 3-8 (c)

Temporary Overhead Service Options

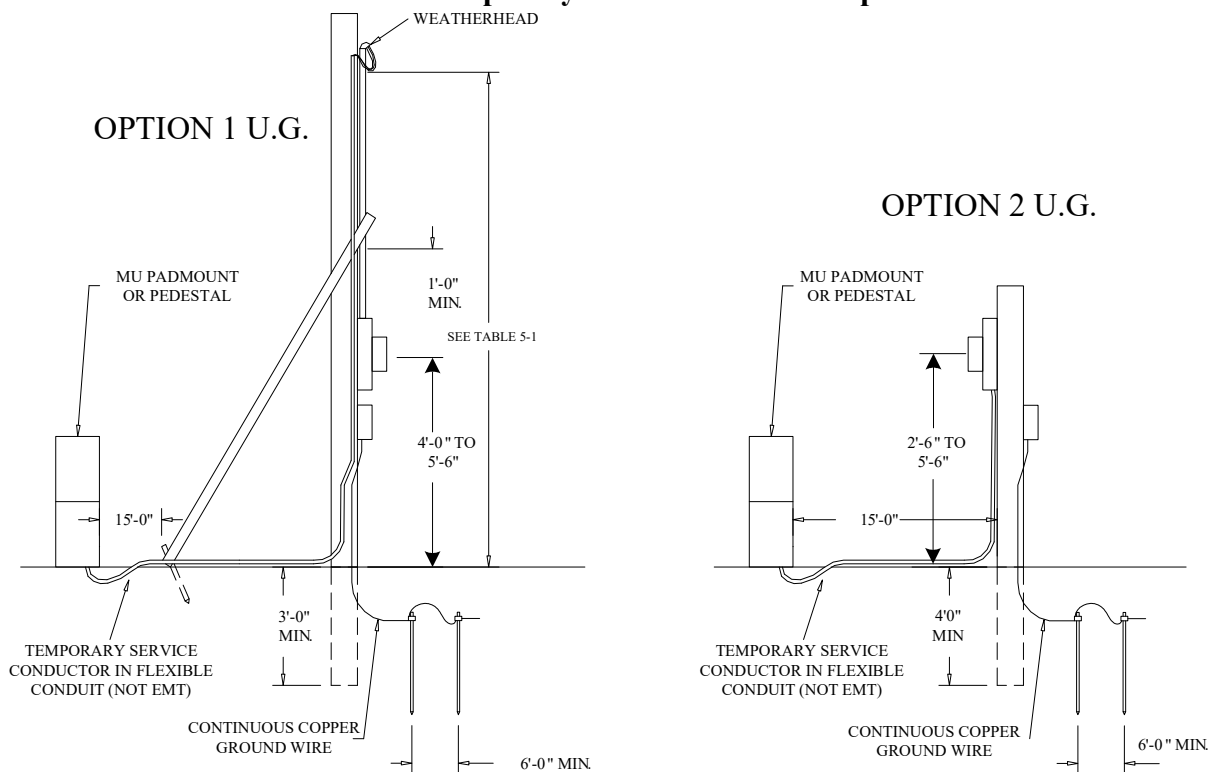


Figure 3-8 (d)

Temporary Underground Service Options

3.1.6 Permanent/Temporary Underground Service

The customer may install a permanent meter pedestal and breaker panel as shown in Figure 3-9 and avoid using a temporary service. The breaker panel must be weatherproof or protected from a wet or damp environment. To utilize this option, the basement walls must be backfilled and tamped for MU to run a permanent underground service. See permanent underground services for additional requirements.

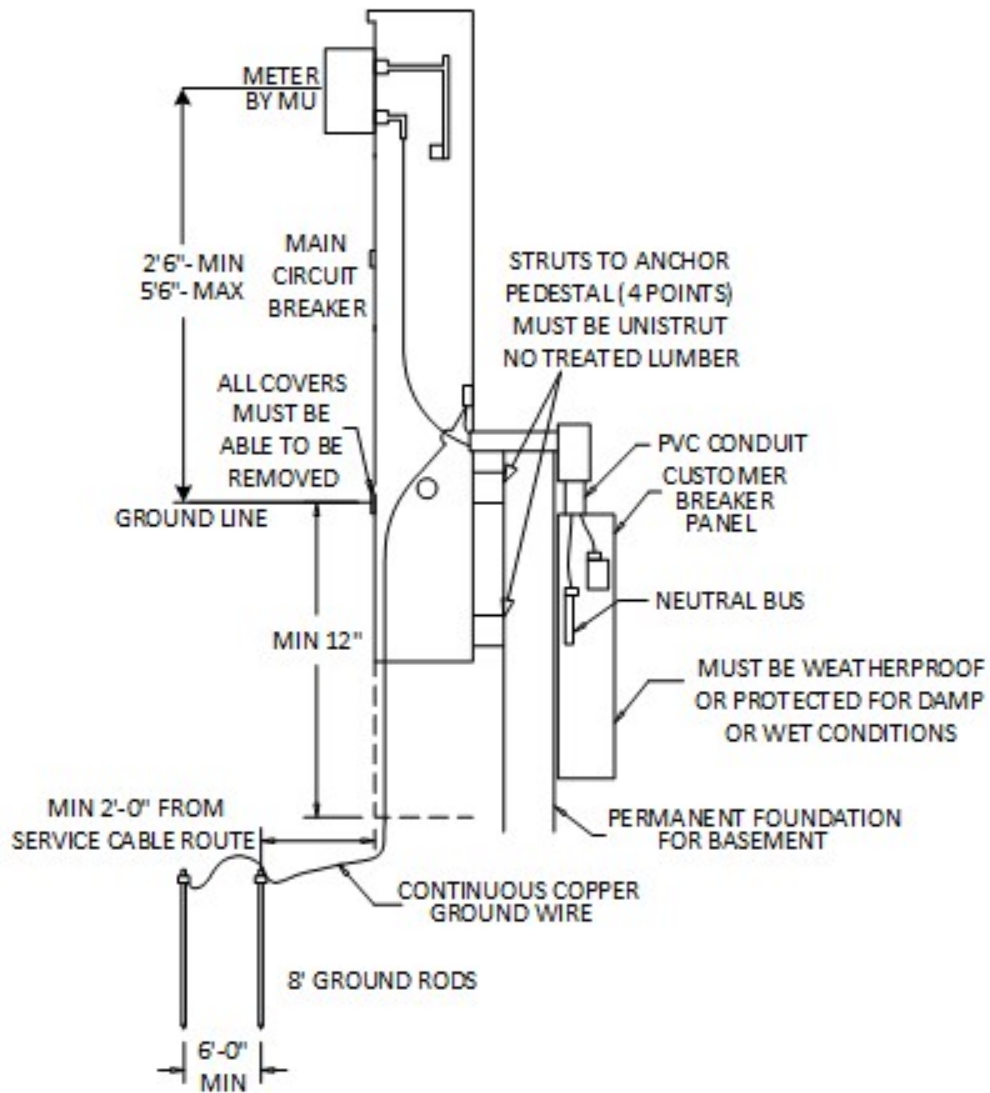


Figure 3-9

Temporary/Permanent Underground Service Option

Note: *When two ground rods are applicable

3.1.7 Mobile Home Services

A mobile home is defined by NEC 550.2 to be: "a factory-assembled structure or structures transportable in one or more sections, that are built on a permanent chassis and designed to be used as a dwelling without a permanent foundation where connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electric systems contained therein. For the purpose of this code and unless otherwise indicated, the term "mobile home" includes manufactured homes".

Mobile homes, if the axles, wheels, and/or tongue are still in place are considered movable. The code authority, local or state inspector should be consulted for the applicable code sections if the mobile home has been rendered immovable. MU will consider all manufactured homes to be mobile homes unless the code authority issues an opinion to the contrary.

Mobile home service extensions shall comply with the following standards:

1. MU will spot the location of the service entrance facilities to comply with all code clearances. The customer will install the mobile home service pedestal(s) with the meter pointed toward the driveway or street. The customer shall also label the pedestal to identify the mobile home being served where it is not obvious.
2. Other NEC 550.32 requirements for mobile home service are:
 - a. Service will be 120/240-volt single phase.
 - b. The service entrance equipment must be rated 100 amperes or greater, be waterproof, and be mounted at least 2 feet above finished grade level.
 - c. The service entrance equipment cannot be mounted on the mobile home, must be within sight of the mobile home, but not more than 30 feet from the mobile home.
 - d. The entrance panel must have at least a 50 ampere 120/240 volt breaker.
 - e. The electrical panel shall have branch circuit capability for serving an accessory building, structure, or additional electric equipment. The entrance equipment should also have provisions for serving an outdoors 15 or 20 ampere, 120-volt GFI outlet.
 - f. Two 8 foot ground rods with a minimum 6 feet separation shall be installed for grounding. The grounding electrode conductor shall be at least #6 copper enclosed in PVC conduit and terminated in the service panel without entry into or connection to the meter socket.
 - g. The customer cable or cord from the entrance panel shall have an equipment ground, neutral conductor, and two hot conductors.
3. Figure 3-11 shows the freestanding meter pedestal support post installation requirement.
4. Adequate clearances and separations must be followed. See Section 5 on clearances.

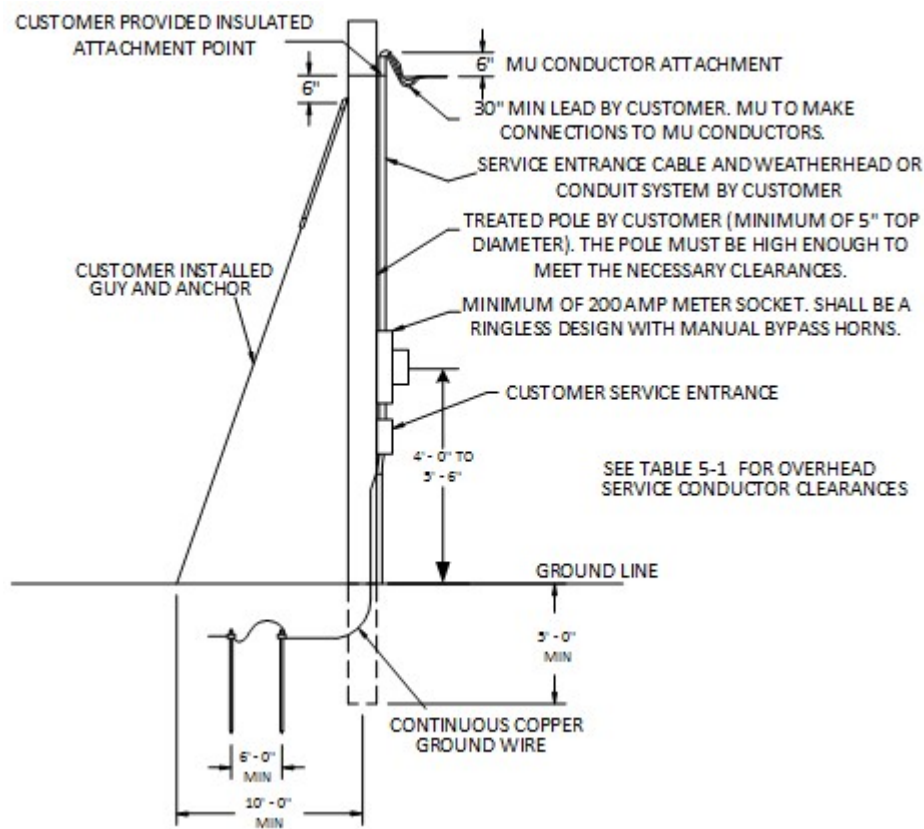
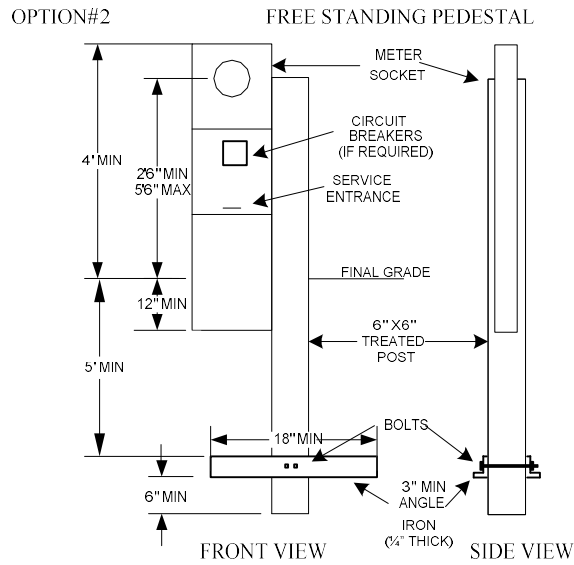
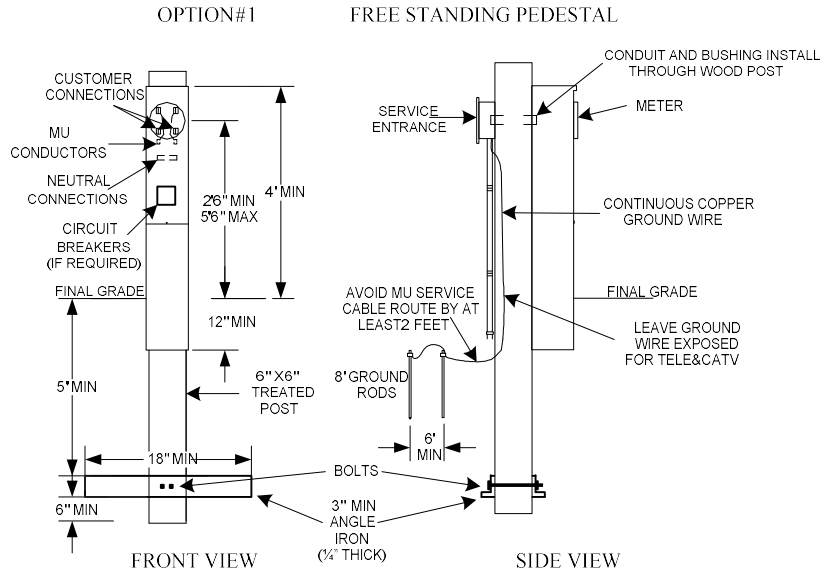


Figure 3-10
 Typical Overhead Service Arrangement
 Note: *When two ground rods are applicable



NOTE: FOR BOTH OPTIONS POST SHOULD BE WRAPPED A MINIMUM OF TWO TIMES WITH A MINIMUM OF 6 MIL PLASTIC BETWEEN THE GROUNDLINE AND THE ANGLE IRON

**Figure 3-11
Free Standing Pedestal Options**

3.2 Single Phase 120/208 Volt Network Service (0-200 Ampere)

This voltage is common near commercial areas and in multi-unit condominium/apartment developments. Single-phase service is limited to a maximum of 200 amperes. Larger installations shall use a three-phase service to supply single-phase loads and metering with the total load balanced on all three phases.

The fifth jaw shall be added to single-phase 120/240-volt meter sockets for 120/208 single-phase service. The fifth jaw shall be added at the 9 o'clock position, anchored to the meter socket, and secured as shown in Figure 3-12. The customer should purchase the fifth jaw from the supplier of the meter socket.

METER SOCKET - SINGLE PHASE 120/208 VOLT NETWORK SERVICE

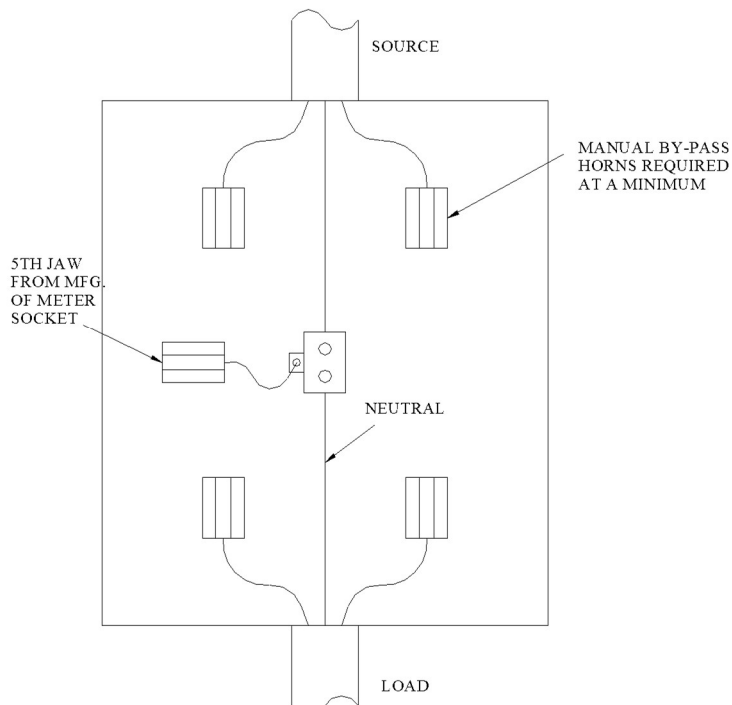


Figure 3-12
Single Phase 120/208 Network Meter Socket

3.3 Single Phase Service Installations for 2-4 Meters

Meter sockets must be ringless style, 200 amp minimum rating (main bus), clamp type jaws, and sealable with wrench-operated connectors. See Section 3.1.4 for underground service requirements and Section 3.1.5 for overhead service requirements.

Figure 3-13 shows a typical two-meter arrangement.

Each meter position must be permanently labeled with the address or apartment number **on the inside and on the exterior** of the meter socket identifying the service panel. If possible, avoid exterior labeling on removable portions of the socket. Meters will not be set until the meter socket has been permanently labeled and the office has a listing of the service addresses. See table 4-1 for additional requirements for multiple meter installations.

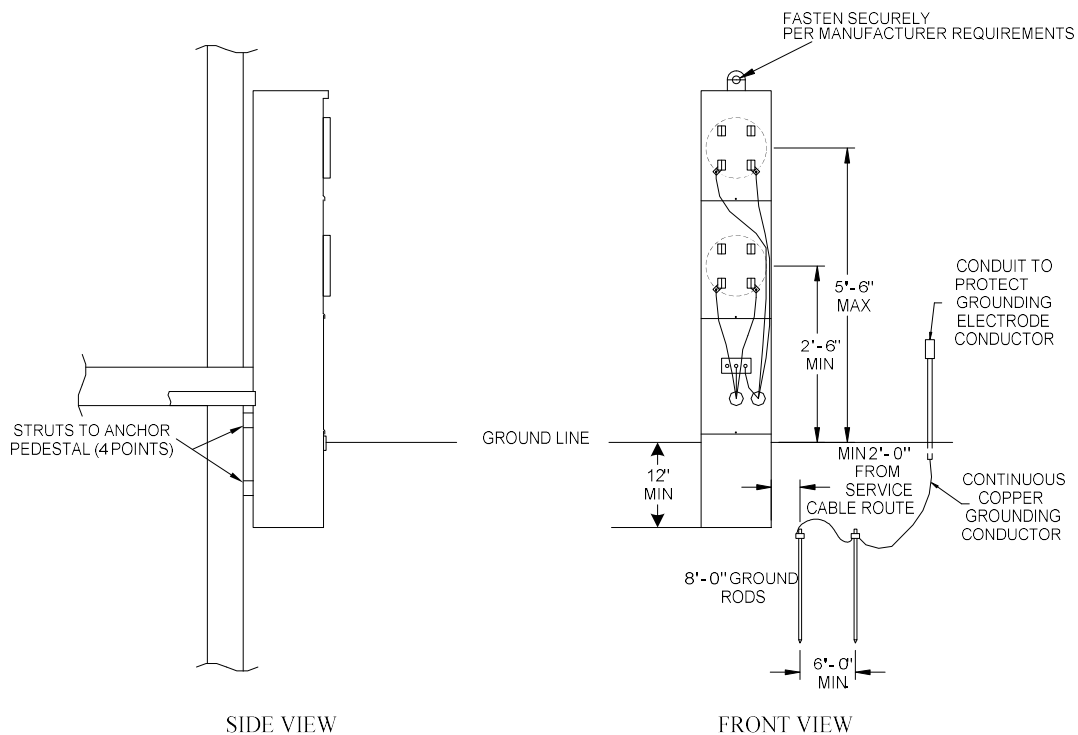


Figure 3-13
Typical Two-Meter Pedestal Installation
Note: *When two ground rods are applicable

3.4 400 Ampere Single-Phase Residential Service

Residential 400-ampere service will be supplied at 120/240 volts with a 320-class meter. Clearance, separation, and grounding requirements are the same as for other 120/240-volt single-phase services.

The meter socket shall meet the following specifications:

1. Socket must be of the ringless type.
2. Socket must be heavy duty with studs and replaceable lugs or crimped on connectors.
3. Socket must include a lever bypass that releases the jaws when in the bypass position.
4. All 400-ampere sockets must include an anti-inversion kit installed by the contractor or manufacturer to prevent installation of a 200-ampere meter and inversion of a class 320 meter.

All single-phase residential services exceeding 200 amperes will use class 320 meters instead of an instrument transformer metering installation. Commercial installations over 200 amperes will be evaluated to determine if the class 320 meter will be adequate. All three-phase services exceeding 200 amperes will be metered with instrument transformers.

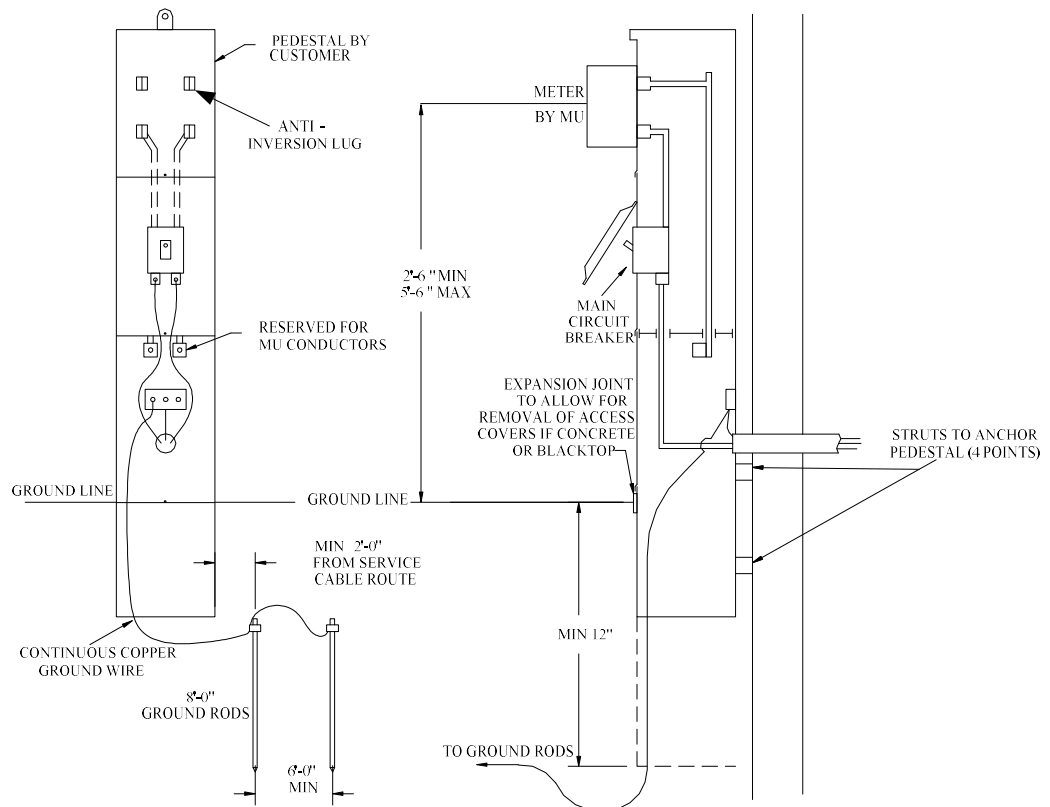


Figure 3-14 (a)

400 Ampere Single Phase Underground Service with Main Breaker

Note: *When two ground rods are applicable

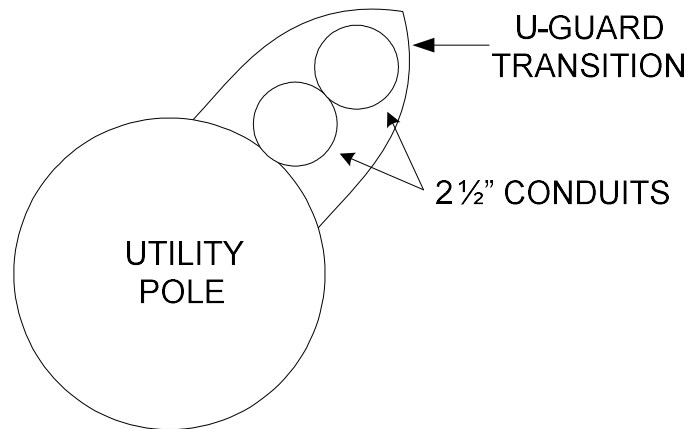


Figure 3-14 (b)
400 Ampere Single Phase Underground Service Conduit Location at Utility Pole

3.5 Underground Electric Service Guidelines

MU’s standard service lateral will be single phase, 200 ampere consisting of up to 100 feet (trench length) of 4/0 aluminum triplex installed in 2-1/2 inch schedule 40 PVC or 2 inch HDPE conduit from the meter pedestal to our equipment. The route for the standard underground service shall be frost free. All services are to be buried to a minimum depth of 30 inches regardless of size. Red caution tape must be installed no less than 1 foot below grade and no less than 1 foot above service. Schedule 80 conduit is required if the conduit is exposed. The meter pedestal will be installed in a location approved by MU to minimize the service route. MU will calculate the nominal cost of the standard underground service on an annual basis.

All requests for new service connections must be made a minimum of ten (10) business days prior to the desired connection date. Sufficient notice is required on services larger than 200 amperes to ensure that any necessary preparations can be made. Given sufficient notice, MU will make every reasonable effort to ensure that the service lateral is installed within the allotted time. The services will normally be installed in the order that they are inspected and approved for installation. Request for permanent service must be made at Marshfield Utilities. In general, frost conditions usually are encountered around November 15th. It is possible frost conditions could be encountered before that date. Services installed in frost/frozen ground will result in extra charges to the customer and customer must sign a waiver cost sheet before the service will be installed.

Underground service will be installed in a timely manner as schedule and weather conditions allow. A minimum of three (3) days is required to call in locates.

Customer Requirements

1. The customer shall furnish and install a utility approved meter pedestal (200 amperes min).
2. All work must conform to national, state, and local regulations.
3. The meter shall be located at least 3 feet from an existing deck, patio, or door. This clearance may be reduced in certain situations. Contact MU for approval before installation. The preferred location for new services will be on the front or sides of the house. Rear house locations are discouraged. Existing services may remain in the rear but should be relocated to the side or front if there are possible encroachment issues such as decks, A/C units, etc.
4. A 12 foot wide service installation route shall not be under any existing or proposed structure or deck and must be clear of trees, stumps, or any other obstruction. The route must be level, within 3 inches of finished grade, and frost free.
5. All conductors and connections on the load side of the meter socket are the responsibility of the customer.
6. Final restoration of the service lateral route is the customer's responsibility.
7. After installation, the customer must keep a 12 foot (6 feet either side) clear zone along the route of the underground service lateral. All obstructions, including storage sheds, garages, decks, or patios must be kept out of this zone.

Standard Underground Service Installation

MU will install or arrange for the installation of the standard service lateral. Customers will not be allowed to install these service laterals. Customers will be charged additional fees if the installation cost exceeds MU's calculated nominal cost for a standard underground service. Additional expenses may result from, but are not limited to, road or sidewalk bores, concrete or asphalt replacement, improper fill, rocky conditions, or extremely wet conditions. Customers will always be responsible for any additional fees due to frost or frozen ground. The metering point designates the point of ownership change between MU and the customer. Service laterals after the metering point will be owned and maintained by the customer. MU will terminate both ends of utility installed service laterals.

Non-Standard Underground Services

On single-phase services over 200 amperes and all three-phase services, the customer will provide the service lateral installation to include trench, conduit, and conductors installed to MU specifications. Conduits and conductors must be proper size and type to meet all applicable codes. Conduits at poles should extend approximately 3 inches above final grade. Contact MU for location where conduit should come up on pole. The electrical inspector will approve all installations in the City of Marshfield before connection by Marshfield Utilities. The customer is responsible for terminating the service lateral conductors at the customer end and Marshfield Utilities will terminate at MU end. Each will provide Utility approved termination lugs for the applicable terminations. Marshfield Utilities will assume ownership of the service once installed and accepted, and will maintain the service lateral. The metering point will be the point of ownership change on all services. Service lateral installations with the meter at the transformer will be owned and maintained by the customer. The customer will receive an allowance for the cost of a standard service lateral based on the actual length. Table 3-4 shows MU's standard service wire and conduit sizes for service entrance sizes ranging from 200 – 3,000 amperes.

Existing Services

Marshfield Utilities will assume ownership and be responsible for any required replacement of existing service laterals. The customer is responsible for the maintenance and replacement of the meter socket and all wiring on the load side of the meter socket. Service laterals that need to be relocated at customer request will need to be replaced at customer expense. "Zero-length" services where the meter is located on one pole ahead of the service will be replaced as needed and considered as new services.

Costs associated with moving meters or service laterals which are infringed upon by decks, storage sheds, etc., or that do not meet other code/MU requirements will be borne by the customer unless a written variance had been granted by MU. The customer is responsible for removing any obstructions along the service lateral route as required in the future for maintenance or replacement. If MU removes or contracts the removal of obstructions, the customer will be responsible for the cost. If a service fails in an area that is not accessible because of an obstruction the customer will be responsible for the replacement of the service. The service will not be spliced and partially rerouted around the obstruction. Existing installations requiring maintenance will be subject to the same restrictions and guidelines as a new service. This includes replacement of the meter socket with a meter pedestal when the service lateral or the service entrance conductors are replaced.

Overhead to Underground Conversions

MU will install the standard service laterals per all applicable requirements of the new service lateral installations. The customer will pay the full cost of the underground service lateral, less the cost of an equivalent overhead service drop not to exceed 100 feet. This cost will be recalculated on a per foot basis each year. MU will install the standard underground service lateral where the customer is upgrading their service entrance equipment, which normally includes the main distribution panel and meter equipment from a 100 amp or less service to a 200-amp service.

Underground Service Upgrades

Underground service lateral upgrades to 200 amperes required because of increased loads will be installed by MU per all applicable requirements of the new service lateral installation, at no cost to the customer. MU will make the determination as to whether the existing service lateral is adequate or in need of upgrade. Upgrades to services in excess of 200 amperes will be handled as a new non-standard service.

Maximum Service Lateral Length

A maximum service lateral length has been established as a guideline for standard residential 4/0 underground service. Service laterals in excess of this length or services with higher than normally anticipated electric loads should be evaluated on a case-by-case basis. This would apply to any air conditioning loads that exceed 3 tons. These service laterals may need to be upgraded to 400 amperes or may require an extension of the primary line.

Service laterals extending directly from a transformer should be limited to 250 feet. Service laterals extending from a pedestal should not exceed 150 feet. Longer lengths are acceptable if service loading is to be significantly lower than normal.

Table 3-4				
Acceptable Underground Service Lateral Configurations				
<u>Rated Amps</u>	<u>Min. Conduit Size</u>	<u>Aluminum Conductor</u>	<u>Copper Conductor</u>	<u>Compact AL Conductor</u>
200 (1Ø)	2 ½"	1 – 4/0 AWG	1 - 3/0 AWG	1 – 4/0 AWG
200 (3Ø)	2 ½"	1 – 4/0 AWG	1 - 3/0 AWG	1 – 4/0 AWG
400 (1Ø)	(1) 4"	-----	1 - 500 kcmil	-----
	(2) 2 ½"	2 – 4/0 AWG	2 – 3/0 AWG	2 – 4/0 AWG
400 (3Ø)	(1) 4"	-----	1 - 500 kcmil	-----
	(2) 2 ½"	2 – 4/0 AWG	2 – 3/0 AWG	2 – 4/0 AWG
600 (1Ø)	(2) 4"	2 – 400 kcmil *	2 – 300 kcmil	2 – 400 kcmil *
600 (3Ø)	(2) 4"	2 – 400 kcmil *	2 – 300 kcmil	2 – 400 kcmil *
800 (3Ø)	(3) 4"	3 – 400 kcmil	2 – 500 kcmil	3 – 400 kcmil
1200 (3Ø)	(4) 4"	4 – 500 kcmil	3 – 600 kcmil	4 – 500 kcmil
1600 (3Ø)	(5) 4"	5 – 600 kcmil	4 – 600 kcmil	5 – 600 kcmil
2000 (3Ø)	(6) 4"	6 – 600 kcmil	5 – 600 kcmil	6 – 600 kcmil
3000 (3Ø)	(9) 4"	9 – 600 kcmil	8 – 500 kcmil	8 – 750 kcmil
Acceptable Overhead Service Lateral Configuration				
All services	Per NEC	500 kcmil or less	500 kcmil or less	500 kcmil or less

For any other conductor sizes, consult with MU.

Each parallel run of conductors shall have its own conduit.

* Acceptable if load calculation is 540 amperes or less

For residential consult Table 3-1

Allowable conductor sizes for underground AL and CU service conductor: 4/0, 250, 300, 350, 400, 450, 500, and 600.

Allowable conductor sizes for underground compact AL service conductor: 4/0, 350, 400, 450, 500, 600, and 750.

3.6 Voltages or Phase Conversion (Load Balance)

All 3 phase customers are required to balance their loads in accordance with table 3-5. Customers changing from a Delta voltage such as 120/240 to a Wye voltage such as 120/208 or changing from single phase to three-phase service will generally accomplish load balance by replacing any single-phase distribution panels with three phase distribution panels. It is acceptable to distribute existing or planned single phase panels across the 3 phases to meet the listed requirements if a sufficient number of single-phase distribution panels are involved. The main distribution panel must be three phase.

Table 3-5 Three Phase Load Balance Requirements	
Actual Load	Maximum Difference Between Phases
Under 100 amps	20%
100-200 amps	15%
Over 200 amps	10%

The percent difference calculation is:

$$\% \text{ Difference} = \left(\frac{\text{Amps High Phase} - \text{Amps Low Phase}}{\text{Amps High Phase} + \text{Amps Low Phase}} \right) * 200$$

3.7 Pad-mounted Transformers

Refer to Section 5.2 for separation and clearance requirements for the location of pad-mounted transformers near buildings, which are taken from Volume 1 of the Wisconsin State Electrical Code. In general, 3 feet on the sides and back and 12 feet in front of the transformer pad must remain clear at all times.

Protective posts are required where pad-mounted transformers, poles, and related utility equipment are subject to vehicular traffic. The cost associated with installation of these protective posts is the responsibility of the customer. If MU has to install this protection, the cost will be billed to the customer or included in the service extension contract. Figure 3-16 shows how the posts should be installed.

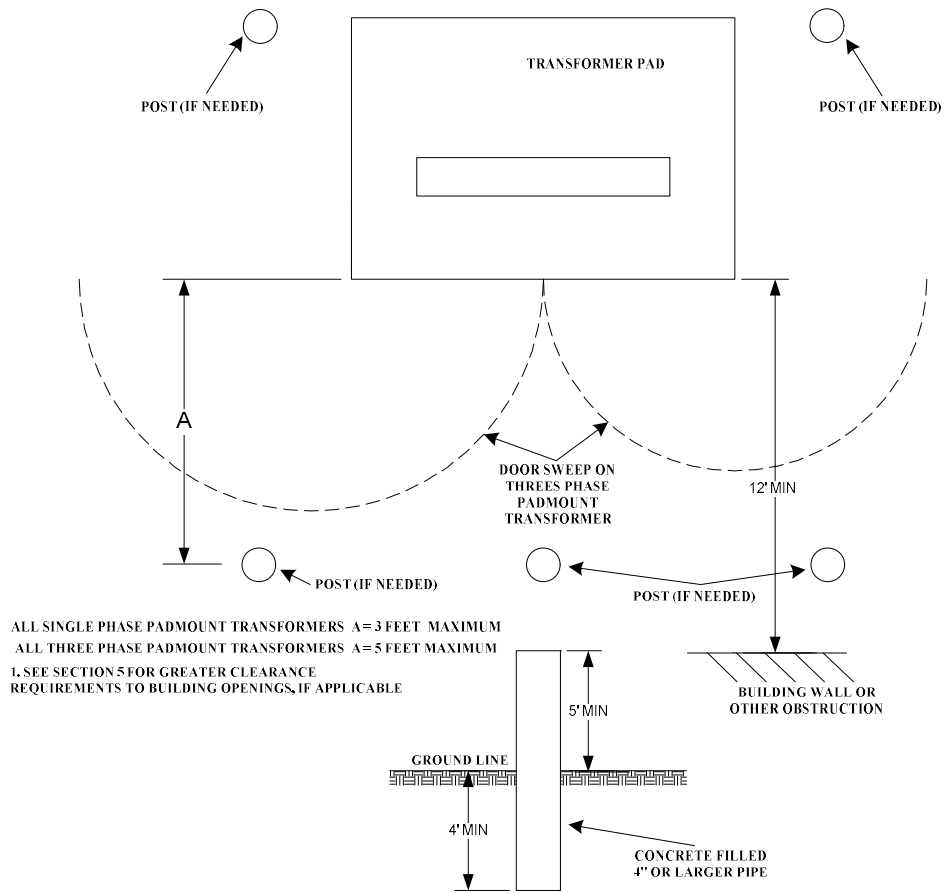


Figure 3-15
 Protective Posts for Pad-mounted Transformers

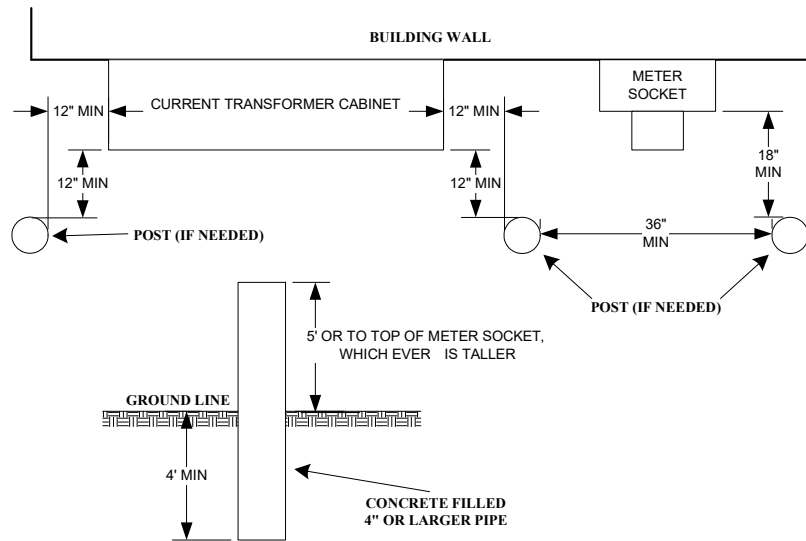
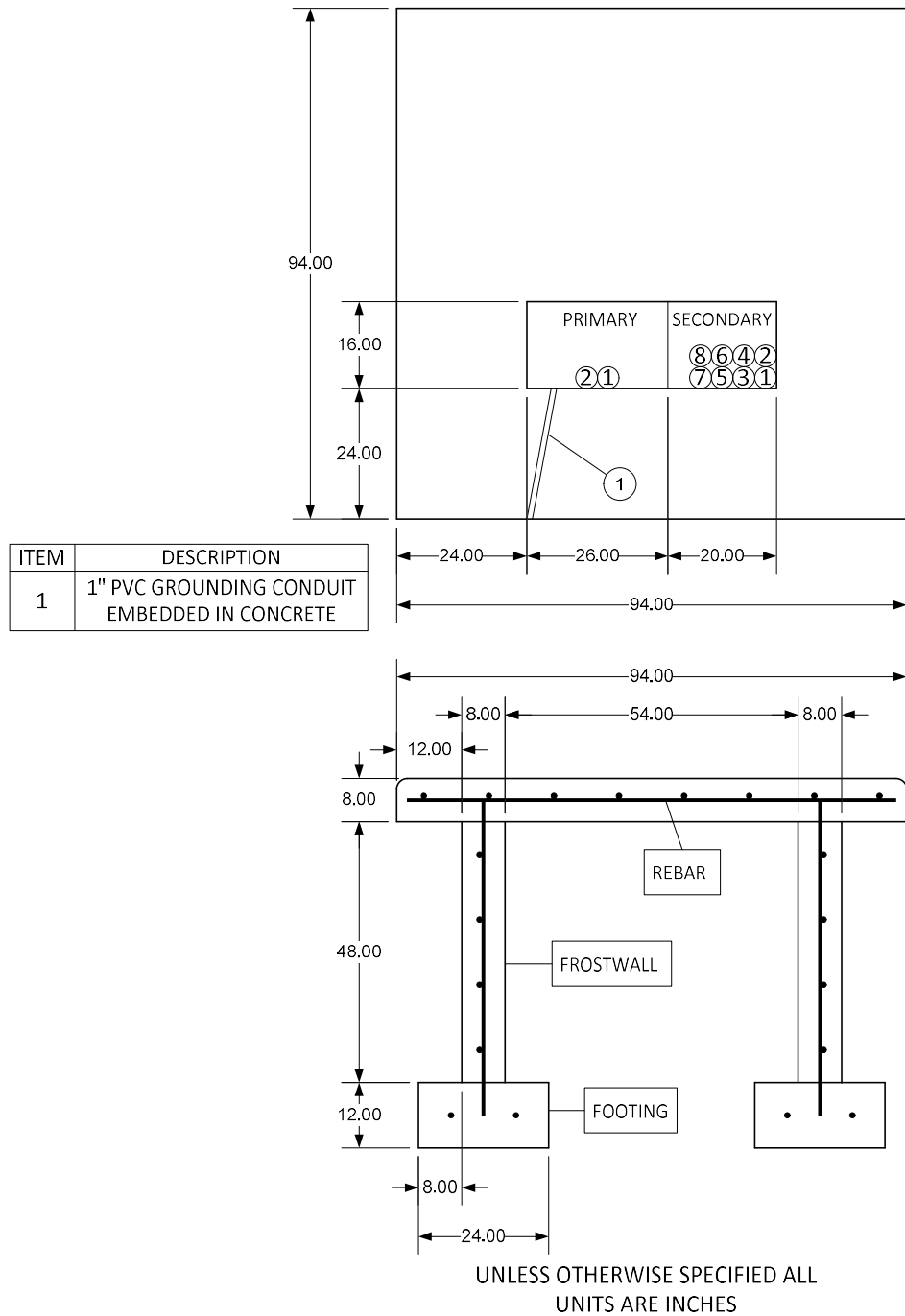


Figure 3-16
 Protective Posts for Current Transformer Cabinets and Meter Sockets

3.8 Concrete Pads for Padmount Transformers

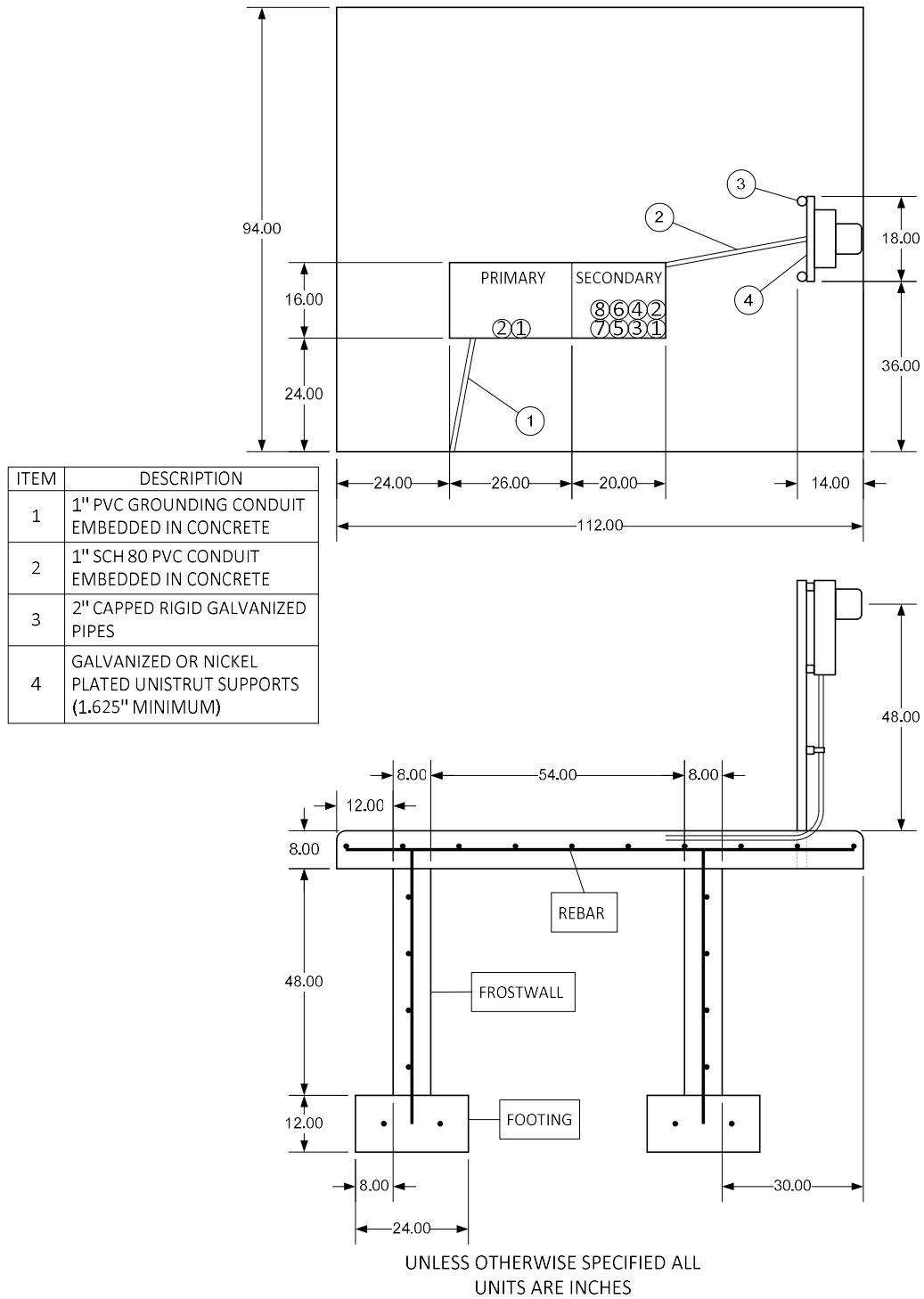


Refer to table 3-6 for construction notes

Figure 3-17
Three Phase Transformer Pad (75 – 750 KVA) Without Metering

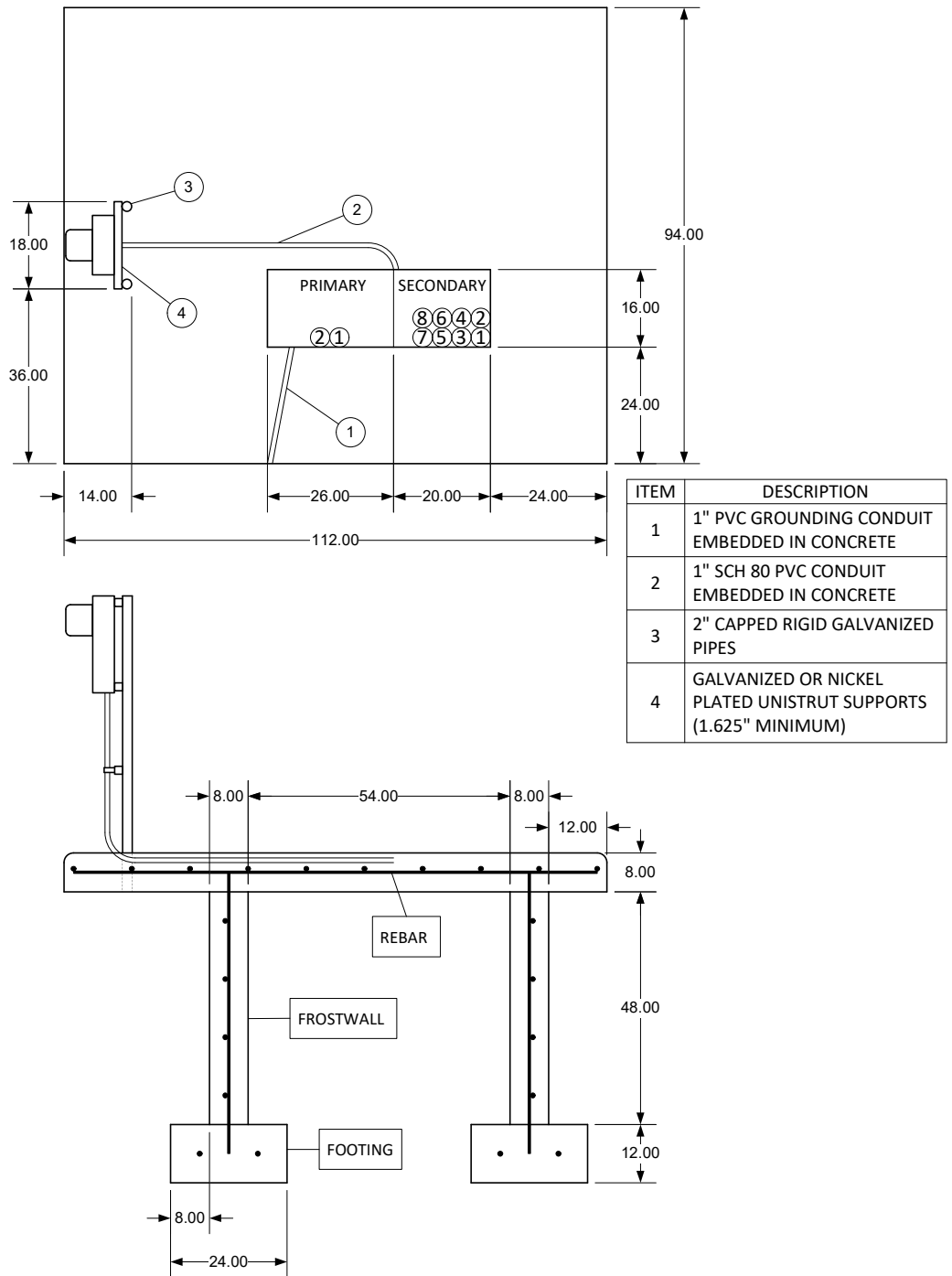
*Note: Meter socket can be installed on the pad-mount transformer (with MU approval)

*Ufer grounding allowed as alternative to PVC Grounding Conduit



Refer to table 3-6 for construction notes

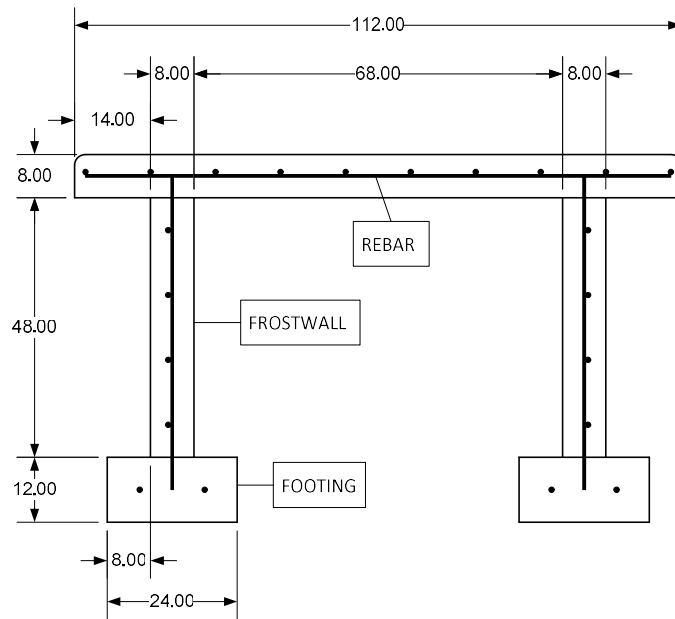
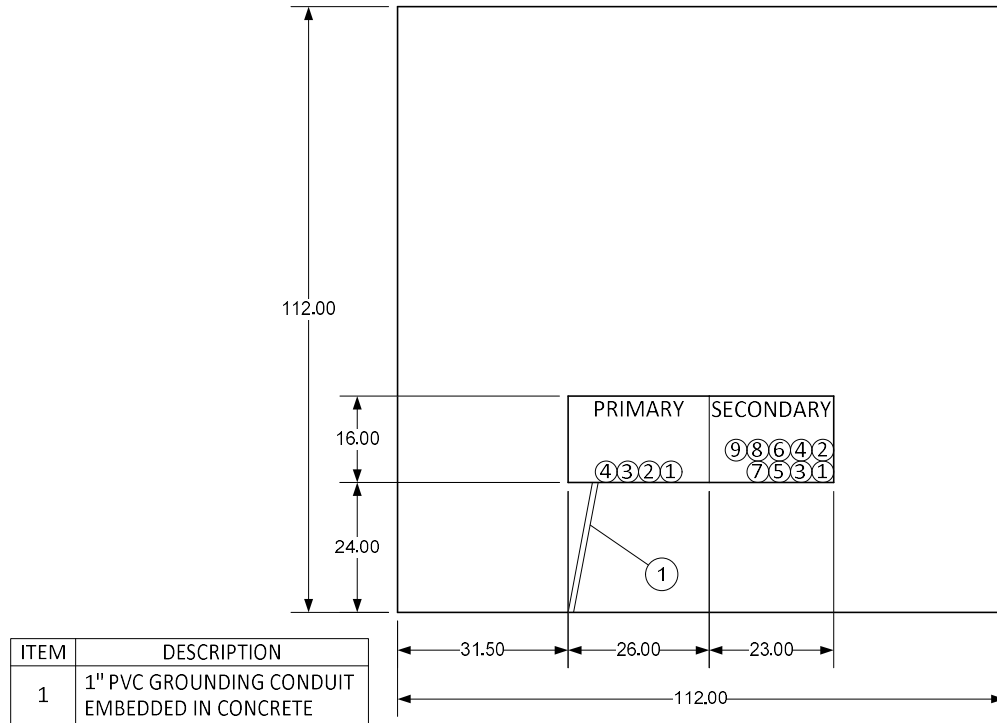
Figure 3-18
Three Phase Transformer Pad (75 – 750 KVA) with Metering on Secondary Side
 *Ufer grounding allowed as alternative to PVC Grounding Conduit



UNLESS OTHERWISE SPECIFIED ALL UNITS ARE INCHES

Refer to table 3-6 for construction notes

Figure 3-19
Three Phase Transformer Pad (75 – 750 KVA) with Metering on Primary Side
 *Ufer grounding allowed as alternative to PVC Grounding Conduit



UNLESS OTHERWISE SPECIFIED ALL
UNITS ARE INCHES

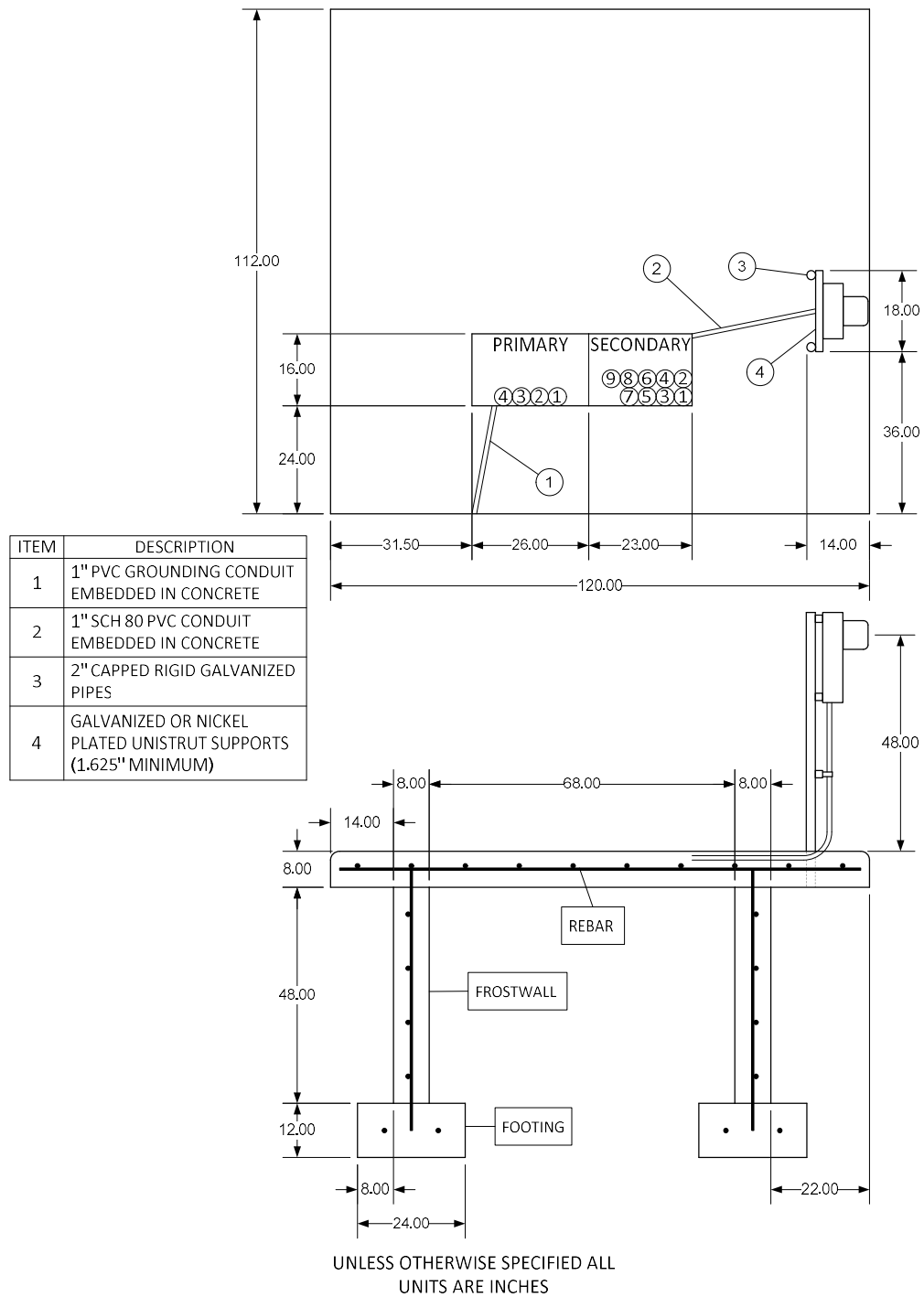
Refer to table 3-6 for construction notes

Figure 3-20

Three Phase Transformer Pad (1000 - 2500 KVA) Without Metering

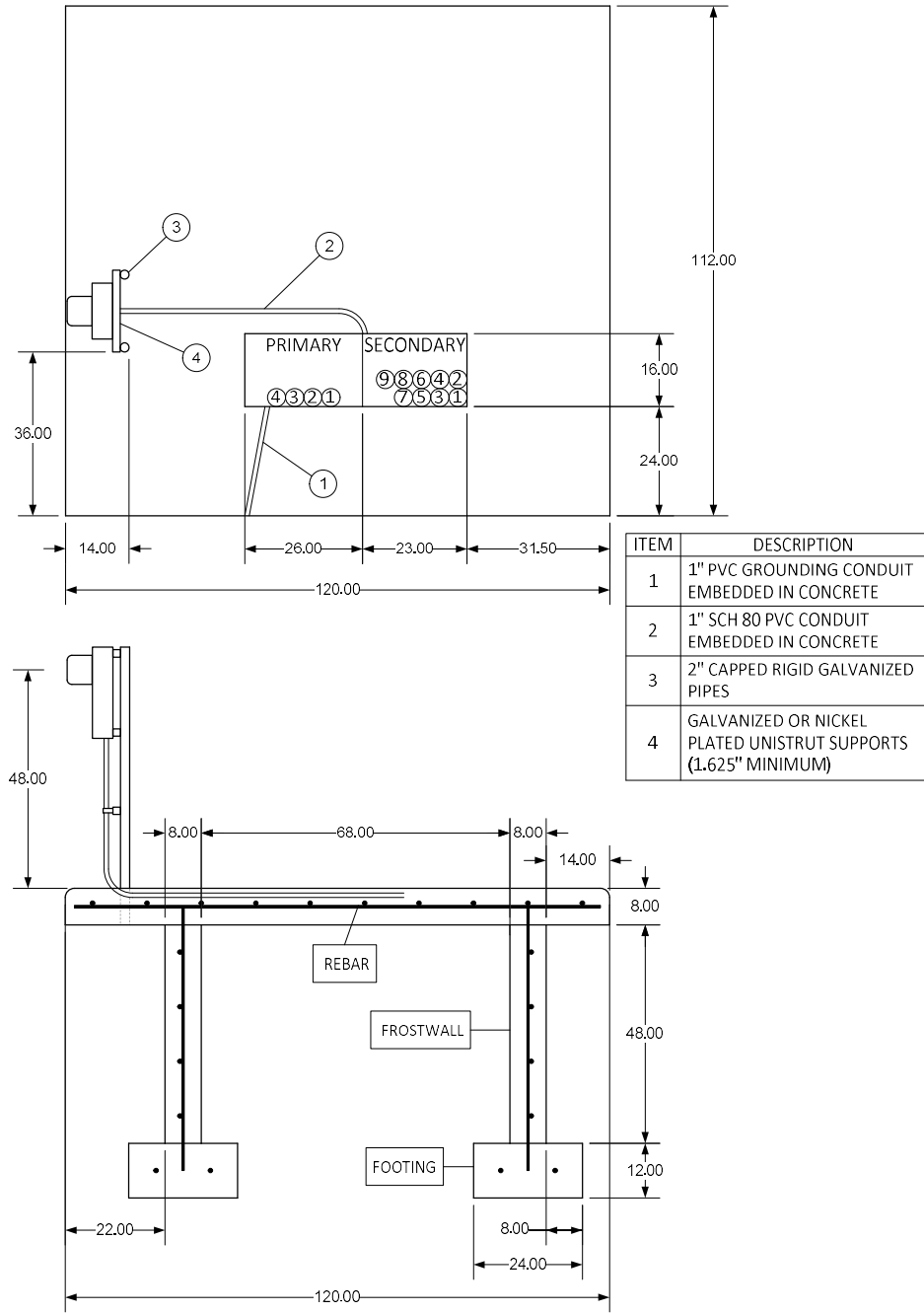
*Note: Meter socket can be installed on the pad-mount transformer(with MU approval)

*Ufer grounding allowed as alternative to PVC Grounding Conduit



Refer to table 3-6 for construction notes

Figure 3-21
Three Phase Transformer Pad (1000 – 2500 KVA) with Metering on Secondary Side
 *Ufer grounding allowed as alternative to PVC Grounding Conduit



UNLESS OTHERWISE SPECIFIED ALL
UNITS ARE INCHES

Refer to table 3-6 for construction notes

Figure 3-22
Three Phase Transformer Pad (1000 – 2500 KVA) with Metering on Primary Side
*Ufer grounding allowed as alternative to PVC Grounding Conduit

Table 3-6	
Three Phase Transformer Pad Construction Notes	
1.	All conduits are to be installed BEFORE PAD is poured. Consult with MU for orientation, size, and length of conduits. All elbows must be long sweep with a minimum of 36 inch radius on 4 inch conduit and 48 inch radius on 6 inch conduit. Use 4 inch conduit unless otherwise specified from MU.
2.	If metering in transformer, a 1 inch metering conduit must be embedded in the concrete from the meter socket into the secondary side of the transformer. The metering conduit shall not pass through the primary compartment of the transformer.
3.	Ufer Grounding or a 1 inch grounding conduit must be embedded in the concrete within 2 inch of the bottom of the pad from the front left side of the primary compartment to the outside edge of pad. Final grade shall sufficiently cover the end of the conduit.
4.	Contact MU about pad location, orientation and meter equipment location. *Note: Meter socket can be installed on the pad-mount transformer(with MU approval)
5.	Concrete shall have a minimum compressive strength of 3500 psi at the time of stripping or first lift. All concrete shall be air entrained (4% to 6% by volume) with a W/C ratio of 0.45. Minimum cure time before setting a transformer is seven days.
6.	Reinforcing steel shall be ASTM A615 Grade 60. Reinforcing steel should be placed at 1-foot spacing and tied to prevent displacement during concrete placement. (1/2 inch minimum size) Reinforcing steel should tie the footing to the frost wall and frost wall to the pad.
7.	The finished top surface of the pad shall be flat and level with a wood float finish.
8.	All conduits to be in window area and just above top (2 inch max) of the pad with conduit bushing or bell end connector installed. Service conduits must start from the right front corner of the window and be positioned tightly to the right front corner. (Consult MU for the number and size of conduits). Primary conduits must be in the front of the window and centered in the primary portion of the window.
9.	Check pad dimensions against actual transformer dimensions if possible on larger transformers.
10.	Backfill around footing, frost wall and pad shall be crushed rock or sand.
11.	Upon completion, remove all framing materials from the pad, including those from inside the conduit opening.
12.	Soil compaction of 95% or better is required under the pad.
13.	Conduit shall not pass through the frost wall or footing.

- | |
|---|
| 14. Install a 5/8 inch x 8 inch copper plated steel grounding rod a minimum of 8 inch from grounding conduit external to transformer pad. |
| 15. Top of pad is to be approximately 4 inch above finished grade. |

3.9 Conductor Identification for Three-Phase Wiring

All three-phase conductors are to be properly identified with colored tape in accordance with Table 3-7 to ensure proper connections and phase rotation. MU intends to have a clockwise, ABC, left-to-right rotation on all service conductors in meter sockets and in the main panel. This includes CT/PT metering installations.

Phase:	A	B	C
Position:	Left	Center	Right
Tape Color:			
120/208	Black	Red	Blue
277/480	Brown	Orange	Yellow
Primary	Red	White	Blue

3.10 Vertical Space to Terminate in Switchgear and Entrances

Table 3-8 shows the minimum vertical termination space required in customer owned switchgear for incoming MU service conductors.

SWITCHGEAR (AMPS)	MINIMUM NUMBER OF CONDUCTORS PER PHASE	WIRE SIZE ALUMINUM	MINIMUM NUMBER OF CONDUITS AND SIZE - INCHES	MINIMUM VERTICAL DISTANCE - INCHES
400	2	4/0 AWG	2-2 1/2"	12"
600	2	500 KCMIL	2-4"	18"
800	3	400 KCMIL	3-4"	24"
1000-1200	4	600 KCMIL	4-4"	30"
1600	5	600 KCMIL	5-4"	36"
2000	6	600 KCMIL	6-4"	42"
2500	8	600 KCMIL	8-4"	42"
3000	9	600 KCMIL	9-4"	42"

3.11 Farm Services

Farm services requiring a minimum 400-ampere service capacity shall follow this general standard. The customer will install an electrical distribution center. The electrical distribution center may be built on a yard pole, self-supporting structure, or a building.

1. Customer owned equipment is not allowed on Utility owned poles.
2. MU will not install additional service drops to any farm building or structure within 150 feet of the customer's electrical distribution center. Beyond this distance, MU will evaluate the situation to determine if additional service points are warranted. A separate meter may be installed at the distribution center for another building, which is not part of the farm operation. This will normally be at the same location as the first meter to ensure one service to a customer site.
3. The farm customer shall protect the electric distribution center equipment from physical damage by vehicles and farm operations. The customer shall maintain the equipment in good operating order. When a Utility-owned yard pole is replaced, it is the customer's responsibility to move all customer equipment at customer expense. At MU's option, the existing pole may be given to the customer and MU may install a new transformer pole.
4. All equipment must be installed in accordance with all applicable electrical codes.
5. MU will perform all work on Utility equipment and complete the connection to the customer's service conductors. The customer shall not connect conductors to Utility equipment or extend wires or service from the customer's equipment that is unmetered.
6. The customer will furnish, install and maintain an electrical distribution center that includes the following:
 - a. CT cabinet (if 400 amperes or larger)
 - b. Main disconnect or up to 6 disconnects with over current protection (A pole top transfer switch does not provide over current protection).
 - c. Meter socket, metering conduit, and metering weather head
 - d. Service ground
 - e. Other items that may be required include:
 - 1) Guys for customer overhead branch service circuits.
 - 2) Overhead circuits - 4 wire (single phase) or 5 wire (three phase)
 - 3) Standby generator circuit within conduit and weatherproof junction box.
7. All conductors on the yard pole shall be installed in conduit.

3.12 Termination Enclosures

Termination enclosures may be necessary with certain wiring, spacing, clearance, or equipment choices. The customer should consult with MU before planning or utilizing these enclosures. Typical enclosure arrangements are shown in Figure 3-20.

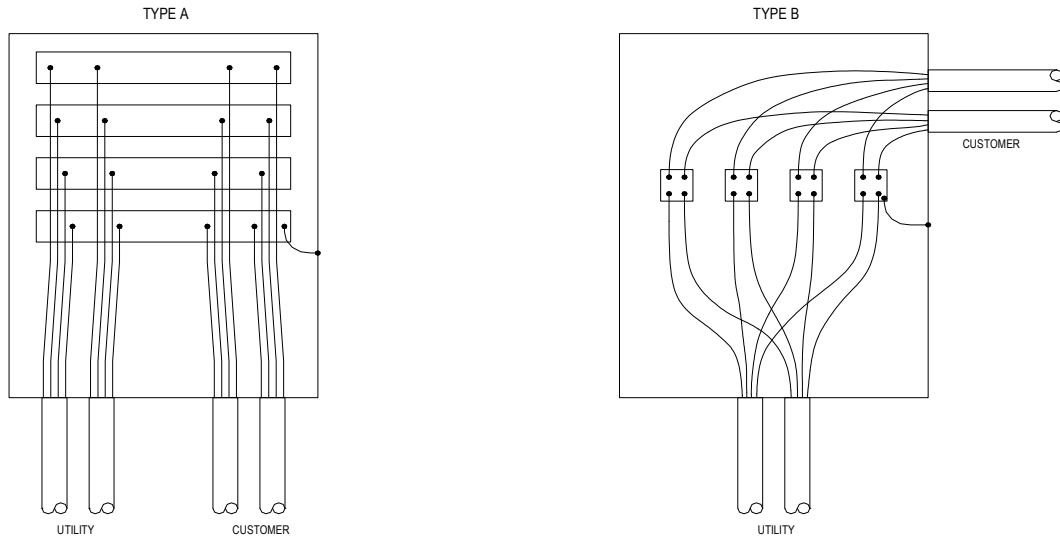


Figure 3-23
Typical Termination Enclosure Arrangements

Table 3-9 Pre-approved Termination Enclosures					
Amperes		Type	Manufacturer	Catalog #	HxWxD (")
400	1Φ 3-wire	B	Erickson	TB-365N	45.5x20x7.25
	1Φ 3-wire	B	GalvaClosure	TB-413-1	42x20x8
800	3Φ 4-wire	B	Erickson	TB-465N	45.5x20x7.25
	3Φ 4-wire	B	GalvaClosure	TB-434-1	42x20x8
	3Φ 4-wire	B	Erickson	TB-467N	48x24x11
1200	3Φ 4-wire	A	GalvaClosure	TBBX-834-3	48x36x14
	3Φ 4-wire	B	GalvaClosure	TB-834-3	54x36x14
	3Φ 4-wire	B	Erickson	TB-468N	60x36x15
1600	3Φ 4-wire	A	GalvaClosure	TBBX-1234-5	54x46x14
	3Φ 4-wire	B	GalvaClosure	TB-1234-4	54x36x14
	3Φ 4-wire	B	Erickson	TB-469N	60x35x15
2000	3Φ 4-wire	A	GalvaClosure	TBBX-1634-4	54x46x14
	3Φ 4-wire	B	GalvaClosure	TB-1634-5	60x38x16
	3Φ 4-wire	B	Erickson	TB-4610N	64x40x15
2500	3Φ 4-wire	A	GalvaClosure	TBBX-2034-5	66x54x14
	3Φ 4-wire	B	GalvaClosure	TB-2034-6	72x42x20
	3Φ 4-wire	B	Erickson	TB-4611N	64x40x15
3000	3Φ 4-wire	A	GalvaClosure	TBBX-2534-7	72x50x20
	3Φ 4-wire	B	GalvaClosure	TB-2534-7	72x42x20
	3Φ 4-wire	B	Erickson	TB-4612N	78.25x44x20.625
	3Φ 4-wire	A	GalvaClosure	TBBX-3034-8	72x50x20
	3Φ 4-wire	B	GalvaClosure	TB-3034-8	72x42x20

3.13 Cable Television Power Supplies

Cable television power supply service is available at 120/240-volt 3-wire single phase. The customer should consult MU to ensure that this voltage is available at the desired location. At times, 120/208-volt 3-wire single phase may be the voltage available. These services will normally be installed on utility owned poles after approval by MU.

1. All installations must conform to all applicable electrical codes and MU's requirements for clearances, climbing space, and working space. Only qualified and authorized cable television representatives shall make this installation. Those representatives shall be trained and knowledgeable of clearance requirements and working rules of the NESC, Volume I of the WSEC, and applicable requirements of OSHA. Furthermore, these representatives shall be trained and competent in:
 - a. Identifying and distinguishing electric utility system components and exposed live parts.
 - b. The techniques necessary to determine the nominal voltage of exposed live parts.
 - c. The minimum safe approach distances corresponding to the voltages to which the qualified representatives will be exposed.
2. The customer will furnish and install all equipment and materials except for MU meter.
3. The meter socket shall be a minimum of 100 ampere, ringless, and have manual bypass horns for 120/240-volt 3-wire service. If 120/208-volt service is supplied, a fifth terminal will need to be provided by CATV.
4. The service entrance conductors shall be run in non-metallic conduit. The service entrance conductors shall use 600-volt insulation and shall extend a minimum of 36 inch beyond the weatherhead. MU will make the service connections and specify the masthead height on the pole.
5. The service disconnect, power supply unit, meter socket, and cable television cable shall be located in the same quadrant on the pole and shall normally face in the direction of the street or road. There shall also be a maximum of 6 inches between the service entrance conductors and the cable television cable.
6. Service grounding shall comply with the NEC 250. If located on a:
 - a. Steel pole, bond the service to the pole.
 - b. Wood pole (with one ground rod), bond to ground wire and install additional 8 foot ground rod.
 - c. Wood pole (with no ground rods), install two 8 foot ground rods and ground wire.
7. The service conductor may be sized for the actual disconnect size utilized.

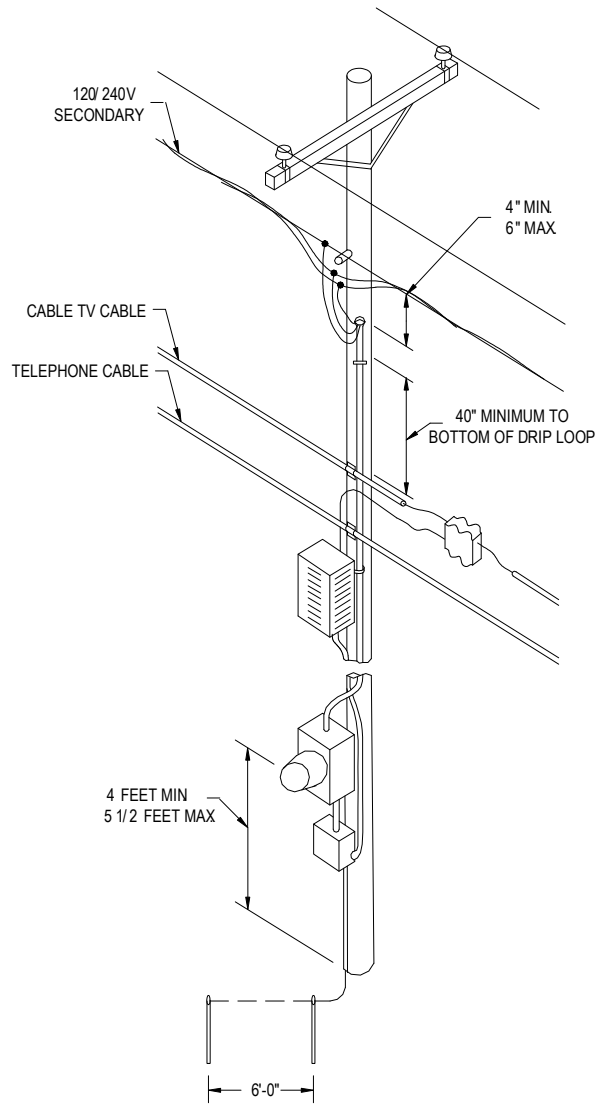


Figure 3-24
Typical Cable Television Power Supply Arrangement

SECTION 4: Metering Requirements

Customers shall provide a location for meters and associated metering equipment that is acceptable to MU.

Meters shall:

- Be in an accessible location to permit them to be read, inspected, and tested as required by MU. A 30 inch wide path to the meter must be kept clean of obstructions to a height of 6 foot 6 inch.
- Be located on a solid structure that is free from vibration, potential mechanical damage, and supported to maintain the meter socket in a level and plumb position.
- Be protected from damage by falling ice, snow, or other objects. A protective shield for the meter shall be provided where a roof overhang does not shield the meter.
- Have a clear working space in front of the meter panels extending out to a minimum of 36 inches for 208 or 240 volt services or 42 inches for 480 volt services. The working space shall extend vertically to a height of 6 foot 6 inches or to the height of the equipment, whichever is greater and horizontally to 24 inches to either side of the equipment. Where instrument transformer cabinets are used, the clear working space in front of the cabinet shall be 24 inches greater than the width of the cabinet cover in an open and extended position or 36 inches for 208 and 240 volt services or 42 inches for 480 volt services, whichever is greater.
- Have a minimum of 4 inches of clearance on all sides of the meter socket.
- Be located in a dry location free of hazardous conditions such as explosive fumes or materials.
- Be located outdoors along with all related equipment unless the Electric Department manager grants a written variance. Group-metered installations of more than 6 meters shall have a single disconnecting means. The customer shall consult MU before planning or installing such an installation.
- Have pedestal style meter sockets for outdoor locations for underground services. This is applicable for installations of up to 6-meter positions.
- The meter socket shall be at least 36 inches from any part of the gas meter or gas service.

Meters shall not:

- Be installed in patio, porch, deck, carport area, or areas likely to be enclosed. Changes to the customer's premise shall not result in making an existing metering location unsafe or inaccessible for reading, inspecting, or testing. The customer will be required to make changes to this wiring if such changes create a situation that does not comply with these rules. If after a reasonable length of time has passed after receiving a non-compliance notification from MU and the customer has not suitably brought the installation into compliance, MU will terminate service until the non-compliance has been remedied.
- Be installed on mobile homes unless mobile home is installed on a permanent basement or foundation consisting of footings and frost walls.
- Have customer or customer-owned lightning arrestors or surge protection devices installed in metering equipment. The customer should install these devices on the load side of the service overcurrent protection devices. Similarly, metered and unmetered conductors shall not be installed in the same raceway or conduit, nor shall any customer meters or instruments be connected to MU meter wiring.
- Be installed on a driveway, sidewalk, or other high traffic areas, unless protected per figure 3-16 and MU approval.
- Bonding to other systems shall not be done on or within a metering enclosure (i.e. CATV or telephone shall not install external ground clamps on meter sockets/pedestals, ct cabinets, etc.)
- Specific equipment cannot be placed on a separate meter and metered at a different rate schedule. If a time-of-use meter is utilized, all usage must be on the time-of-use meter.
- Be enclosed or hidden from sight. This presents a safety issue when power needs to be disconnected in cases of emergency.

4.0 Multiple meter arrangements for apartment buildings and commercial shopping centers can be located indoors with advance approval from MU. Figure 4-1 and Table 4-1 show the requirements for these types of installations.

Table 4-1 Multiple Metering Requirements	
1.	A minimum clear working space of 36 inches for 208/240 volt or 42 inches for 480 volt in front of, and 24 inches on either side of the meter panel must be maintained. Headroom shall be a minimum of 6 foot 6 inch or the height of the equipment, which ever is higher. The main entrance enclosure or termination enclosure shall be at least 4 inches from any barrier or wall. Also, meter sockets shall be located no closer than 10 inches to a barrier or wall.
2.	Each meter socket must have a horn type or manual lever by-pass, be ringless, sealable, and UL approved.
3.	Each meter socket must have permanent label identification, both inside and out, matching the identification of the space that is metered. This identification should be on a non-removable part of this metering equipment. Black magic marker does not meet the requirement of "permanent label identification." Marker can easily be crossed out or modified. Too often, this leads to metering mistakes and confusion. A marking with raised or indented text that will hold up through the years is required. Meters will not be set until the meter socket has been permanently labeled and the MU office has a listing of the addresses corresponding to each space metered.
4.	Customer shall furnish, install and maintain multiple metering equipment. This includes all meter sockets, switches, fuses, circuit breakers, termination enclosures, load conductors, lugs, and associated equipment.
5.	Meters shall be individually sealable.
6.	Meters require protective barriers if traffic through a doorway could cause damage to the meter. A minimum clearance of 12 inches is required from the centerline of the meter-connection device to the barrier.
7.	All indoor metering must be approved by the MU Electric Department Manager. If approved, a key shall be provided by the owner for 24-hour access by MU. No other materials shall be stored in the indoor metering area.
8.	All single or three phase multiple meter installations may require one main disconnect for the group or individual disconnects ahead of each meter socket. Contact MU for approval before installation.

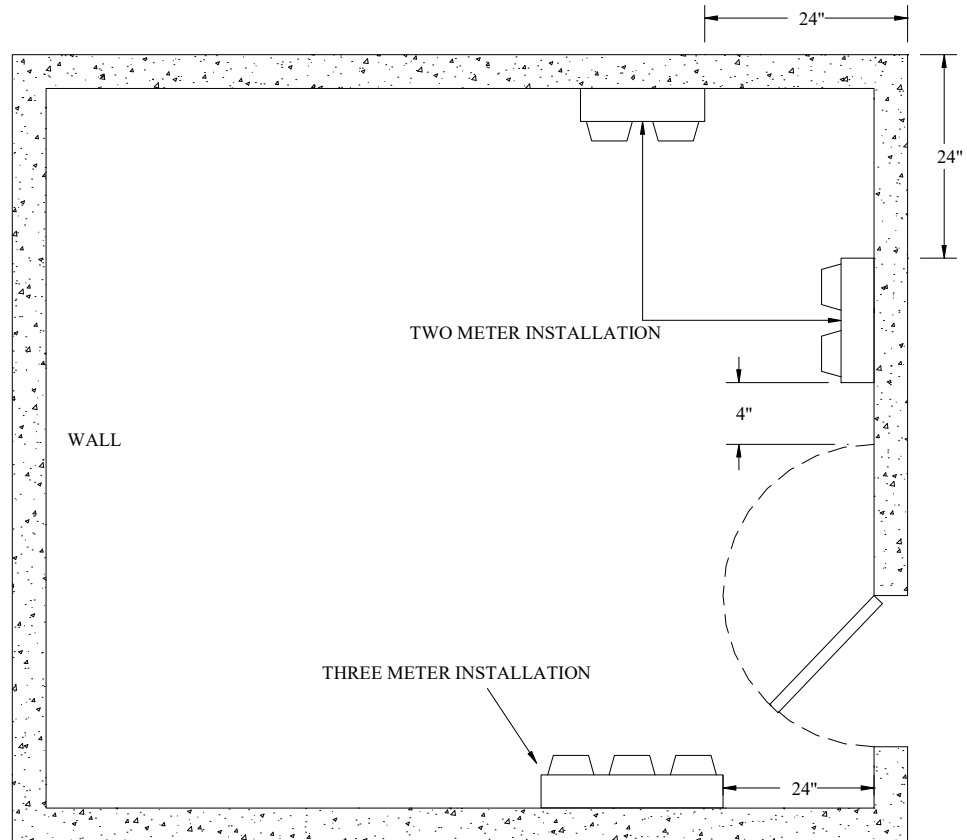


Figure 4-1
Indoor Meter Clearance Requirements (measure from inside wall)

4.1 Meter Heights

Meters heights are located in Table 4-2. When a number of meters are placed on the same meter panel, the distance between centers should be not less than 8.5 inches vertically or 7.5 inches horizontally. For meters installed both indoors and outdoors, there shall be a minimum of 36 inches for 208/240 volt or 42 inches for 480 volt of unobstructed space in front of the meter measured from the surface of the meter enclosure.

Table 4-2		
Meter Height Clearance Requirements		
	PSC 113 required Range	MU preferred Range
Outdoor Overhead meter	4' – 6'	4' - 5' 6"
Outdoor Underground meter	2' 6" – 6'	2' 6" - 5' 6"
Indoor meter	4' – 6'	4' - 5' 6"
Outdoor meter pack	2' 6" – 6'	2' 6" – 5' 6"
Indoor meter pack	2' 6" – 6'	2' 6" - 5' 6"

All measurements are from final ground grade to the center of the meter glass.

4.2 Meter Sockets

- Single Phase

- Must be UL approved, be rated 200 amperes minimum, be ringless, sealable, and have manual bypass horns.
- Table 4-4 through 4-14-list pre-approved single-phase meter sockets.
- Other meter sockets/pedestals to what is listed in the tables may be used with prior MU approval.

Table 4-3	
Example 200 Amp Overhead Meter Sockets without Main Breaker	
Manufacturer	Catalog #
Milbank	U1773-XL-TG-KK

Table 4-4	
Approved 200 Amp Overhead Meter Sockets with Main Breaker	
Manufacturer	Catalog #
Midwest	R281CB1
Milbank	U5844-PXL-200

Table 4-5		
Approved 200 Amp Service Pedestals without Main Breaker		
Manufacturer	Catalog #	Pedestal Extension if needed
Landis & Gyr (Siemens)	UAP317-PPWI	5007718 (15")
		5007725 (30")
Milbank	U3358-0-KK	K5800 (15")
		(2) - K5800 (30")
Eaton (Cutler Hammer)	UHTRP242363CH	1007680CH (18")
		1008786CH (30")
Square D	UHTRP242363	1009618 (18")
		1008786 (30")

Table 4-6 Approved 200 Amp Service Pedestals with Main Breaker		
Manufacturer	Catalog #	Catalog # for Breaker
Landis and Gyr	UAPB317-PPWI H659-0121 5007718 5007725	200-amp single-phase pedestal 5 th terminal grounded – kit if needed. 15” Pedestal extension 30” Pedestal extension
Milbank	NU8980-O-KK-LP UQFP-M-200 UQFPH-M-200 K4714 5T8K2 K4694	200 A single phase ped low profile 200 amp breaker (10,000 AIC) 200 amp breaker (22,000 AIC) Series wiring kit 5 th terminal kit if needed 24” Pedestal extension
Milbank (Unit has provisions for two receptacles)	U5706-O-200S-KK K5T K5708	200-amp single-phase pedestal 5 th terminal kit if needed 12” Pedestal extension

Table 4-7 Approved Mobile Home Pedestals				
Manufacturer	100 Amp Single Position	200 Amp Single Position	100 Amp Duplex	200 Amp Duplex
Midwest	R101CP6HP EK129	R281C1P6H EK129	R101CB6HP EK129	R281C1B6H EK129
Milbank	U5136-O-100S	U5136-O-200S	U5137-O-100S	U5137-O-200S

* Must order catalog number S2291-TO for pedestal raceway, also.

Table 4-8					
Approved Multi-Meter Socket Arrangements without Main Breaker 200 Amp Rated					
Manufacturer	Service	# Of positions	Catalog #	Pedestal Extension	5 th Terminal
Milbank	OH	2	U1252-X-KK	----	K5T
Milbank	OH	3	U1253-X-KK	----	K5T
Milbank	OH	4	U1254-X-KK	----	K5T
Milbank	UG	2	U1252-X-KK-K1-PED*	S2571 (12")	K5T
Milbank	UG	2	U1783-O-KK	S8988 (30")	K5T
Milbank	UG	3	U1253-X-KK-K3-PED*	S2571 (12")	K5T
Milbank	UG	4	U1254-X-KK-K3-PED*	S2571 (12")	K5T
Milbank	UG	5	U1255-X-KK-K4-PED*	S2571 (12")	K5T
Milbank	UG	6	U1256-X-KK-PED*	S2571 (12")	K5T

Table 4-9						
Approved Multi-Meter Socket Arrangements with Main Breaker 200 Amp Rated						
Main Bus Rating	Manufacturer	Service	# Of positions	Catalog #	Pedestal Extension	5 th Terminal
250 A	Milbank	UG	2	U2862-X-KK-K1-PED* **	S2571	K2381
300 A	Milbank	UG	3	U2863-X-KK-K1-PED* **	S2571	K2381
400 A	Milbank	UG	4	U2864-X-KK-PED* **	S2571	K2381
600 A	Milbank	UG	5	U2865-X-KK-PED* **	S2571	K2381
600 A	Milbank	UG	6	U2866-X-KK-PED* **	S2571	K2381

* Must order catalog number S2291-TO for pedestal raceway, also.

** Units are not supplied with circuit breakers; order as extra.

Please contact MU to discuss the arrangement for installations involving more than one meter at a single location.

Table 4-10		
Approved 320/400 Amp Service Pedestals Without Main Breaker		
Manufacturer	Catalog #	Pedestal Extension Catalog #
Landis & Gyr	47604P-9WI	5007719 (15")
Milbank*	U1748-O-WI-K1350 K4802 (2 – 350 kcmil)	S1848 (15")

* Order (1) Anti-Inversion Clip, K4802

Table 4-11		
Approved 320/400 Amp Service Pedestals With Main Breaker		
Manufacturer	Catalog #	Pedestal Extension Catalog #
Milbank*	U3849-O-2/200 K1350 K4802 (2 – 350 kcmil)	S1848 (15")

* Order (1) Anti-Inversion Clip, K4802

Table 4-12	
Approved 320/400 Amp Overhead Meter Sockets Without Main Breaker	
Manufacturer	Catalog #
Milbank*	U1779-RRL-K3-K1350 K4802 (2 – 350 kcmil)

* Order (1) Anti-Inversion Clip, K4802

Table 4-13	
Approved 320/400 Amp Overhead Meter Sockets With Main Breaker	
Manufacturer	Catalog #
Milbank*	U5890-X-2/200-BL K4802

* Order (1) Anti-Inversion Clip, K4802

Table 4-14	
Approved Single Phase Instrument Rated Meter Socket for 400 and 600 Amp Services with Test Switch and Pre-Wired (For use in conjunction with a CT cabinet)	
Manufacturer	Catalog #
Durham	ASTS6-1CTBA SKT/SW 20A 6T FW HCP*

*Includes test switches. MU stocks these sockets for purchase.

Three phase

- Must be rated at 600 volts, 200 amperes minimum, be UL approved, ringless, and have clamp type jaws.
- Shall have a lever bypass which is designed to permit visual checking of the bypass connections with the meter installed. The socket must also be designed so that the cover cannot be installed in the bypass-closed position.
- Table 4-15 lists pre-approved meter sockets and Figure 4-2 shows the typical electrical connections for 200 ampere three phase, four wire applications.
- A disconnect may be required before the meter socket. Contact MU for approval before installation.

Table 4-15 Approved Meter Sockets for Self-Contained 200 Amp Three Phase Four Wire Services		
Manufacturer	OH Catalog #	UG Catalog # / Extension #
Landis & GYR	40007-01QG	40407P-9WI / 5007720
Milbank	U9700-RRL	U9107-O-WI / S3488

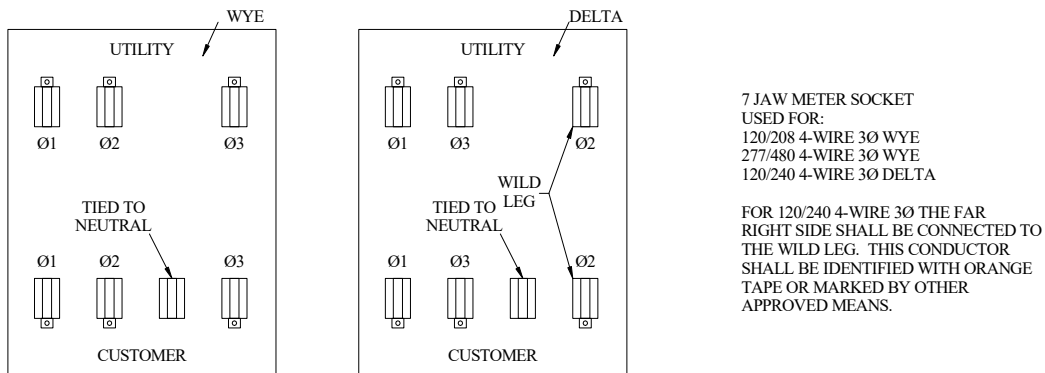


Figure 4-2
Three Phase Four Wire Meter Socket Connections

Table 4-16 Approved Three Phase Transformer Rated Meter Sockets with Test Switch and Pre-Wired	
Manufacturer	13 terminal, 120/208 and 277/480
Durham	1008348 (includes test switch)*

* MU stocks these sockets for purchase.

4.3 Instrument Transformer Metering - General

This metering requirement is applicable for services from 400 amperes through 2000 amperes. For 400-ampere single-phase services, a 320-ampere plug-in meter socket is standard for residential and some commercial services. MU should be consulted before using CT cabinets. Other general requirements are noted below in the narrative, associated diagrams, and tables.

1. The customer shall install the meter socket, current transformer cabinet, and conduit between the meter socket and CT cabinet. MU will supply the meter, current transformers, and meter wiring.
2. The CT cabinet and meter socket must be mounted outdoors.
3. The minimum clear space in front of the CT cabinet shall be 36 inches for 208/240 volts or 42 inches for 480 volts or 2 feet beyond the maximum cover swing distance, whichever is greater.
4. In four-wire 120/240-volt three-phase installations, the wild leg shall be located on the right side and identified with orange tape.
5. The CT cabinet must be bonded in accordance with NEC 250.102(d).
6. MU will bond the meter socket.
7. Pre-approved meter socket are shown in Table 4-16.
8. A rain tight hub or gasket must be used on all conduit connections to the CT cabinet and the meter socket.
9. All CT/PT cabinets must have provisions for installation of a padlock and meter seal by MU.
10. The CT cabinet must be weather tight (NEMA 12), and must be large enough to allow ample space for CT's, PT's, and conductors.

Current Transformers

Current transformers are to be installed in an approved cabinet or in the pad-mounted transformer with Utility permission. All low side wiring on the current transformers will be done by MU. Polarity marks (H1 or white dot) on the CT window must face in the direction of the supply. Conductors are to be routed from the transformer and enter the CT at the end with the polarity mark. All conductors of each phase must pass through the same current transformer. MU will furnish all current transformers.

Potential Transformers

Potential transformers will be required on all transformers rated 480-volt services. Potential transformers may be mounted in the same cabinet as the current transformers or, with MU approval, internal to the padmounted transformer. The potential transformers should be mounted in a location where the conductors will not interfere with proper access. All wiring on the potential transformers will be done by MU. MU will furnish all potential transformers.

4.4 Current Transformers in Padmounted Transformers

This metering option is only available with the permission of MU. In addition, the transformer can only be used to supply a single service to one building and the customer shall own, install, and maintain the service conductors.

The customer shall provide the meter socket. It can be installed near or on (with MU approval) the padmount transformer, or installed on the building wall. If it is installed on the building wall, the maximum distance shall be 15 feet from the padmount transformer to the building wall.

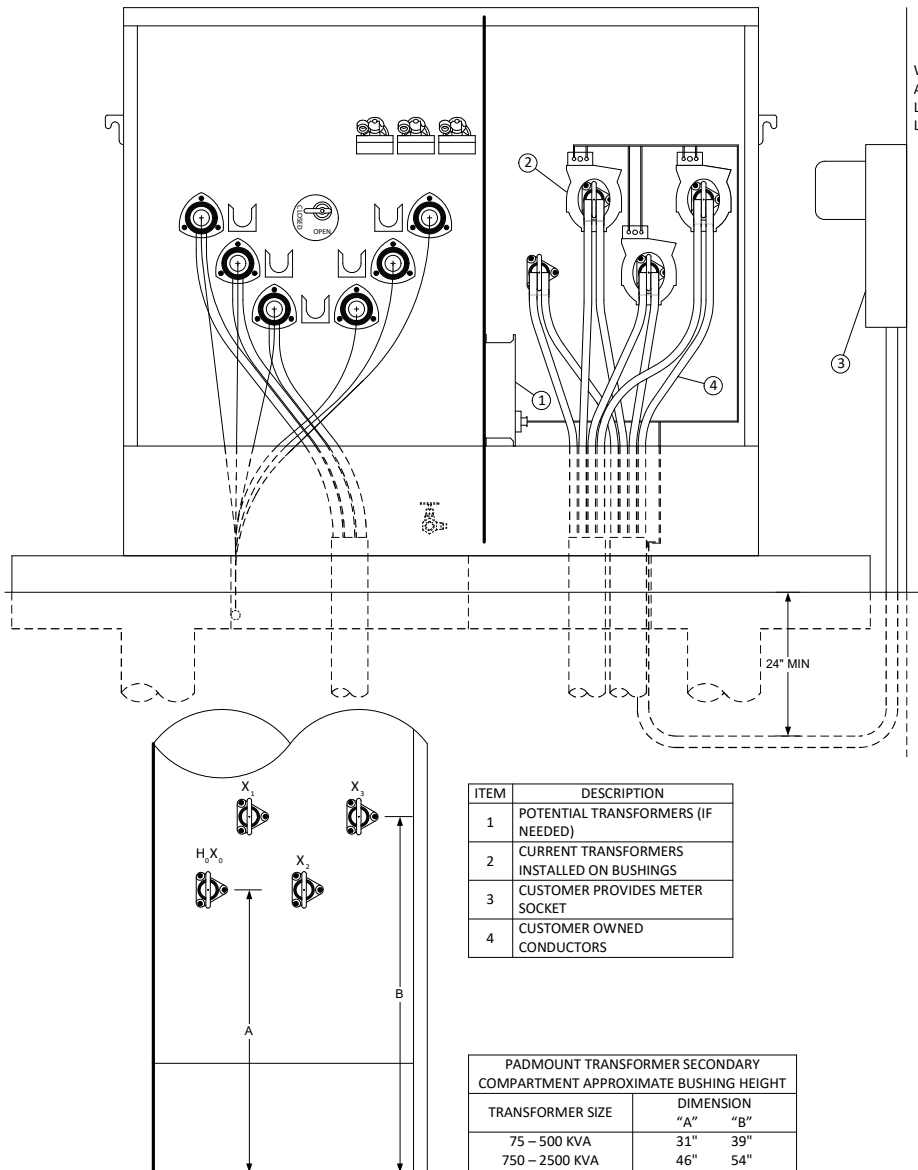


Figure 4-3

Three Phase Transformer Metering Arrangement

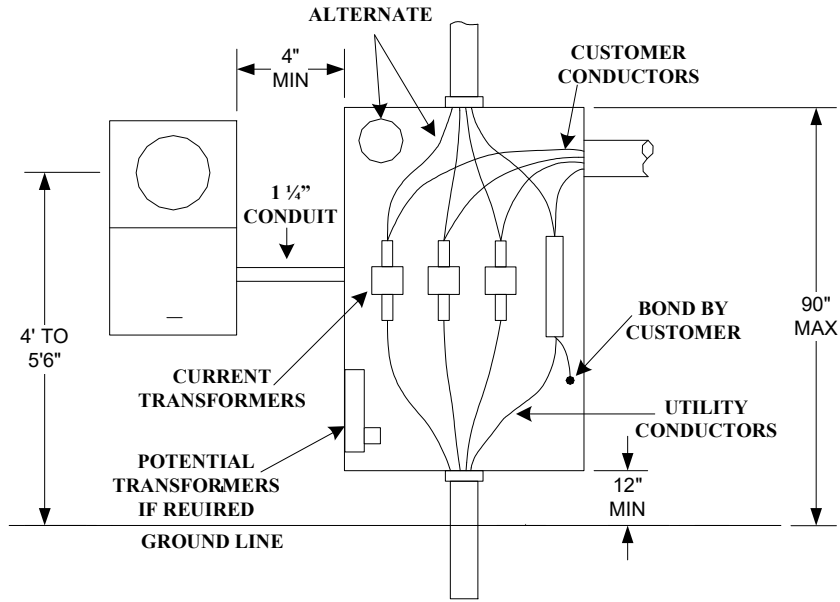
Termination enclosures may be necessary with certain wiring, spacing, clearance, or equipment choices. The customer should consult with MU before planning or utilizing these enclosures.

4.5 Current Transformer Cabinets for 400-2000 Ampere Services

This metering arrangement is applicable for services rated 400-2000 amperes using bolt-in current transformers only. For 400-ampere single-phase services, a 320-ampere plug-in meter socket is standard for residential and certain commercial services. The following requirements shall be met before installing any CT cabinets.

1. The minimum depth of the current transformer cabinet is 10 inches
2. Doors shall be hinged and have a lockable hasp.
3. CT's must be adjustable for depth and height.
4. Bus shall be adequately braced to support CT's and conductors.
5. The customer shall submit detailed drawings to MU for approval before ordering any equipment.

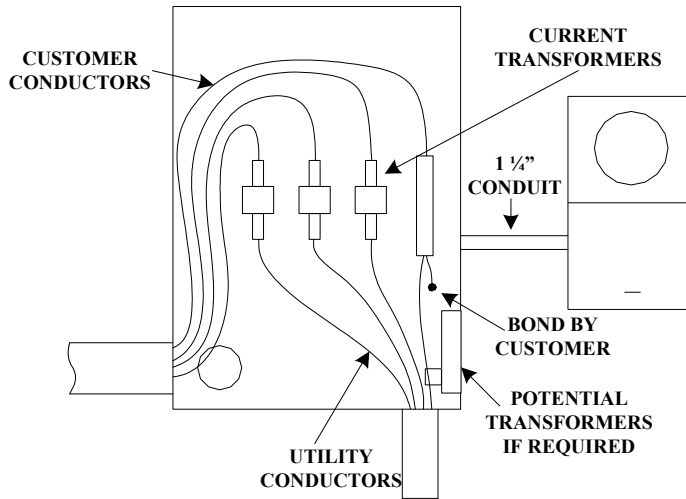
TYPE A



*CUSTOMER TO PROVIDE CT CABINET AND METER SOCKET (MU WILL BOND METER SOCKET)
 *RAIN TIGHT HUB(S) OR GASKET(S) SHALL BE USED ON ALL CONDUIT(S)

Figure 4-4 (a)
 Three Phase Current Transformer Cabinet Arrangements

TYPE A (ALTERNATE)



*SEE TYPE A FOR DIMENSIONS AND NOTES

Figure 4-4 (b)

Three Phase Current Transformer Cabinet Arrangements

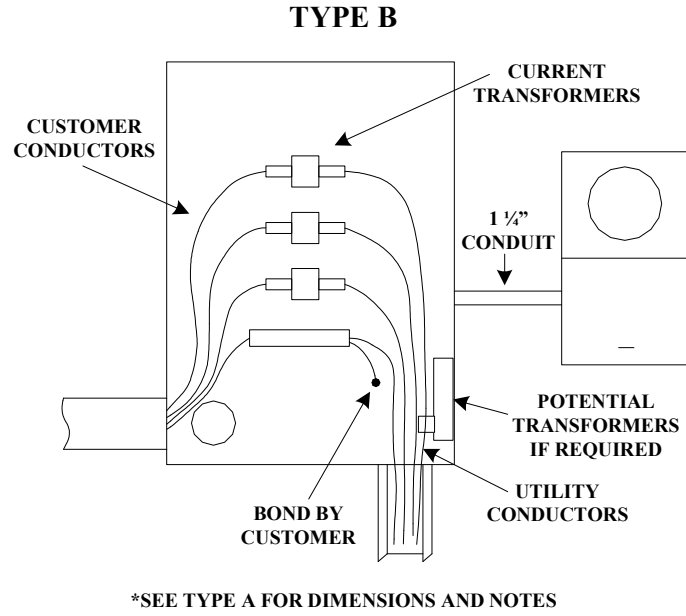


Figure 4-4 (c)
Three Phase Current Transformer Cabinet Arrangements

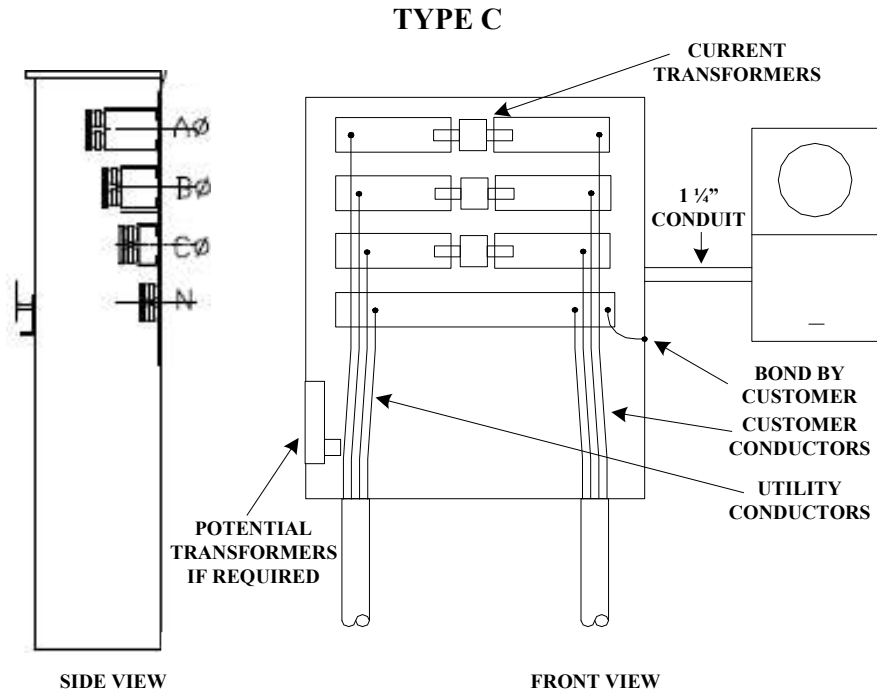


Figure 4-4 (d)

Three Phase Current Transformer Cabinet Arrangements

Detailed drawings must be submitted to MU for approval

4.6 Metering in Switchgear 1600 through 3000 Amperes

This metering option is available to customers with a 1600 through 3000-ampere service entrance. The customer should consult with MU early in the planning and design phase on metering and current transformer layouts to obtain timely approvals. There are two fundamental alternative designs, which are depicted in Figures 4-5 and 4-6.

Elements common to the design of both alternatives are:

6. The minimum depth of the current transformer cabinet is 10 inches
7. Doors shall be hinged and have a lockable hasp.
8. CT's must be adjustable for depth and height.
9. Bus shall be adequately braced to support CT's and conductors.
10. The customer shall submit detailed drawings to MU for approval before ordering any equipment.

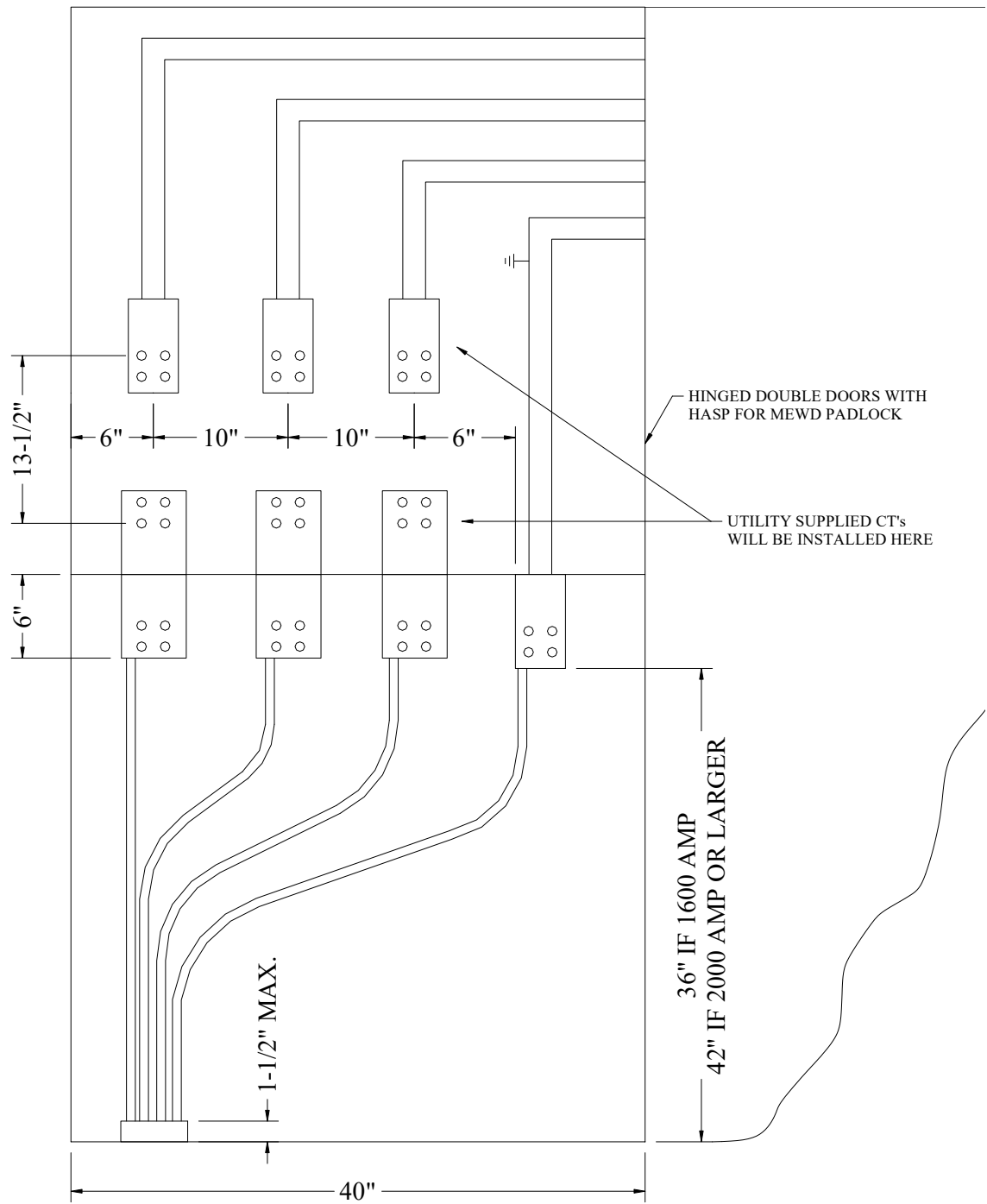


Figure 4-5
Three Phase Metering in Switchgear with Bar-type Current Transformers

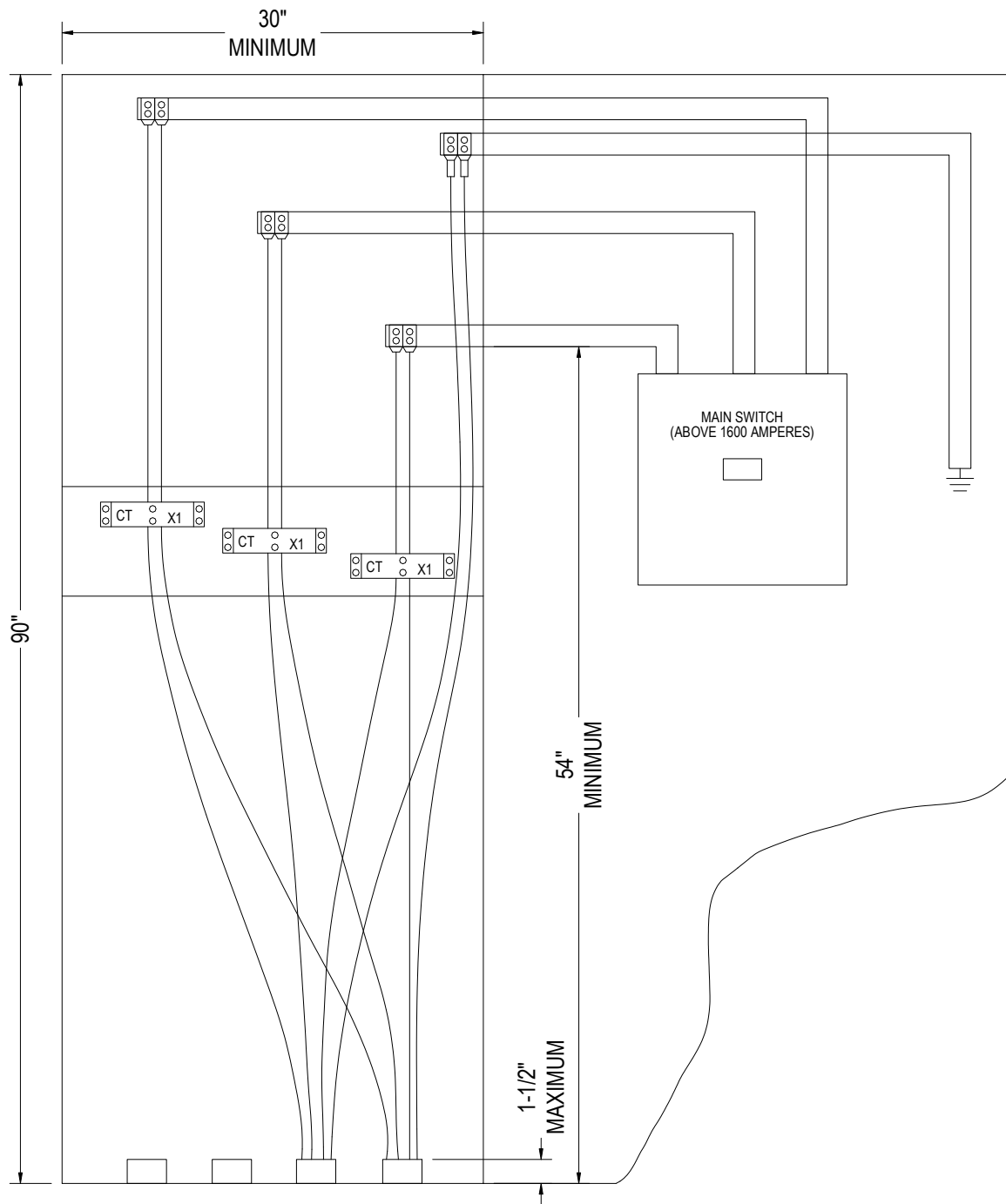


Figure 4-6
Three Phase Metering in Switchgear with Window-type Current Transformers

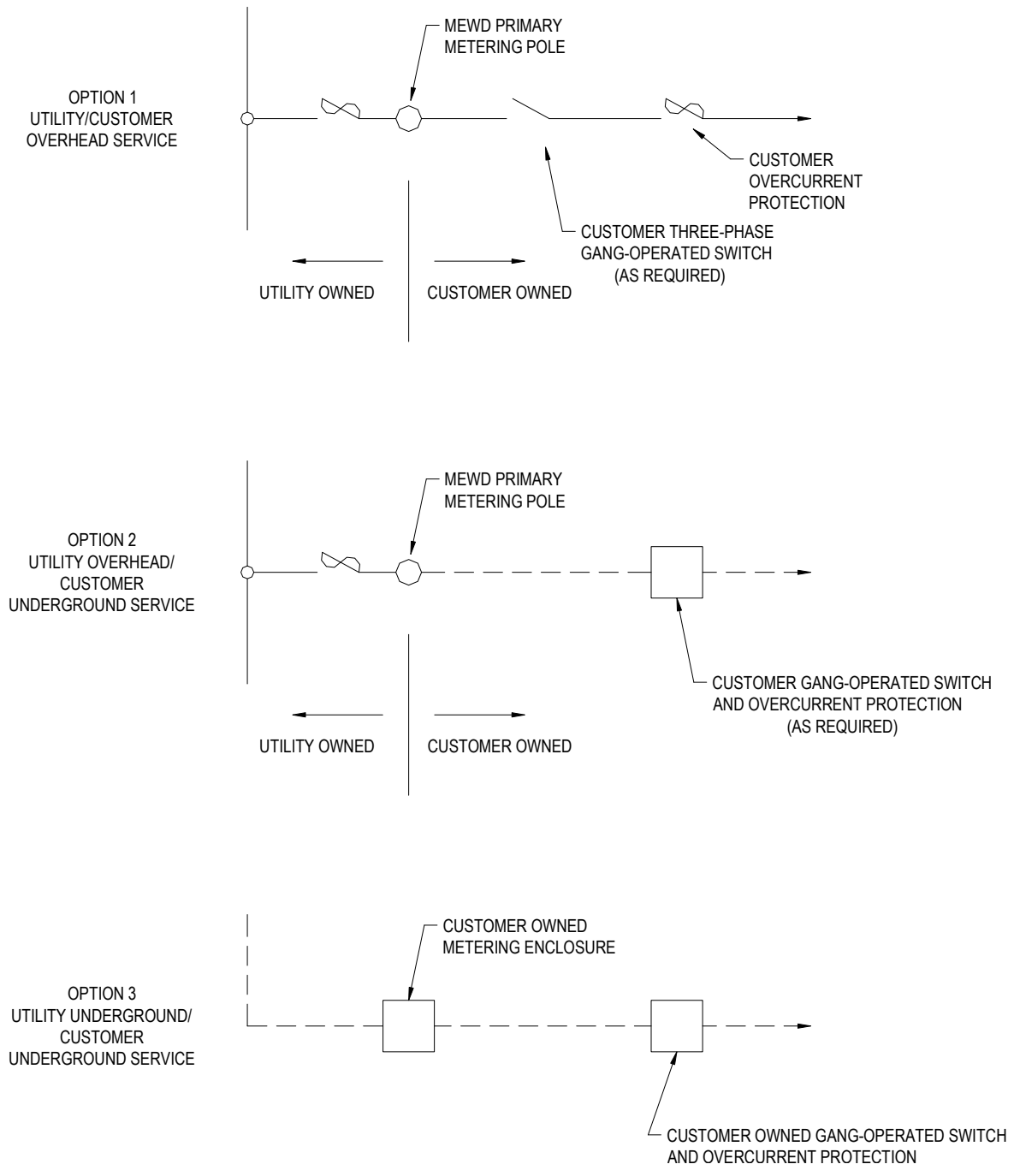
4.7 Primary Metering

Three-phase 13.2 kV primary voltage service is only available upon request by the customer and approval by MU. The customer must make application to MU for the proposed primary service and obtain approval of the location, equipment, and design before starting installation of the service entrance.

MU furnishes, installs, and maintains the primary service and metering equipment in accordance with MU's applicable rates and extension rules. The customer furnishes, installs, and maintains all service entrance facilities at the service point other than the metering equipment regardless of the metering location.

General requirements for primary metered service include:

1. The customer shall submit the plans for the location, equipment, and design to MU for approval.
2. The customer's system beyond the metering point must comply with the NEC and the Wisconsin Electrical Code Volume II requirements. Some of the key requirements are:
 - a. Overcurrent protection of branch lines and transformer overcurrent protection on the primary side of all transformers must be provided.
 - b. Overcurrent protection on the secondary side of transformers.
 - c. Clearances and separations must be maintained to the utilities metering equipment. See Section on Clearances.
3. The customer should avoid utilizing three-legged core transformers. Only grounded wye/grounded wye five-legged or triplex core transformers should be used. This is to minimize the possibility of ferro-resonance with loss of a phase. Contact MU for approval to use delta-wye wound transformers.



**Figure 4-7
Primary Metering Options**

4.8 Meter Ice and Snow Shield

Where meters are not protected by a building overhang and are subject to damage from falling ice and snow, particularly from metal roofs, the following meter ice and snow shield shown in Figure 4-8 shall be utilized. The customer is responsible for furnishing and installing the shield, and for repair costs resulting from damage caused by ice or snow. Unpainted stainless steel or steel shields that are primed and painted with rust-resistant paint are allowed. Shields shall be a minimum of 10 gauge. Wood or Plywood shields are not allowed.

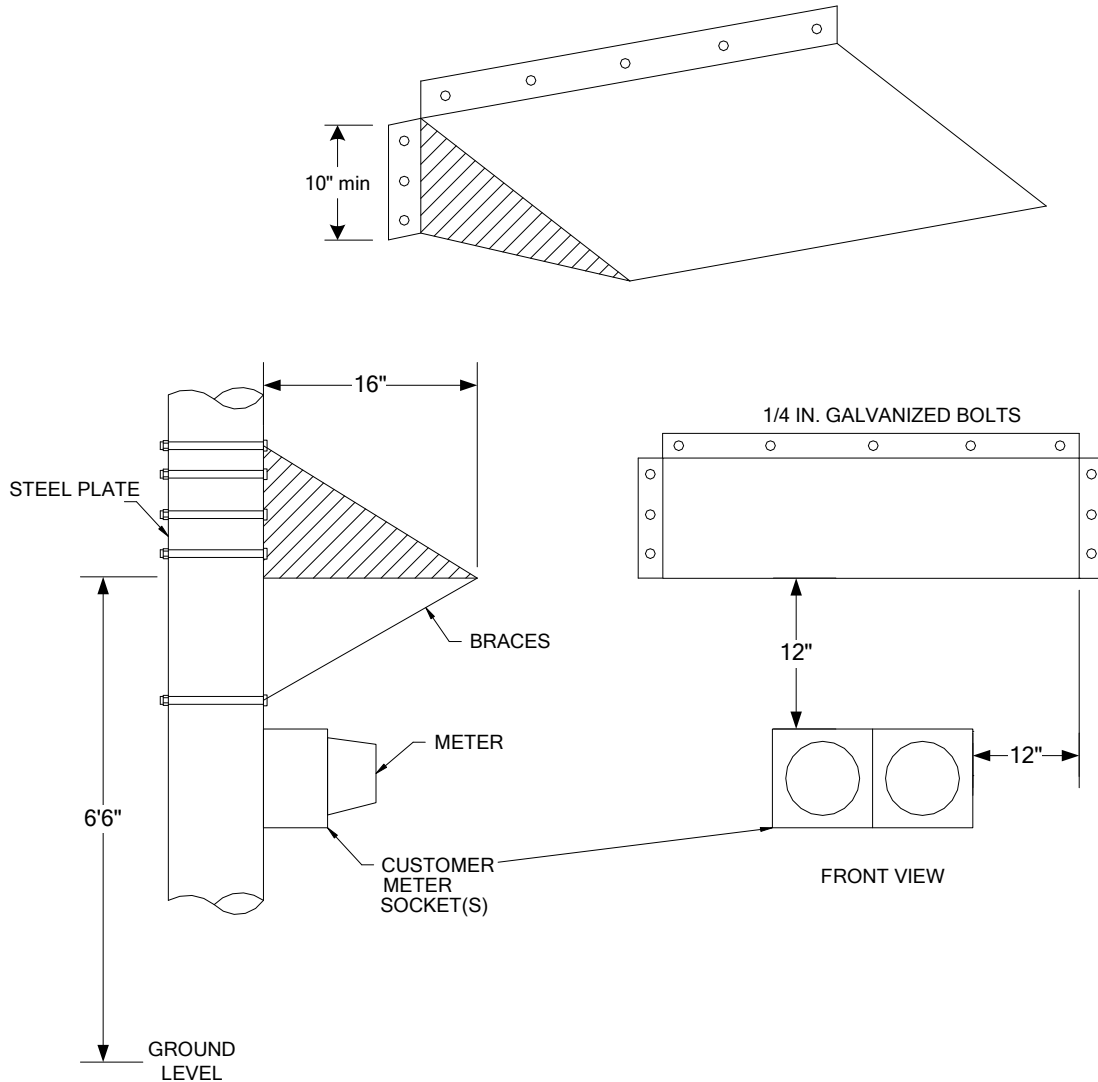


Figure 4-8
Meter Ice and Snow Shield

4.9

SECTION 5

CLEARANCES

The electric line clearances shown in Tables 5-1 are required for buildings, structures, and surfaces to comply with requirements of the National Electric Safety Code, the Wisconsin Administrative Code, and the Department of Labor, Occupational Safety and Health Administration, Safety and Health Regulations for Construction, [OSHA subsection, N1926.416 (g) (2)].

Unless otherwise noted, all clearances are from surface-to-surface and all distances are measured center-to-center.

5.1 Clearances for Electrical Overhead Services

Table 5-1
Clearances for Electrical Overhead Services

Triplex & Quadruplex Cables (most common)		Type A	
Open Wire Insulated Cables or Bare Cables		Type B	
Note that the following are the minimum clearances needed. Allow extra clearance to account for thermal loading, ice loading, and snow depth when looking at vertical clearances.			
VERTICAL CLEARANCES		TYPE A	TYPE B
Roads, Street, Driveways, Parking Lots, Alleys, Cultivated Land, Grazing, Forest, Orchards, and other areas subject to truck traffic.		19'	19'
Residential driveway with no truck traffic.		16'	16.5'
Spaces & ways subject to pedestrian or restricted traffic only (no horses riding or vehicles over eight feet). Less than 300 volts.		12'	12.5'
Spaces & ways subject to pedestrian or restricted traffic only (no horses riding or vehicles over eight feet). More than 300 volts.		15'	15'
Over or under roofs or projections not readily accessible (no permanent stairs or ladder, etc., to the roof; no vehicles).		8'	10.5'
Over or under roofs or projections not readily accessible with a 4/12 pitch or greater.		3'	10.5'
Overhanging portion of roof where 4 feet or less is crossed by 6 feet or less of service cable (does not exceed 300 volts)		1.5'	1.5'
Over or under roofs & balconies readily accessible to pedestrians (as part of structure to which service is not attached).		11'	11.5'
Over roof or balconies over which they pass and the service is attached to that structure.	Accessible	11'	11.5'
	Non-Accessible	8'	8'
Over or under catwalks & other surfaces upon which personnel walk.		11'	11.5'
Other vertical clearances to signs, chimneys, billboards, radio & TV antennas, tanks, and other installations not classified as building or bridges.		3.5'	6'
HORIZONTAL CLEARANCES			
To walls, projections, windows, and areas not readily accessible to pedestrians.		5'	5.5'
Horizontal clearances to signs, tanks, chimneys, billboards, radio & TV antennas & other installations not classified as buildings or bridges.		5'	5.5'

Note: Where these clearances cannot be obtained, the conductors and rigid live parts shall be guarded. (NESC 234C2). Reduced clearance may be allowed under specific conditions, contact MU.

5.2 Padmounted Transformer Clearances

The following underground equipment clearances are reprinted from Volume 1 of the Wisconsin State Electrical Code. These clearances apply to the location of oil-insulated padmounted transformers near buildings.

Combustible or non-rated walls are walls of Type No. V buildings as determined by Wisconsin Building Code (Construction Classification IBC Chapter 6). Type No. III and IV buildings can be considered combustible or non-rated. Check with the local building inspector, before locating transformers, for building ratings. All other walls are considered to be non-combustible or rated.

A. NON-COMBUSTIBLE WALLS

Padmounted oil-insulated transformers may be located within 3 feet of noncombustible walls, if all of the following clearances are maintained from doors, windows, and other building openings.

1. Doors

Padmounted oil-insulated transformers shall not be located within a zone extending 20 feet outward and 10 feet to either side of a building door.

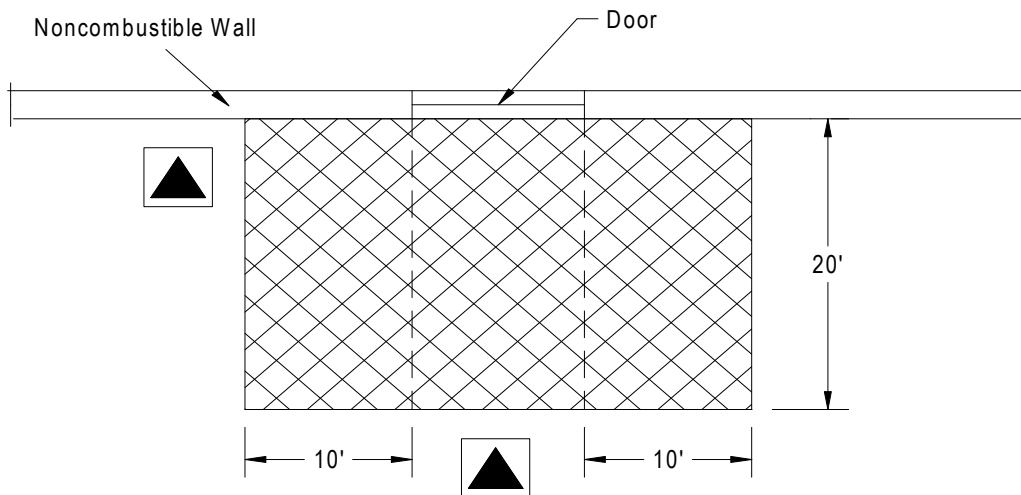


Figure 5-1
Pad-Mount Transformer Door Clearance

2. Air Intake Openings

Padmounted oil-insulated transformers shall not be located within a zone extending 10 feet outward and 10 feet to either side of an air intake opening. If the air intake opening is directly above the transformer, there must be a 25 feet vertical distance from the opening to the transformer.

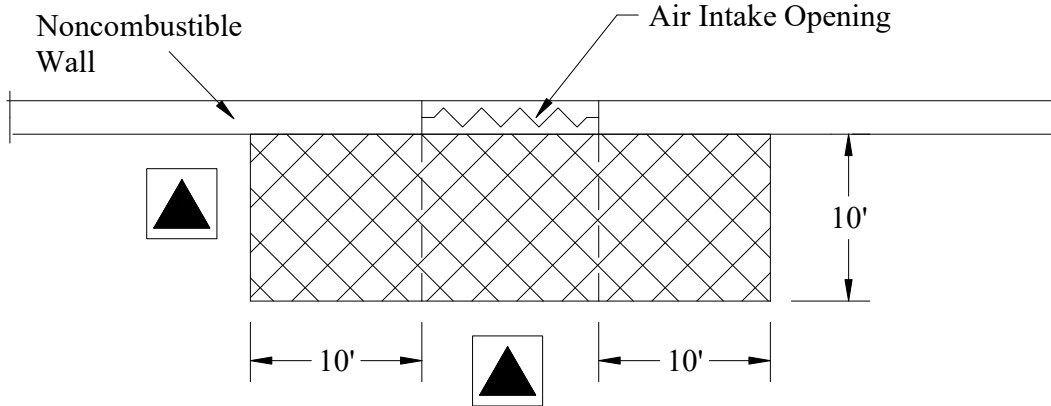


Figure 5-2
Pad-Mount Transformer Air Intake Clearance

3. Windows or openings other than air intake

a. First Story

Padmounted oil-insulated transformers shall not be located within a zone extending 10 feet outward and 3 feet to either side of a building window or opening other than an air intake. Exception: This does not apply to a glass block or fire window meeting the requirements of the Wisconsin Commercial Building Code (Fire Window IBC Chapter 7, Section 714.3).

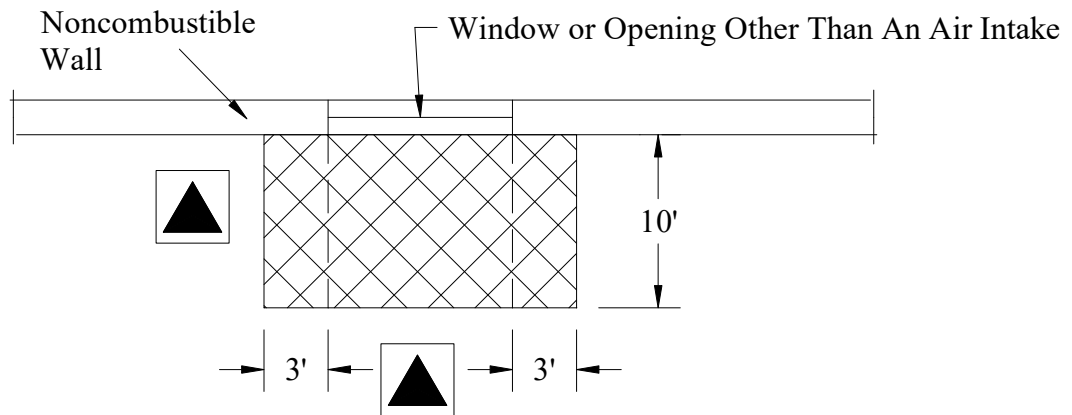


Figure 5-3
Pad-Mount Transformer First Story Opening Clearance

b. Second Story

Padmounted oil-insulated transformers shall not be located less than 5 feet from any part of a second story window. Exception: This does not apply to a glass block or fire window meeting the requirements of the Wisconsin Commercial Building Code (Fire Window IBC Chapter 7, Section 714.3).

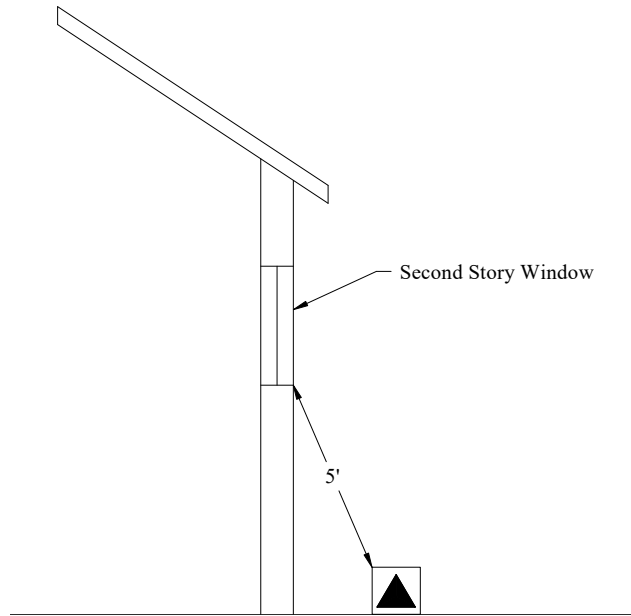


Figure 5-4
Pad-Mount Transformer Second Story Window Clearance

C. COMBUSTIBLE WALLS

Padmounted oil-insulated transformers in sizes up to and including 100 kVA shall be located according to the provisions set forth for non-combustible walls.

Padmounted oil-insulated transformers in sizes above 100 kVA shall be located a minimum of 10 feet from the building wall in addition to the clearances from building doors, windows, and other openings set forth for non-combustible walls.

In addition to PSC 114 MU also requires:

Installations using 75 kVA three phase padmounted transformers should be designed using the clearance requirements for above 100-kVA transformers to permit a future capacity upgrade.

D. BARRIERS

If the required clearances specified above cannot be obtained, a fire-resistant barrier shall be constructed in lieu of the required separation. The following methods of construction are acceptable:

1. Non-Combustible Walls

The barrier shall extend to a projection line from the corner of the padmounted transformer to the furthest corner of the window, door or opening in question. The height of the barrier shall be 1 foot above the top of the padmounted transformer.

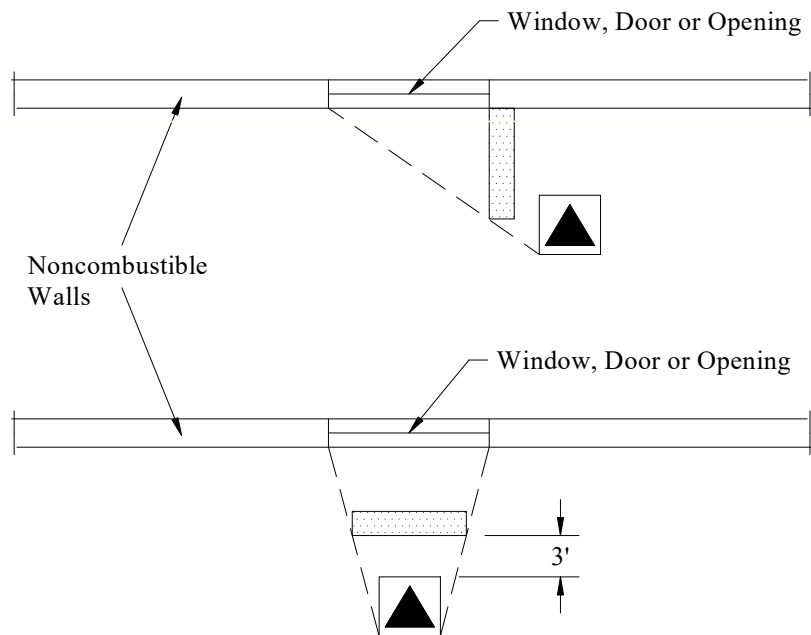


Figure 5-5
Pad-Mount Transformer Non-Combustible Wall Clearance

2. Combustible Walls

The barrier shall extend 3 feet beyond each side of the padmounted transformer. The height of the barrier shall be 1 foot above the top of the transformer.

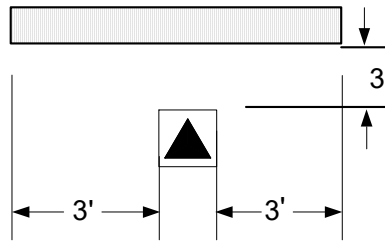
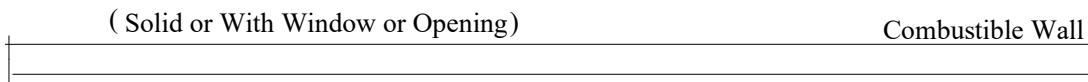


Figure 5-6

Pad-Mount Transformer Combustible Wall Clearance

E. FIRE ESCAPES

1. Horizontal Clearance - Padmounted oil-insulated transformer shall not be located within a zone extending 20 feet outward and 10 feet to either side of the point where a fire escape meets the ground.
2. Vertical Clearance - Padmounted oil-insulated transformers located beneath fire escapes shall have a vertical clearance of not less than 10 feet from the top of the transformer to the bottom of the fire escape.

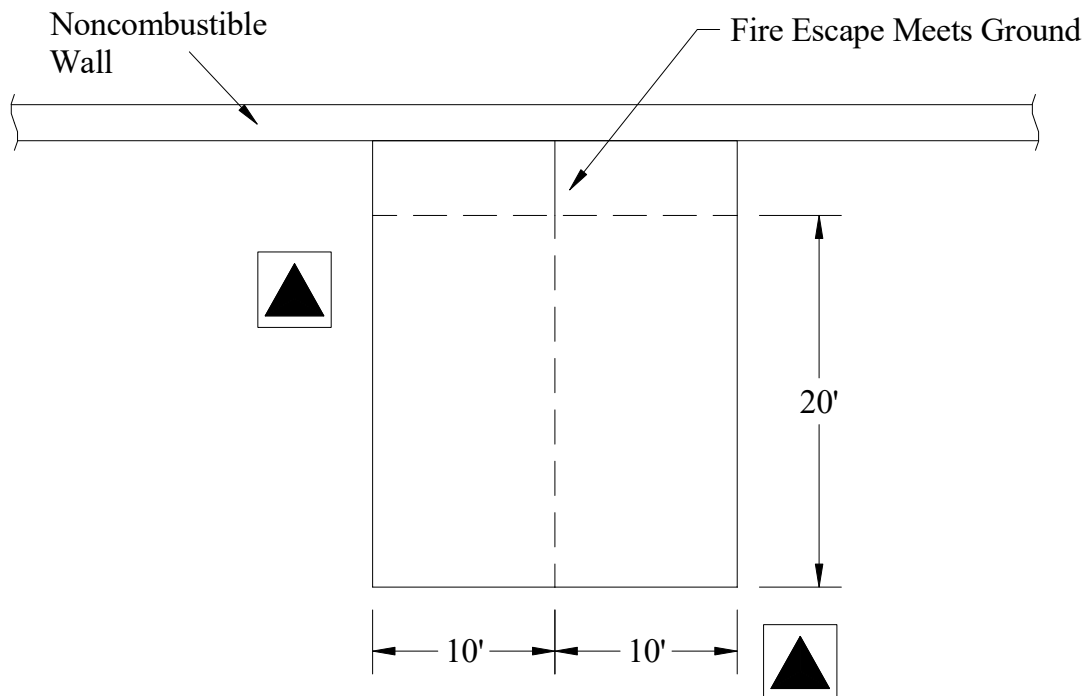


Figure 5-7

Pad-mount Transformer Fire Escape Clearance

E. Generators

Generators shall not be located within 20 feet horizontally of any of the following: padmounted transformer, electrical metering, electrical service equipment, or normal power distribution equipment. The 20 feet requirement may be reduced to a minimum of 3 feet where a noncombustible barrier is installed that extends at least 3 feet. Beyond each side of the widest piece of electrical equipment (generator, transformer, metering, etc.) and 1 foot above the top of the tallest piece of involved equipment, provided all clearances required by the generator manufacturer are met. The 3 feet minimum would have to be increased depending on location of over current protection devices and voltage levels. The noncombustible barrier cannot be located less than 3 feet to the distribution transformer.

5.3 Gas Lines

The separation in any direction from as measured from the nearest duct in the conduit shall be a minimum of 12 inches and should have sufficient space to permit use of pipe maintenance equipment.. [NESC 320.B (5)] If this clearance cannot be attained, the gas line shall be protected from damage that might result from the proximity of the electric supply or communication direct-buried system.

5.4 Clearance of Lines near Wells

Overhead open supply conductors shall not run over wells. A horizontal clearance with conductors at rest shall be no less than $\frac{3}{4}$ of the vertical clearance to ground, and a horizontal clearance of not less than 10 feet with conductors displaced by wind.

Underground supply cable should be installed with a 5 feet separation to the well installation.

5.5 Clearance to Sewers

The horizontal separation between service cable and other underground structures should not be less than 12 inches to permit access to ground maintenance of either facility without damage to the other.

Drain field, alternate field, and septic tank separation to service cable should be at 5 feet if less than 480 volts and 10 feet if 480 volts or more by MU policy and/or local ordinance as applicable.

Separation between service cable and mound systems should be 20 feet. The 20 feet should be measured from the perimeter of the mound system.

5.6 Stored Materials

Overhead lines shall not be run over designated material storage areas where material is regularly stored and handled by cranes, dump trucks, elevators or other types of high machinery unless the clearance of such lines is adequate to permit the full use of the equipment while maintaining all code required clearances.

5.7 Clearance of Lines near Fuel Storage Tanks

Electric lines shall not be run over aboveground flammable liquids or liquefied petroleum gas (LPG) storage tanks. A horizontal clearance of not less than 8 feet is required for services and secondary cables and 15 feet for all other conductors. LPG tanks with a capacity of 1000 gallons or less or tanks enclosed in a building or fully covered by a roof or canopy capable of preventing a falling overhead supply conductor from directly contacting the tank are exempt from this requirement.

Underground supply cables shall not come within 10 feet of above ground or below ground fuel storage tanks. Underground cables shall not go under fuel storage tanks.

5.8 Antennas

Outdoor antennas and supporting structures attached to buildings shall have a horizontal clearance from utility electric lines at least 10 feet greater than the total height of the antenna and supporting structure.

Service cables of 150 volts or less to ground shall have a minimum clearance of 3 feet 6 inches from the antenna and supporting structure except a minimum clearance of 2 feet is permitted from the service conductor drip loop.

5.9 Buildings

Underground electric lines are only permitted under buildings if installed in conduit. MU approval is required.

5.10 Swimming Pools

The following parts of swimming pools shall not be placed under existing service-drop conductors or any other open overhead wiring nor shall such wiring be installed above the (1) pool and 10 feet horizontally from the inside walls of the pool; (2) diving structure; or (3) observation stands, towers, or platforms.

Exception: Structures listed in (1), (2), and (3) above shall be permitted under utility-owned supply lines or service drops (insulated wires 750 volts or less) where such installations provide the following clearances for utility service drops:

A = 22.5 feet, B = 14.5 feet, C = 10 feet minimum or normal clearances. [NEC 680.8(a)]

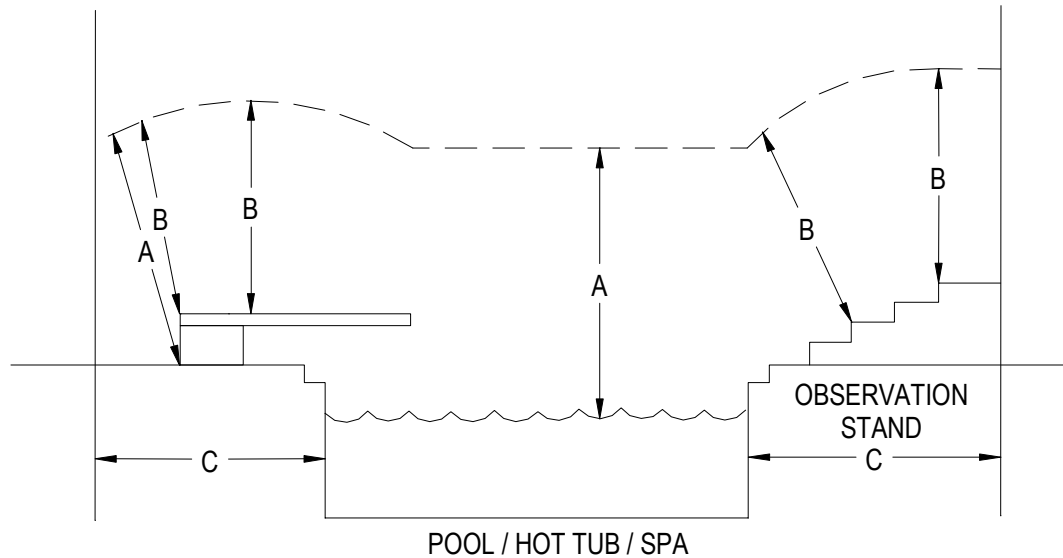


Figure 5-8
Underground Cable Pool Clearance

Underground cable shall not be installed under or within 5 feet of a swimming pool, hot tub, or spa.

5.11 Grain Bins

A clearance of not less than 18 feet in all directions must be maintained for a grain bin and any related equipment for all wires, conductors, and cables. MU should be consulted before installing grain bins near any wires, conductors, or cables.

5.12 Alternate Sources of power

Alternate sources of power located outdoors for emergency systems shall be located at least 10 feet horizontally from any combustible portion of a Type III, Type IV, or Type V building and at least 20 feet from an outdoor electrical transformer, electrical metering, service equipment, or normal power distribution equipment. These dimensions may be reduced by one-half where a noncombustible barrier is installed that extends at least 3 feet beyond each side of the transformer and alternate power source. The height of the barrier shall be at least one foot above the top of the transformer, electrical metering, service equipment, or alternate power source, whichever is higher.

SECTION 6

MU - POLICIES AND RULES

6.1 Code Compliance and Inspection

All wiring must be done in accordance with the requirements of the Wisconsin Administrative Code Volume 2 Electrical Code. Volume 2 essentially follows the National Electrical Code (NEC) requirements with few changes and several additions. Wiring must also comply with any MU rules and local requirements which may apply.

All new electrical services or changes to existing services within the city limits of Marshfield will require an inspection by the Marshfield electrical inspector prior to any service work being performed by MU. Service changes within the village limits of Hewitt will require an inspection by the Hewitt electrical inspector. For areas outside the city limits of Marshfield or the village limits of Hewitt, an inspection completed by the authorized township inspector must be completed. A form stating code compliance from the inspector shall be given to MU.

MU will not interpret the electrical code. Questions concerning electrical code interpretations should be referred to the local or state electrical inspector.

MU is not responsible for the inspection of the customer's wiring or electrical equipment. However, if a MU employee discovers the customer's wiring or equipment is unsafe or in violation of the state or local codes, MU will withhold or disconnect service.

6.2 Continuity and Quality of Service

MU will use reasonable care to provide uninterrupted supply of service and shall not be liable for any loss, injury, or damage resulting from interruptions of service not due to negligence on its part.

MU shall have the right to cause service to any customer to be interrupted or limited at any time without liability, by automatic devices or otherwise, when in the judgement of MU such interruption or limitation of service is necessary or desirable due to emergency conditions.

MU may also curtail or temporarily interrupt the customer's electric service in order to make repairs, replacements, or changes to MU's facilities either on or off the customer's premises. MU will, whenever practical, give notice to the customers who might be seriously affected by such suspension or curtailment of service.

MU will use reasonable care to provide service of acceptable quality, but shall not be liable for any loss, injury, or damage resulting from deficiencies or imperfections of service not due to negligence on its part.

6.3 Service Outages

At various times MU will require scheduled or non-scheduled outages to safely perform construction or maintenance work on the electric system. Listed below are some guidelines related to scheduled outages.

a) Utility Requested Outages – Residential

These outages will normally be scheduled during work hours.

b) Utility Requested Outages – Commercial/Industrial

These outages are scheduled during normal work hours whenever feasible. If not feasible, MU will shift work hours to attempt to complete them earlier in the morning or later in the afternoon. If this is not feasible, and if the outage will cause a loss of revenue or significant inconvenience for our customers, we will schedule the outage on weekends at a mutually agreeable time. If the outage time suggested by the customer will result in extraordinary cost or difficulty for MU, the customer shall be responsible for the added costs.

c) Customer Requested Outages

These outages should be done during normal work hours if possible. If the work is requested to be completed after hours or on a weekend, the customer shall be responsible for the full cost incurred by MU.

These guidelines for scheduled outages shall be followed whenever practical. However, each case may have to be reviewed to take into consideration any extenuating circumstances.

6.4 Service Utilization

All motors, appliances, welders, or equipment interconnected to MU system Infrastructure shall be designed, installed, and operated to avoid causing interference to other customers, service equipment, or MU in maintaining proper system conditions.

The customer shall provide motor protection for under-voltage, over-voltage, and loss of phase or phase reversal.

MU will do its best to provide service in compliance with the Wisconsin Administrative Code. This Code allows voltage transients of an infrequent nature, which may adversely affect the operation of certain sensitive equipment. The customer shall provide protection, uninterruptible power supplies, or other accessories needed to prevent undesirable operation of sensitive equipment caused by these transients.

It is normal for MU's system neutral to have low voltage levels, particularly in rural areas. This voltage creates no difficulty for most customers. If the customer experiences a

problem with this voltage, it may be possible to use available measures to reduce it. The customer and electrician can help mitigate any problem by ensuring proper grounding and bonding of wiring and other electrical equipment on the customer's premises.

6.5 Resale of Energy

Generally resale of energy will not be permitted by MU. Conversely, there may be extenuating circumstances necessitating the resale of energy. MU must be consulted for a situation believed to require the resale of energy. If MU grants permission for the resale of energy, the rate charged cannot exceed the current rate MU charges customers. The installation of test or check meters are allowed for informational purposes.

When meters are used for testing or accounting purposes, the customer is responsible for purchasing, installing, and maintaining such meters.

MU does not sell electric meters.

6.6 Diversion (Theft) of Electricity

State law allows MU to prosecute persons who tamper with metering or other service equipment or who attempt to steal electricity. It is the intention of MU to prosecute such offenders to the full extent of the law. Common violations of the law could include:

- Energizing a new service without proper authorization
- Re-energizing a service which has been disconnected by MU for nonpayment or other reasons.
- Bypassing a meter, jumpering a meter socket, or in any other way diverting energy around the meter.
- Breaking meter seals or entering metering equipment, service termination boxes, wire raceways, and service entrance switches containing unmetered conductors without proper MU authorization.

The customer shall be responsible for compensation to MU for any energy consumed, but not metered, whether intentional or not. All costs (labor, vehicle, etc.) associated with investigation, fixing, reconnecting, etc. will be the customer's responsibility. See MU rate file 201.5 for additional information.

6.7 Meter Socket Access

Only MU employees are normally allowed to remove meter seals from MU meter installations. An electrical contractor requiring access to a meter socket is to contact MU. MU will dispatch an employee to the site or grant permission for the electrical contractor to break the meter seal for inspection and testing purposes. Only MU employees are allowed to remove or set meters.

MU will seal all access panels on equipment located ahead of the meter in addition to the meter socket cover.

Only MU employees are to seal meter installations. The socket and related wiring is to be thoroughly inspected before any seal is placed. The electrical inspector may seal a meter on which he/she has broken the seal for inspection purposes. He/She shall not seal an otherwise unsealed meter.

6.8 Utility Equipment on Customers Premises

MU shall have the right to install, inspect, and maintain its equipment on the customer's premises as necessary to furnish proper service. This includes the right to have access to electric meters at all reasonable times, including unrestricted access for meter readings, maintenance, inspections, etc. All such equipment will remain MU property and MU shall have the right to remove it upon discontinuance of service.

The customer shall be responsible for damages and losses resulting from interference, tampering, or damage MU equipment caused or committed by the customer. In the event MU equipment is interfered with, tampered with, or damaged, MU may require the customer to install tamper-proof equipment, relocate equipment, or repair or replace damaged equipment. Such expense will be borne by the customer.

6.9 Cable Locates

State law dictates that no digging or excavating (including the installation of ground rods, etc.) be done in any area where electrical wires are buried until those wires are located and marked by MU. MU or MU contracted locating service will locate MU owned electrical underground wires at no charge. All locate requests are to be called into Digger's Hotline at least three (3) working days before the excavation is to take place. Note: MU is not responsible for locating any underground wires owned by the customer that are located beyond the metering point. Violations of this statute will be reported by MU to the proper authorities.

6.10 Line Extensions on Other than Private Property

MU shall obtain all necessary licenses or permits for rights-of-way along the route, which are not on private right-of-way such as highway permits, railroad licenses, etc. The customer requesting service is responsible for the associated costs, including license and permit fees.

6.11 Line Extensions on Private Property

Extensions of MU overhead and underground distribution lines onto property of the customer will be made in accordance with MU extension rules. These rules provide, among other things, that MU will own and be responsible for the maintenance and operation of such lines and shall have the right of access at all reasonable times for construction, rebuilding, tree trimming, and inspection of lines and equipment. MU also has the right to extend its facilities to serve other customers and to remove lines and equipment upon discontinuance of service.

MU will prepare all necessary easements along the selected route. The customer requesting service shall be responsible for obtaining the necessary signatures and all associated easement costs. When facilities are installed at customer request, the customer shall grant right-of-way satisfactory to MU.

Permanent certified survey stakes identifying property lines shall be installed prior to MU installation of facilities. The developer on all new developments shall provide certified survey stakes.

The customer shall identify all privately owned underground equipment before MU installs its facilities. Repair of damage to customer-owned underground equipment not located and/or identified by the customer shall be the customer's responsibility.

The customer shall provide the following at no expense to MU:

The right-of-way as designated by MU shall be cleared of trees and obstructions. Any clearance of these obstacles by MU must be arranged in advance of construction and the cost of the clearance will be at the expense of the customer.

The grade along the route of proposed underground facilities must be within 3 inches of final grade.

Conductors located or to be located beneath buildings, pavement, or other obstructions shall be placed in conduit extending at least 3 feet beyond the obstruction.

If obstructions are placed on the facilities right-of-way after the facilities are installed, any additional repair costs incurred due to the obstruction(s) will be billed to the customer if repairs to the facilities become necessary.

6.12 Attachments on MU Poles

Attachments to MU poles are not permitted without the knowledge of and explicit written approval of the Electrical Department Manager. Some examples of attachments include lighting, birdhouses, signs, posters, notices, and structural devices such as wires, conductors, electrical apparatus, fencing, antennas, and traffic control units. MU poles must be kept free of these potential climbing hazards.

Section 86.19 of the Wisconsin Statutes requires that:

"No signs shall be placed within the limits of any street or highway except such as are necessary for the guidance or warning of traffic...."

The National Electric Safety Code 217A4 states:

"No attachment of any kind to a supporting structure of a utility line (including lighting and metering structures) shall be allowed without the concurrence of the structure owner. Non-utility attachments shall also have concurrence of the occupant(s) of the space in which the attachment is made.

- a. No attachment shall cause any portion of the resulting installation to be in noncompliance with the clearance, grounding, strength, or other requirements of the NESC.
- b. Attachments shall neither obstruct the climbing space nor present a climbing hazard to utility personnel. Through-bolts shall be properly trimmed. Vines, nails, tacks, or other items which may interfere with climbing should be removed before climbing."

Any items improperly attached or otherwise infringing on MU facilities will be removed at customer expense.

6.13 Service Days

Service work, including both temporary and permanent installations, will be performed on scheduled service days. Service days are any weekday that MU's main office is open.

6.14 Service Location

All metering facilities shall be on the exterior of the building. On overhead services, the proposed route shall be clear of obstructions from trees and have sufficient clearances to windows, doors, etc. The service mast conduit is not to be covered before the meter socket other than what passes through the roof overhang. The customer should consult with MU for the proper meter and service conductor attachment locations to the building if there are any questions. The meter shall be located at least three feet from an existing deck, patio, or door. This clearance may be reduced in certain situations, contact MU for approval before installation. The preferred location for new services will be on the front or sides of the house. Rear house locations are discouraged. Existing services may remain

in the rear but should be relocated to the side or front if there are possible encroachment issues. Ex. Decks, A/C units, etc.

Existing meters, which are in violation of this rule, shall be required to comply when modifications to the service occur, (e.g. an upgrade, replacement, etc.). In addition, any location found unsuitable to MU shall be required to be moved at the customer's expense. Figure 6-1 shows the separation requirements from doors, and gas utility equipment. Code requires 3' of separation between the gas regulator exhaust vent and the electric service.

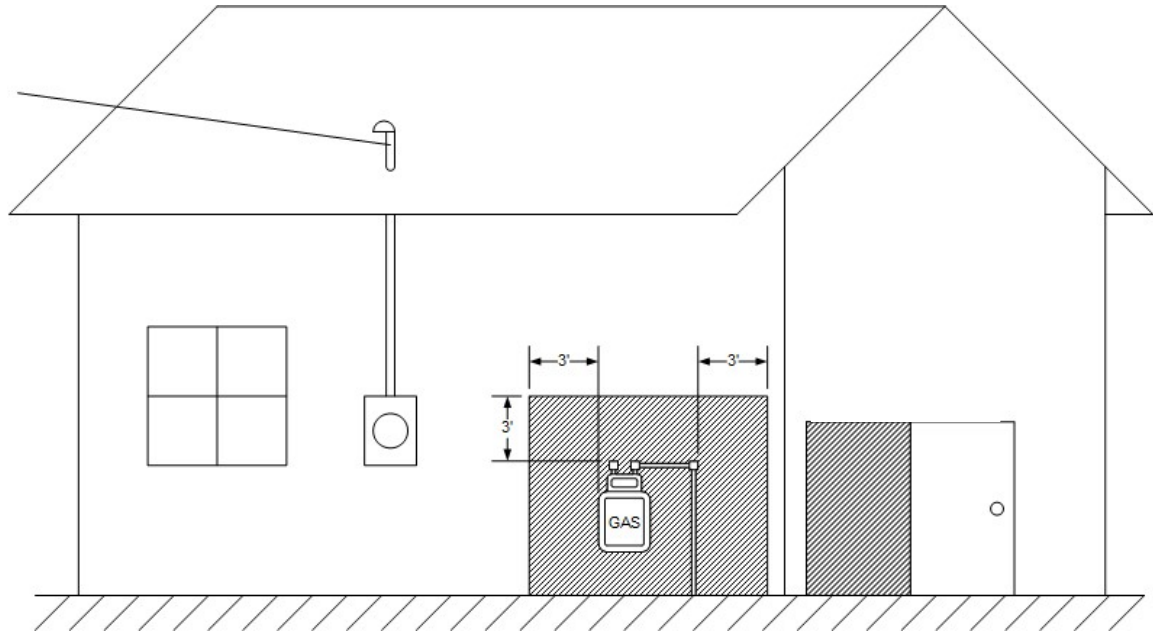


Figure 6-1
Service Location Requirements

6.15 Address Posted

Before any service work is performed on the customer site, the house numbers must be posted on the house or on a construction permit to ensure that MU crews are at the correct address. If the address is not clearly posted, service will be delayed until the next service day after the address is properly posted. Failure to have address posted may result in extra charges for the service hook-up.

6.16 Cut-Off Time

All service orders to be completed must be approved and in MU offices by NOON OF THE DAY PRIOR TO THE DAY WORK IS TO BE COMPLETED.

6.17 Service Entrance Wiring

The main disconnect must be turned off and all service entrance wiring completed, including proper grounding, before connection to MU facilities. Any load connected beyond the meter shall be detected as a fault and, therefore, the meter shall not be set until the suspected fault is removed. Should faulty wiring, lack of proper grounding, or other electrical code violation be detected by MU crew assigned to energize the electrical service, the service shall not be connected until the problem has been corrected. Furthermore, it is MU's option to charge the customer for the crew's time for the second and any subsequent attempts to energize the service.

6.18 Meter on Utility Poles

No permanent metering facilities other than CATV are permitted on Utility owned poles without written authorization from MU's Electrical Department Manager.

6.19 Temporary Services

All customer temporary service locations require Utility approval prior to connection. Temporary service facilities of the customer may be directly attached to MU pole with verbal approval. The customer's temporary service facilities to be served from the overhead MU system shall be located near MU distribution facilities on a customer or contractor furnished meter pole. In underground areas, the temporary service facilities shall be located within 10 feet of a MU secondary pedestal or near the transformer cabinet if no pedestal is available. Verify proposed location with MU before installation.

Payment for temporary service must be made prior to hook-up.

Temporary services must comply with all applicable codes including but not limited to ground fault protection.

6.20 Motors and Associated Equipment

All customer-owned equipment shall be protected from excessive current which may result from overvoltage, undervoltage, or single-phase operation of three phase equipment, phase reversal, or other abnormal conditions with fuses, thermal cutouts, overload relays, or other relays and devices designed to protect the individual device. The customer, considering the characteristics of the utilization equipment and the requirements of the process and function being performed, should apply protection. The customer is also responsible for notifying MU in a timely manner of planned increases in the customer's peak load as well as planned service modifications. The timely notification will permit MU to evaluate the adequacy of the existing facilities to serve the planned load increases and increase the capacity of the facilities if necessary.

In order to prevent impairment of service to other customers, it is necessary to establish limits for the allowable starting currents for motors. Before selecting motor equipment, the customer should consult MU to determine the specific voltages available at any location.

When a motor issued to drive equipment that requires varying torque during each cycle of operation, such as a compressor or reciprocating pump, the combined installation should have enough momentum in its moving parts so that its operation will not interfere unduly with service to other customers. For air conditioner motors, see section 6.26.

1. Types of motor service available on general service lighting rates, single-phase only are as follows:
 - a. Single-phase fractional horsepower motors: Automatically controlled and frequently started, whose locked rotor currents do not exceed 23 amperes may be connected to 120-volt circuits.
 - b. Single-phase motors, one horsepower or less: Manually controlled or infrequently started, whose locked rotor currents do not exceed 50 amperes may be connected to 120-volt circuits. No single-phase motor larger than 1 horsepower shall be operated on a 120-volt circuit.
 - c. Infrequently started single-phase motors of 10 horsepower or less may be connected to 240-volt commercial lighting and residential circuits if their locked rotor currents do not exceed the values shown in the next section describing motor service available on power rates.
 - d. In urban areas infrequently started three-phase motors of 10 horsepower or less; connected through single-phase to three-phase converters may be used on residential and commercial lighting circuits.
 - e. Single-phase motors above 10 horsepower are not permitted in rural areas.

2. Types of motor service available on power rates and combined light and power rates, single-phase and three-phase are as follows:
- a. Motors with long periods of continuous operation under maximum load conditions and having not more than four starts per hour may be connected if their locked rotor currents do not exceed those listed in the following table. Consult MU where these conditions cannot be met, or where equipment ratings and/or starting characteristics exceed the values in the table:

Table 6-1 Motor Starting Table	
Motors Rated	Total Locked Rotor Current not to Exceed
120 volts, single-phase	50 amperes
240 volts, single-phase	
2 horsepower or less	60 amperes
2 to 6.5 horsepower	60 amperes plus 20 amperes per horsepower in excess of 2 horsepower
6.5 to 15 horsepower	250 amperes plus 10 amperes per horsepower in excess of 6.5 horsepower
240 volts, three-phase	
2 horsepower or less	50 amperes
2 to 19.9 horsepower	50 amperes plus 14 amperes per horsepower in excess of 2 horsepower
20 horsepower to 40 horsepower	300 amperes plus 4 amperes per horsepower in excess of 20 horsepower
50 horsepower and over	8 amperes per horsepower

- b. Motors above 10 horsepower rating are to be three-phase.
- c. New installation of motors of 50 horsepower or larger shall be approved by MU as to motor type, starting and protective equipment, and as to availability of an adequate power supply at the proposed location
- d. For motors of higher voltage rating than shown in the motor starting table, the allowable currents are inversely proportional to the voltages.
- e. Motors subject to frequent starts, such as elevator and hoist motors, when connected to the secondary distribution system, should have their starting current limited to 100 amperes.

6.21 Electric Water Heating

All electric water heaters shall be connected in accordance with local and state electrical codes.

Water heaters shall be equipped with resistive heating elements, which may be connected to 120 volts or 240 volts. If connected at 120 volts, the maximum heating element is 1650 watts. If connected at 240 volts, the maximum heating element size shall be 5500 watts. Water heaters having two or more elements shall have the heating elements interlocked to limit the connected load to the above limits.

Instant recovery water heaters with wattages above 5500 require the permission of MU to connect.

6.22 Electric Space Heating

Electric space heating equipment designed to operate at 120 volts shall be limited to 1650 watts controlled by a single thermostat. Electric space heating equipment designed to operate at 208 volts and greater shall be limited to 6000 watts controlled by a single thermostat. Equipment exceeding 6000 watts shall be energized in stages not exceeding 6000 watts per stage and at time intervals between stages of at least 3 seconds.

6.23 Lighting

Lighting systems utilizing ballasts or transformers shall maintain not less than a 90 percent lagging power factor. Utility owned area lighting is available for installation on customer owned poles. The lighting may be installed on Utility poles if such poles are already available in the area to be lighted. Customer furnished poles must be of sufficient heights and properly guyed to meet all code requirements. This would normally require a minimum of a 30 foot pole set at least 5-1/2 feet deep. MU would install the lights and conductors to provide service to the customer-installed pole. The customer should contact MU about the location and availability of lighting from MU.

Poles are available at a nominal charge from MU for pickup and installation by the customer. The customer will continue to own the pole after installation.

The customer agrees to keep the area lights in service for a period of at least one year.

6.24 Electric Welders and Furnaces

Electric welders and furnaces shall not be operated such that they cause interference or impairment to the service of other customers. MU requests notification before a welder or furnace is connected to ensure that MU's facilities have adequate capacity, and service to other customers is not impaired.

6.25 Harmonics and High Frequency Equipment

All utilization and production equipment causing high frequency current or harmonics must comply with Wisconsin Administrative Code PSC 113.0704, which adopts IEEE Standard 519 as a guide to intolerable voltage and current harmonics.

All wiring carrying high-frequency current shall be located as remotely as possible from the meter and wiring of the building. MU may require the customer to install an isolation transformer or filters to protect the meter and metering devices.

6.26 Air Conditioners

- a. Air conditioners for use at 120 volts single-phase are limited to a maximum locked rotor current of 50 amperes and a maximum of 4 starts per hour.
- b. Air conditioners and heat pumps for use at 240 volts or 208 volts single-phase are limited to locked rotor currents as follows and a maximum of 4 starts per hour.
- c. Two smaller air conditioners should be installed instead of one large unit on larger homes to avoid objectionable flicker at start-up.

Table 6-2 Air Conditioner Locked Rotor Current Limits

BTU per Hour Rating (BTUH)	Total Locked Rotor Current Limitation
Up to 20,000	60 amps
20,000 to 36,000	60 amps plus 3 amps per 1000 BTUH in excess of 20,000 BTUH.
Over 36,000	Consult MU
<i>Note: 12,000 BTU = 1 Ton, 1 Ton is equivalent to 1.4 Hp</i>	

For starting limitations on three-phase air conditioners, refer to Table 6-1.

6.27 Standby Generators

Standby generating equipment shall utilize a double-throw switch or throwover switches that are mechanically interlocked, have adequate current and voltage rating, and are so connected that the customer's generating equipment cannot energize MU's supply lines.

6.28 Parallel Generation

To operate customer-owned generation in parallel with MU's system requires that the owner/operator enter into a contractual agreement with MU. MU uses PSC 119 as its standard. The customer should consult MU for the rules and requirements of this service.

6.29 Marker Balls

All power lines that pose a potential hazard to aircraft should have marker balls installed. The following criteria should be used to determine if a line is a potential hazard to aircraft:

1. Line falls within glide slope criteria for airport hazard per FAA or Wisconsin DOT – Division of Aeronautics guidelines.
2. Accident or near accident which indicates line is a hazard.
3. Notification by airstrip owner that line is a hazard.

MU will provide marker balls. The customer is responsible for the cost of labor and equipment to install the marker balls. An agreement form between MU and the customer must be signed prior to installation.

6.30 Rebates

Rebates available to customers can be found on the MU website. Additional rebates can be found at focusonenergy.com.

SECTION 7

CODE INFORMATION

7.1 State of Wisconsin Codes

In general, the rules and codes applicable to electric service are contained in:

- National Electric Safety Code (NESC)
- National Electrical Code (NEC)
- Wisconsin Administrative Code
- Marshfield Utilities Rates and Rules

Various other definitions are also utilized. These are discussed below.

Wisconsin Administrative Code SPS 316.100 (2)(a) Definition of Building

"Building" means a structure that stands alone or is separated from adjoining structures by fire walls having not less than a 3-hour fire resistive rating with all openings in the wall protected with 3-hour fire-rated door assemblies.

7.2 NEC 230.2 Number of Services

A building or other structure served shall be supplied by only one service. (MU will normally provide only one service to a customer site).

Exceptions:

1. For fire pumps where a separate service is required.
2. For emergency, legally required standby, optional standby or parallel power production systems where a separate service is required.
3. By special permission¹ buildings where there is no available space for service equipment accessible to all occupants; or a single building or other structure sufficiently large to make two or more services necessary.
4. Capacity Requirements - Additional services shall be permitted:
 - a. Where the capacity requirements are in excess of 2000 amperes at a supply voltage of 600 volts or less.
 - b. Where the load requirements of a single-phase installation are greater than the serving agency normally supplies through one service.
5. Additional services shall be permitted for different voltages, frequencies, phases or different cases such as different rate schedules.

¹ "Special permission" per SPS 316.100 (2)(b) means a petition for variance in accordance with s. SPS 316.005.

6. per SPS 316.230 (1)(b), Two or more service drops or laterals may be installed for the same class of service if located more than 150 feet apart, measured in a straight line, and provided that all electrical wiring supplied by each service has no common raceway or connection with any other service. This will only be allowed by special permission in advance by MU.
7. Underground sets of conductors, size 1/0 and larger, running to the same location and connected together at their load end shall be considered to be one service lateral. Couldn't find this referenced in NEC 230.2
8. For row house construction, per SPS 316.230 (1)(c), a separate service drop or lateral shall be permitted for each 2 attached units.

7.3 Wisconsin Administrative Code Modifications to the NEC

SPS 316.230 Services:

(1) NUMBER OF SERVICES.

SPS 316.230(1)(a)(a) These are department informational notes to be used under NEC 230.2 (intro.):

Note: See definition of building in s. SPS 316.100 (2) (a). (listed above in section 7.1)

Note: It is recommended that the electric utility or cooperative supplying electric current be contacted prior to service equipment installations for any special requirements.

(b) Substitute the following wording for NEC 230.2 (B) (2): Two or more service drops or laterals for the same class of service if located more than 150 feet apart, measured in a straight line, and provided that all electrical wiring supplied by each service has no common raceway or connection with any other service.

(c) This is a department rule in addition to the requirements of NEC 230.2 (B): For a building which is not more than 3 stories in height and which contains only 3 or more attached, vertically separated, side-by-side or back-to-back dwelling units, with each dwelling unit served by an individual exterior exit within 6 feet of the exit discharge grade, a separate service drop or lateral shall be permitted for each 2 attached units.

(2) NUMBER OF SERVICE-ENTRANCE CONDUCTOR SETS. The requirements specified in NEC 230.40 Exception No. 3 are not included as part of this chapter.

(3) SERVICE EQUIPMENT — DISCONNECTING MEANS.

(a) General. This is a department rule in addition to the requirements of 2011 and 2017 NEC 230.70: Disconnecting means shall be provided to disconnect the utility wiring from the premises wiring at any point where utility wiring terminates and premises wiring extends overhead or underground to more than one building or structure.

(b) Location. This is a department rule in addition to the requirements of 2011 and 2017 NEC 230.70 (A): Raceways containing service conductors or cables, or service entrance cable not contained within a raceway, may not extend longer than 8 feet into a building to the service disconnect or the first service disconnect of a group of

disconnects as permitted by NEC 230.71. The raceways or conductors shall be considered to have entered the building at the point where they pass through the outer surface of the building exterior, except as permitted by NEC 230.6.

(4) RATING OF SERVICE DISCONNECTING MEANS – 2011 NEC This is a department rule in addition to the requirements of 2011 NEC 230.79:

(a) Two- or multi-family dwellings. Except as provided in par. **(b)**, for 2-family or multi-family dwellings, the service equipment shall have a rating of not less than 150 amperes, 3-wire or 4-wire. Where the combined rating of all service disconnecting means is 150 amperes or larger, the service or feeder equipment rating for each dwelling unit shall have a rating of not less than 60 amperes.

(b) Exception. Service equipment having a rating of not less than 100 amperes, 3-wire or 4-wire, may be installed in an existing 2-family dwelling only where both of the following conditions are complied with:

1. The load computed in accordance with NEC 220 does not exceed 80 amperes.
2. Specific written approval is granted by the municipal inspection department having jurisdiction.

(5) RATING OF SERVICE DISCONNECTING MEANS – 2017 NEC. This is a department rule in addition to the requirements of 2017 NEC 230.79: For 2-family or multi-family dwellings, the service equipment shall have a rating of not less than 150 amperes, 3-wire or 4-wire.

History: CR 08-047: cr. Register February 2009 No. 638, eff. 3-1-09; CR 13-042: Renum. (3) to (3)(b)(title), renum. (4) to (3)(A) and am. (3)(a)(title), renum. (5) to (4) Register November 2013 No. 694, eff. 12-1-13; Cr 16-093: am. (1)(a)(intro.), (c),(2),(3)(a),(b),(4)(Intro.), cr.(5) Register June 2018 No. 750 eff. 8-1-18.

MU requires all energy to be metered. Jumpers are not to be placed in meter sockets, and service to billboards, signs, traffic signals, cable TV amplifiers, telephone equipment, railroad signals, etc. will be metered.

Underground service conductors shall enter the customer's building aboveground to prevent water or seepage entry due to soil or ground water conditions. The Utility is not responsible for any damage caused by water entry through the customer's raceway or conduit.

7.4 Grounding Electrode System Addition to NEC 250.53 (SPS 316.250)

(A) Rod, Pipe, and Plate Electrodes. Rod, pipe, and plate electrodes shall meet the requirements of 250.53(A)(1) through (A)(3). Per WI Administrative code SPS 316.250 (1) The exception in NEC 250.53 (A) (2) is not included.

(1) **Below Permanent Moisture Level.** If practicable, rod, pipe, and plate electrodes shall be embedded below permanent moisture level. Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel.

(2) **Supplemental Electrode Required.** (A rod electrode must be supplemented by an additional electrode that's bonded to:)A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 250.52(A)(4)

through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following:

- (1) Rod, pipe, or plate electrode (Another rod electrode)
- (2) Grounding electrode conductor
- (3) Grounded service-entrance conductor (The service neutral conductor)
- (4) Nonflexible grounded service raceway (A nonflexible metal service raceway)
- (5) Any grounded service enclosure (The service disconnect)

- (3) Supplemental Electrode. If multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than 1.8 m (6 ft) apart. SPS 316.250 (2) Supplemental Electrode. This is a department rule in addition to the requirements in NEC 250.53 (A) (3): A single electrode consisting of a rod, pipe or plate shall be augmented by one additional electrode of any of the types in NEC 250.52 (A) (4) to (A) (8).

Informational Note: The paralleling efficiency of rods is increased by spacing them twice the length of the longest rod.

- (B) Electrode Spacing. Where more than one of the electrodes of the type specified in 250.52(A)(5) or (A)(7) are used, each electrode of one grounding system (including that used for strike termination devices) shall not be less than 1.83 m (6 ft) from any other electrode of another grounding system. Two or more grounding electrodes that are bonded together shall be considered a single grounding electrode system.

- (C) Bonding Jumper. The bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system shall be installed in accordance with 250.64(A), (B) and (E), shall be sized in accordance with 250.66, and shall be connected in the manner specified in 250.77.

- (D) Metal Underground Water Pipe. If used as a grounding electrode, metal underground water pipe shall meet the requirements of 250.53(D)(1) and (D)(2).

- (1) Continuity. Continuity of the grounding path or the bonding connection to interior piping shall not rely on water meters or filtering devices and similar equipment.
- (2) Supplemental Electrode Required. A metal underground water pipe shall be supplemented by an additional electrode of a type specified in 250.52(A)(4) through (A)(8). If the supplemental electrode is of the rod, pipe, or plate type, it shall comply with 250.53(A). The supplemental electrode shall be bonded to one of the following:

- (1) Grounding electrode conductor
- (2) Ground service-entrance conductor
- (3) Nonflexible grounded service raceway
- (4) Any grounded service enclosure
- (5) As provided by 250.32(B)

Exception: The supplemental electrode shall be permitted to be bonded to the interior metal water piping at any convenient point as specified in 250.68(1), Exception.

- (E) Supplemental Electrode Bonding Connection Size. Where the supplemental electrode is a rod, pipe, or plate electrode, that portion of the bonding jumper that is the sole

connection to the supplemental grounding electrode shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum wire.

- (F) Ground Ring. The ground ring shall be buried at a depth below the earth's surface not less than 750 mm (30 in.).
- (G) Rod and Pipe electrodes. The electrode shall be installed such that at least 2.44 m (8 ft) of length is in contact with the soil. It shall be driven to a depth of not less than 2.44 m (8 ft) except that, where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from vertical or, where rock bottom is encountered at an angle up to 45 degrees, the electrode shall be permitted to be buried in a trench that is at least 750 mm (30 in.) deep. The upper end of the electrode shall be flush with or below ground level unless the aboveground end and the grounding electrode conductor attachment are protected against physical damage as specified in 250.10
- (H) Plate Electrode. Plate electrodes shall be installed not less than 750 mm (30 in.) below the surface of the earth.

7.5 Wisconsin Administrative Code PSC 113

Wisconsin has recently updated the Wisconsin Administrative Code PSC 113. Listed below are code sections, which pertain to service requirements and voltage standards.

Definitions - PSC 113.0701

- (1) "Flicker" or "voltage flicker" means a variation of input voltage sufficient in duration to allow visual observation of a change in electric light intensity.
- (2) "Harmonic distortion" means the mathematical representation of the distortion of the pure sine waveform. Distortion of the pure sine waveform is typically caused by loads that draw current discontinuously or whose impedance varies during the cycle of the input AC voltage waveform.
- (3) "Point of service" means the connection point between the customer electrical system and the utility electrical system.
- (4) "Power quality" means the concept of powering and grounding sensitive electronic equipment in a manner that is suitable to the operation of that equipment.
- (5) "Retail power service" means service furnished principally for electromotive or industrial purposes and may include service for lighting incidental thereto as defined in the utility's rates and rules.
- (6) "Sag" means an RMS reduction in the AC voltage, at the power frequency, for durations from a half-cycle to a few seconds.
- (7) "Swell" means an RMS increase in the AC voltage, at the power frequency, for durations from a half-cycle to a few seconds.

- (8) "Transient" means a sub cycle disturbance in the AC waveform that is evidenced by a sharp but brief discontinuity of the waveform. May be of either polarity and may be additive to or subtractive from the nominal waveform.

Note: The definitions used in subsections (1), (2), (4), (7), and (8) are based on the definitions in Authoritative Dictionary of IEEE Standards Terms-7th Ed.

- (9) "Steady state voltage" means the RMS voltage after all sags, swells and transients have decayed to a negligible value.
- (10) "Service voltage," means the steady state voltage at the point of service.

7.6 Harmonics of 60 Hertz Voltage Waves PSC 113.0704

Utilities shall make reasonable efforts to investigate equipment-operating problems suspected to be associated with harmonic distortion of the 60 Hz voltage sinewave at the point of service. When the source of the harmonic distortion is determined to be equipment operated by a specific customer, the utility shall notify the customer and it shall be the customer's responsibility to correct the problem. When corrective action is necessary, the guideline to be used is the 1992 IEEE Standard 519.

7.7 Radio and Television Interference PSC 113.0707

- (1) Each utility shall own or otherwise arrange to have available when needed, suitable monitoring equipment for surveying its lines and equipment for possible radio and/or television interference.
- (2) Each utility shall establish and routinely utilize in the course of regular operation, means whereby the presence of radio and/or television interference may be detected.
- (3) Each utility shall, upon notification or detection of the presence of radio and/or television interference, survey its lines and equipment for possible sources of radio and television interference. When significant interference is found, reasonable measures shall be taken to locate the source and, if on the utility's system, to mitigate the interference. Where the magnitude and nature of the interference is found to be so small, intermittent or insignificant that it affects only a few customers or a particular, unique piece of customer equipment that may have limited capabilities to receive weak signals, it may be necessary to limit the utility's responsibility for mitigation to reasonable, cost-effective measures.

Note: In some cases, some interference from the utility's system may be detected, but found to be insignificant and inconsequential for the majority of customers. Its elimination or mitigation may still not result in adequate reception of some signals. In many areas, radio or television reception of some transmissions is normally inadequate due to frequency; weak signal strength, high ambient noise, and distance from the source, terrain or other obstacles beyond the utility's control. The capabilities and limitations of the customer's receiver should also be evaluated and

considered in determining the nature, extent and cost of the utility's mitigation activities. Also, other options may be available and more feasible, for example, applying the mitigation to the customer's equipment or substitution of cable television (CATV) or digital satellite service for local antenna systems.

- (4) Where the source of interference is determined to be equipment owned by a specific customer, the customer shall be so advised and informed of his or her responsibility to correct the problem (see s. PSC 113.0201).

7.8 Measuring Customer Service PSC 113.0802

- (1) Except as provided in sub. (2), all energy sold to customers shall be measured by commercially acceptable measuring devices owned and maintained by the utility. All other electrical quantities, which the rates or utility's rules indicate, are to be metered shall be metered by commercially acceptable instruments owned and maintained by the utility.
- (2) For temporary or special installations where it is impractical to meter loads, such as certain highway or area lighting which may be billed at a flat rate based on lamp rating and use, the consumption may be calculated.
- (3) The metering and wiring in non-transient, multi-dwelling-unit residential buildings, mobile home parks and commercial establishments where individual unit metering is provided, or required under the provisions of s. PSC 113.0803, shall be so installed or arranged so that each customer or tenant is metered for his or her own consumption only. Energy used by common area loads, for example, hallway lighting and heating, shall be separately metered and billed as appropriate under the utility's filed tariff.
- (4) Utilities shall inspect existing properties for jointly metered service where a tenant reasonably suspects that he or she is being billed for significant usage (e.g., furnace, water heater, etc.) that is service more than one rental dwelling unit. The utility may bill the property owner for such an inspection. See s.196.643, Statutes.

Individual Electric Meters Required for Non-transient Multi-dwelling Unit Residential Buildings, Mobile Home Parks and for Commercial Establishments PSC 113.0803. The requirements for individual metering that follow also apply to upgrades or any change to the electrical equipment due to age, size, damage, and etc. regardless of the date the building was constructed.

- 1) Each dwelling in a multi-dwelling unit residential building and mobile home park constructed after March 1, 1980 shall have installed a separate electric meter for each such dwelling unit. Dwelling unit means a structure or that part of a structure which is used to or intended to be used as a home, residence or a sleeping place by one or more persons maintaining a common household, and shall exclude transient multi-dwelling buildings and mobile home parks, for example: hotels, motels, camp grounds, hospitals,

community-based residential facilities, residential care apartments or similar facilities, nursing homes, college dormitories, fraternities and sororities.

- 2) Each tenant space in a commercial building constructed after March 1, 1980 shall have installed a separate electric meter.
- 3) Any existing building, which undergoes alterations involving a change in type of occupancy or substantial remodeling, shall have installed a separate electric meter for each separate tenant space.
- 4) For the purpose of carrying out the provisions of sub. (1), individual unit metering will not be required:
 - a) In commercial buildings where the commercial unit space requirements are subject to alteration, as evidenced by temporary versus permanent type of wall construction separating the commercial unit spaces. Examples of temporary wall construction are partition walls, which do not extend through the ceiling and walls, which do not constitute a code-required fire separation.
 - b) For electricity used in central heating, ventilating and air-conditioning systems.
 - c) For electric back-up service to storage heating and cooling systems or when alternative renewable energy resources are utilized in connection with central heating ventilating and air conditioning systems.
- 5) For reasonable cause shown, the commission may grant waivers of this rule on a case-by-case basis. Applications for a waiver must be submitted to the commission in writing and set forth the facts or reasons applicant believes justify a waiver. In cases involving multi-dwelling unit residential buildings, the applicant must show that the electric equipment under tenant control is substantially more efficient than required by applicable codes and that the overall electric usage under tenant control is minimal. Example cases, which would not qualify for waiver, are buildings, which are electrically heated, or buildings, which have individual unit electric water heaters.