Section 5 – Miscellaneous Electric Metering

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5-1 Customer Wiring

Electrical wiring should only be done by those who have been trained on safety concerns, wiring techniques, and code requirements. The Company cannot inspect your wiring or provide electrical code interpretations. By law, this is only allowed to be done by State-Certified Electrical Inspectors.

The following are some basic items for wiring up to the main disconnects:

1. The minimum service size is 100 Amp. The main disconnect and meter socket must be rated for a minimum 18,000 Amps of fault current.

2. The minimum service entrance conductor sizes for residential 120/240 single-phase shall be as follows: (This is from the ampacity tables in the NEC 310.15(B)(6)). (See NEC about reduced neutrals.)

Service Rating	Copper	Aluminum
100	#4	#2
150	#1	2/o
200	2/o	4/o
400	400 kcm	600 kcm

3. Galvanized rigid conduit shall be used for any above grade conduit installations that may contain WPS-owned cable. When used, metallic conduit shall be bonded. Pedestals are required for underground services 320 amps or less. Schedule 40 Electrical PVC is usually used for conduit installed on the load side of the electric meter.

4. Rigid metal conduit is required for overhead periscopes (unsupported conduit extending above the roof) (aluminum, IMC, or thin wall is not acceptable). All overhead periscopes must be back-guyed.
   -0-200 Amp Services Minimum 2" Periscope (for strength reasons)

5. The equipment grounds (green and bare) must be bonded to the neutral at and only at the main distribution panel (service entrance equipment).

6. All aluminum connections must be made with aluminum-rated connectors. The conductor must be cleaned (wire brush or other approved means) and immediately coated with an approved corrosion inhibitor. Common brand names for inhibitors are as follows:
   Noalox Joint Compound
   Gardner Bender Oxguard
   Penetrox

7. The main disconnect must be installed as close as possible to the entrance of the building and still in a readily accessible location. In Wisconsin, this must not be more than 8 feet from where the service enters the building. [SPS 316.230(3) and NEC 230.70(A)]

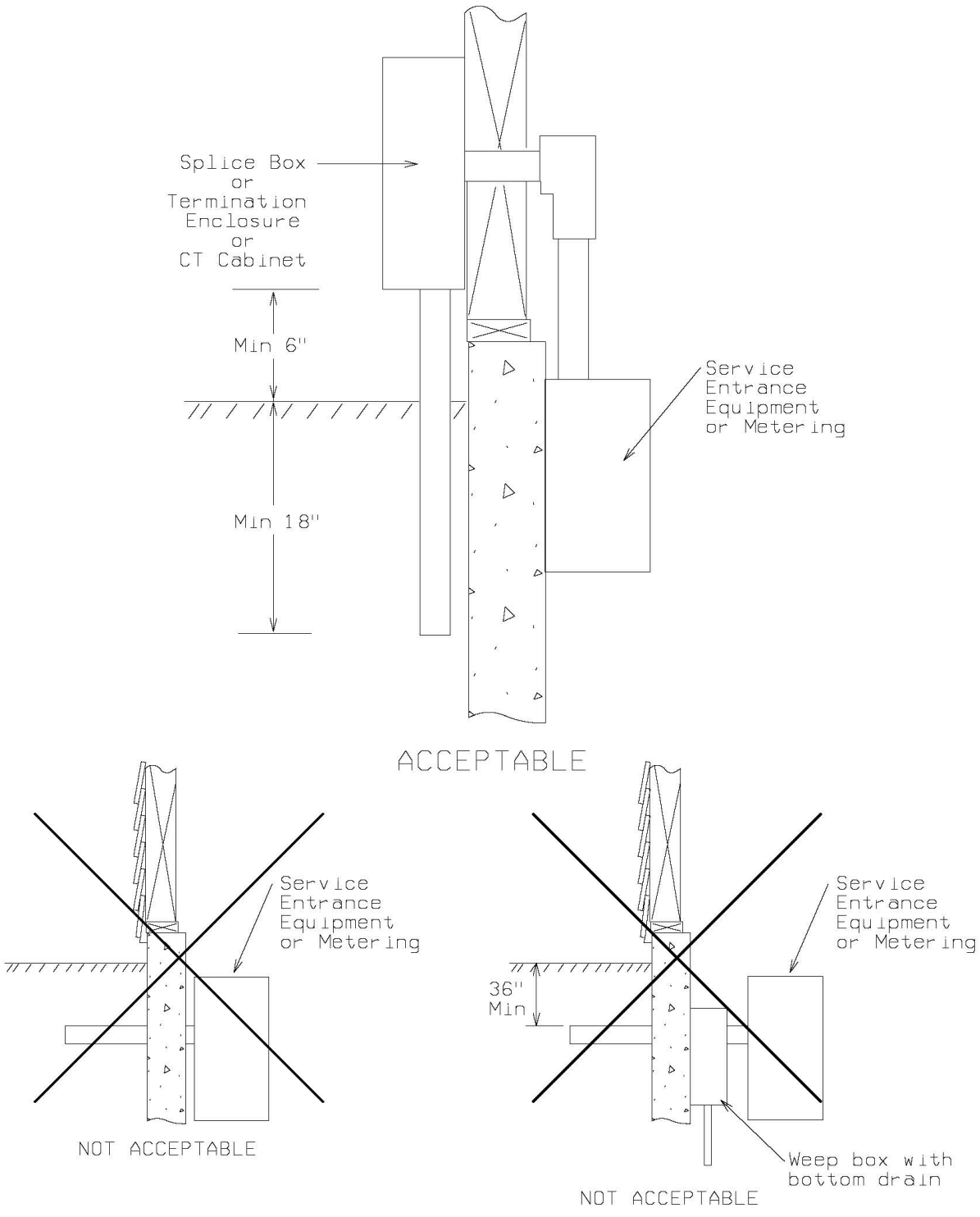
8. The conduit penetrating the outside wall between the meter and the distribution panel conducts cold air. This often causes condensation and potential damage to the electrical system. Things like spray foam or electrical putty will block this air flow.

9. Only service entrance conductors and load control circuits can be installed in service entrance raceways and on into pedestals or meter sockets. (See NEC 230.7).

10. Termination compartments, meter mounting devices, or CT compartments shall not be used as junction boxes, pull boxes, raceways, or similar wire enclosure for additional customer circuits. Once the service entrance or feeder conductors exit the termination compartment, meter mounting device, or CT compartment they shall not re-enter the termination compartment, meter mounting device, or CT compartment.

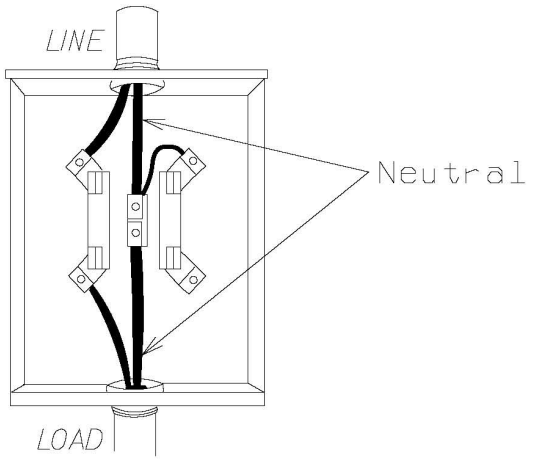
11. In Wisconsin there must be a disconnect where utility wires end and premises wiring extends overhead or underground to more than one building. [SPS 316.230(4)]

5-2 Foundation Penetrations

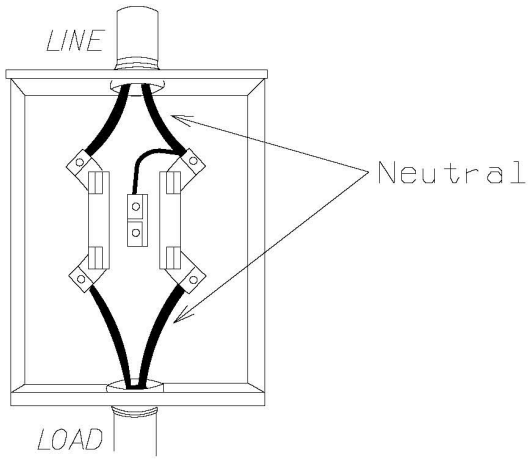


The above diagrams show how to and how not to deal with water seepage through basement walls. The Company will not run its conductors through a basement wall because of the possibility of causing water seepage problems.

5-3 120 Volt Meter Socket



Preferred



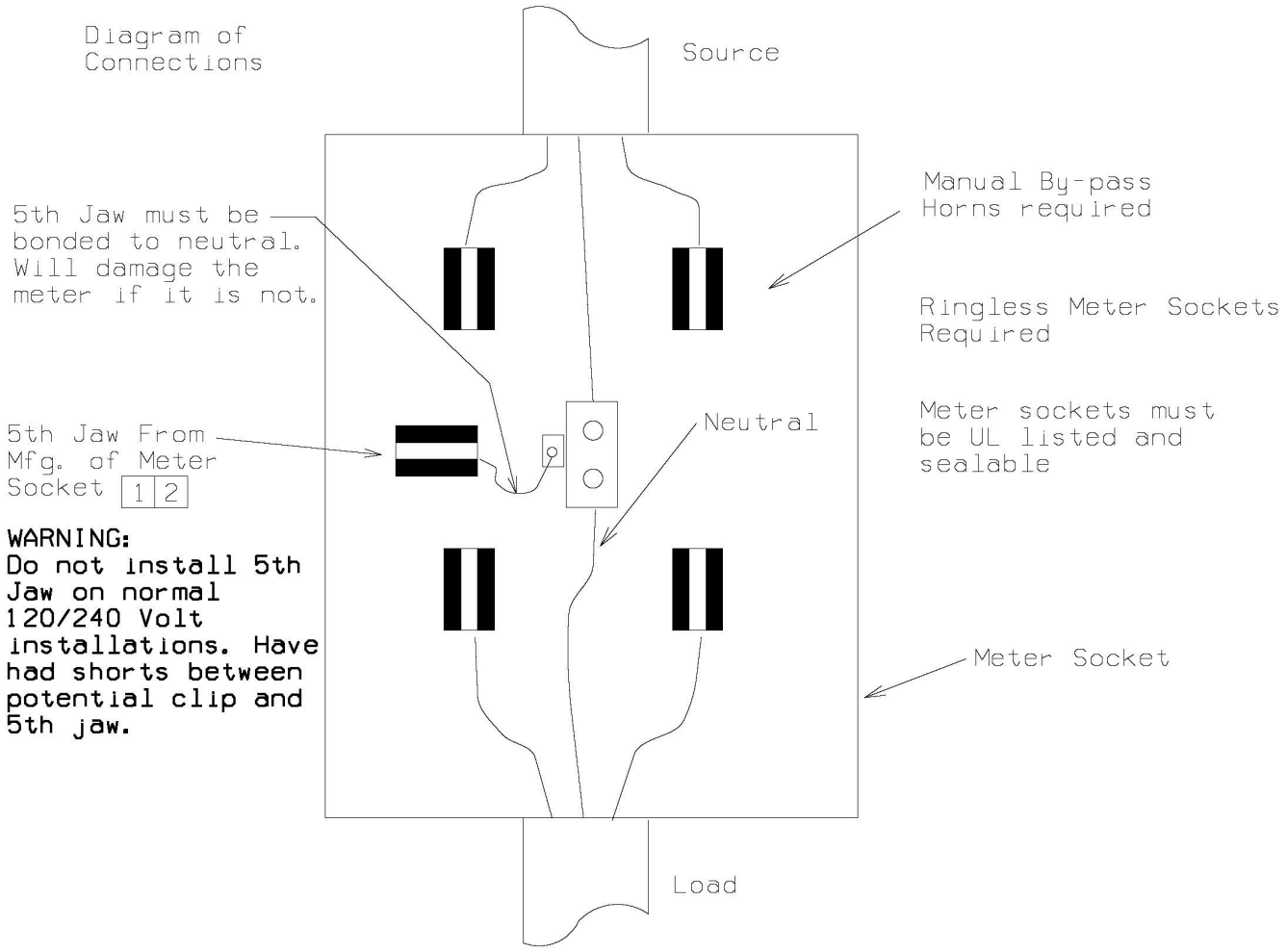
Alternate

(Use care when jumpering out!)

Wired for 2-wire, 120 Volt Service

This service is no longer available. This page is for reference on the old standard way of wiring this type of service.

5-4 Single Phase 120/208 0-200 Amp, Network Metering

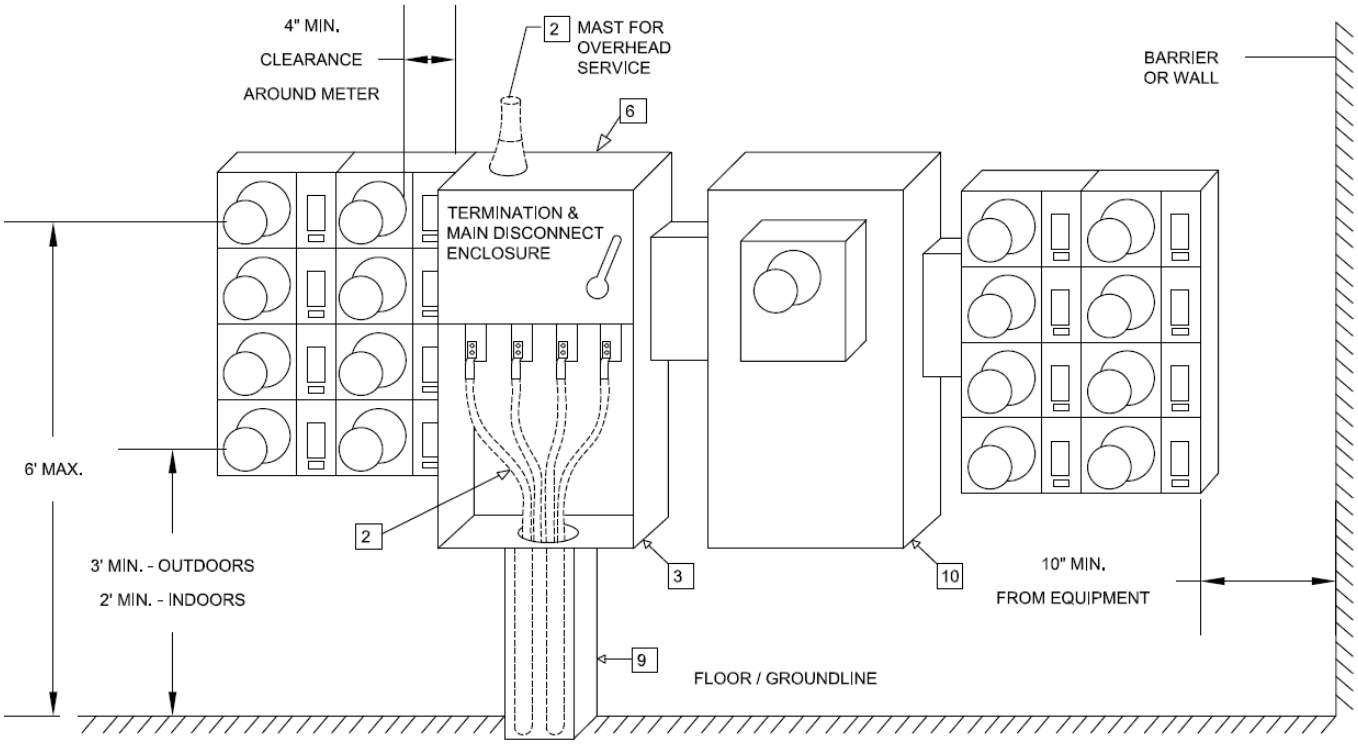


Notes:

1. A fifth jaw can be added to most new-style, single phase 120/240 meter sockets for 120/208 single phase service. The fifth jaw shall be added in the 9 o'clock position as pictured and securely attached (Milbank Snap-in Jaws are not acceptable; they fall apart).
2. This voltage is common in or near commercial areas. It is also common for large apartment complexes.
3. There are some existing installations with the fifth jaw in the 6 o'clock position (as compared to the normal 9 o'clock position) or with a wire jumper between the meter and the meter socket. These should be corrected, if possible, when upgrading the wiring.
4. Single phase service drop application shall be limited to 200 Amp. Larger installations shall have a three phase service drop with the single phase meters and connected loads balanced on all phases. The single phase meters must also be limited to 200 Amp.

5-5 Multiple Metering – Indoor/Outdoor Clearances

Clearances

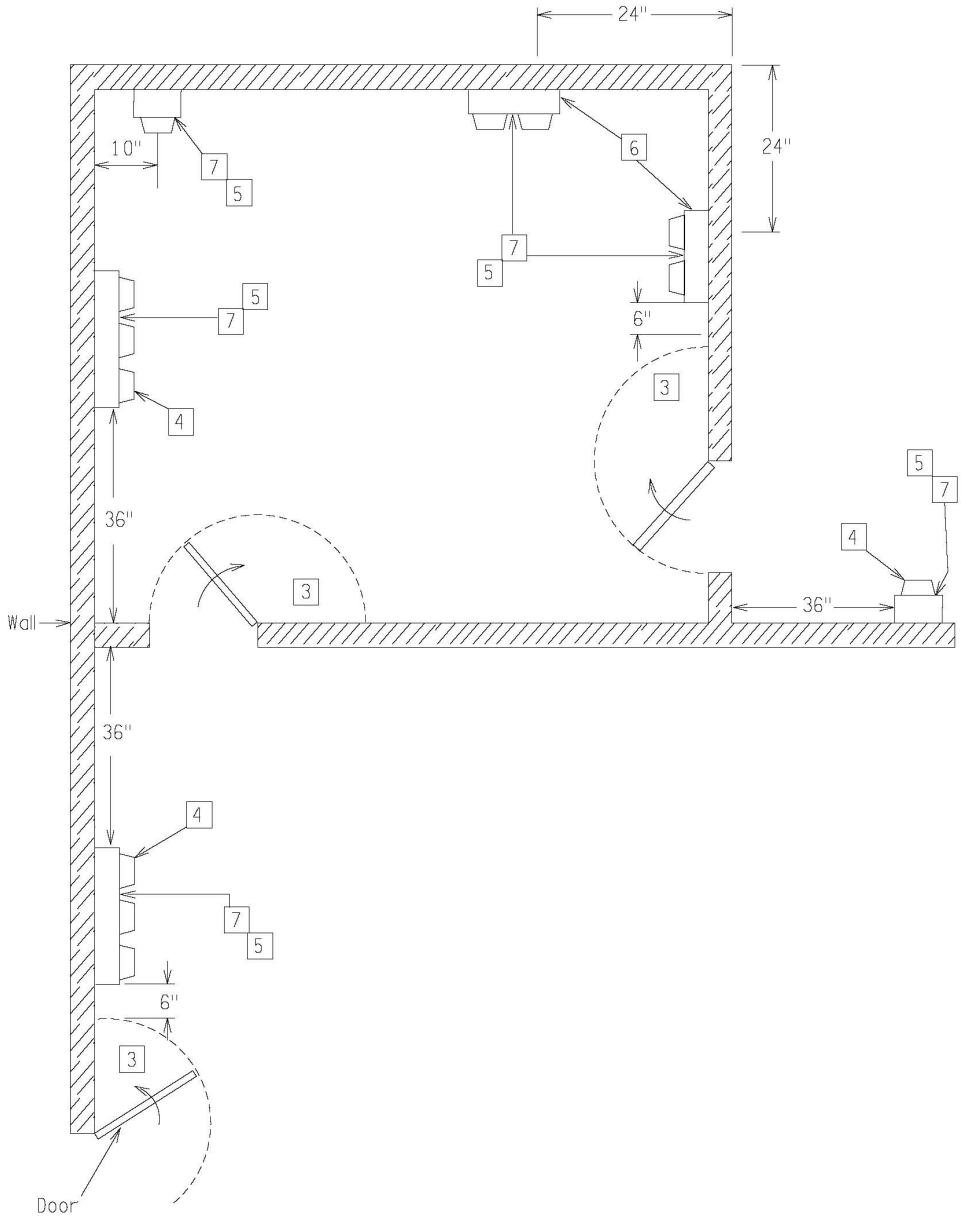


Notes:

1. **Metering shall be outside.**
2. Service drop or lateral.
   A. Underground line conductors and lugs furnished by Company.
   B. Load conductors and lugs furnished and installed by customer.
3. Customer shall furnish, install and maintain multiple metering equipment, including meter sockets, switches, fuses, circuit breakers, termination enclosures and associated equipment. See subsection 3-6 for termination compartments with disconnect/main breaker/fuse.
4. A minimum of 3 feet must be provided in front of all metering installations. See NEC 110.26(A).
5. All 100 Amp or 200 Amp meter sockets shall contain the horn-type bypass for single-phase or network installations, be ringless, UL listed, and not have covers over the meters.
6. 6’6" OH headroom working space required per NEC 110.26(A).
7. The Company uses 90ºC conductor and will only terminate in a main terminal enclosure when used in conjunction with a lug landing pad. The Company will not terminate on main breakers or disconnects.
8. Multi-metered installations shall be installed so as to balance the load on the service.
9. 4” rigid metallic conduit or approved raceways are acceptable for underground services.
10. Company listed transocket and transformer rated meter socket (see sections 3-3 and 3-4)
11. On group installations, each meter socket and service switch shall be permanently marked identifying the location to be served. The location being served shall be identified in the same manner. This identification shall be made on the outside of the metering panels (for the benefit of tenants and meter readers), inside the meter enclosure (non-movable part as cover panels usually are interchangeable), and at the service panel that the meter serves. A label on the service panel is critical because labeling systems for apartments change, making it difficult to trace. This identification is often done with permanent black markers or white paint. See NEC 110.22 and PSC 113.0809.
12. Consult with the Company for indoor installations.
13. Horizontal bus connected termination compartments and metering equipment shall be connected by bus. Conduit and wire extensions to metering equipment will require company approval prior to construction.

5-5 Multiple Metering – Indoor/Outdoor Clearances (Cont'd)

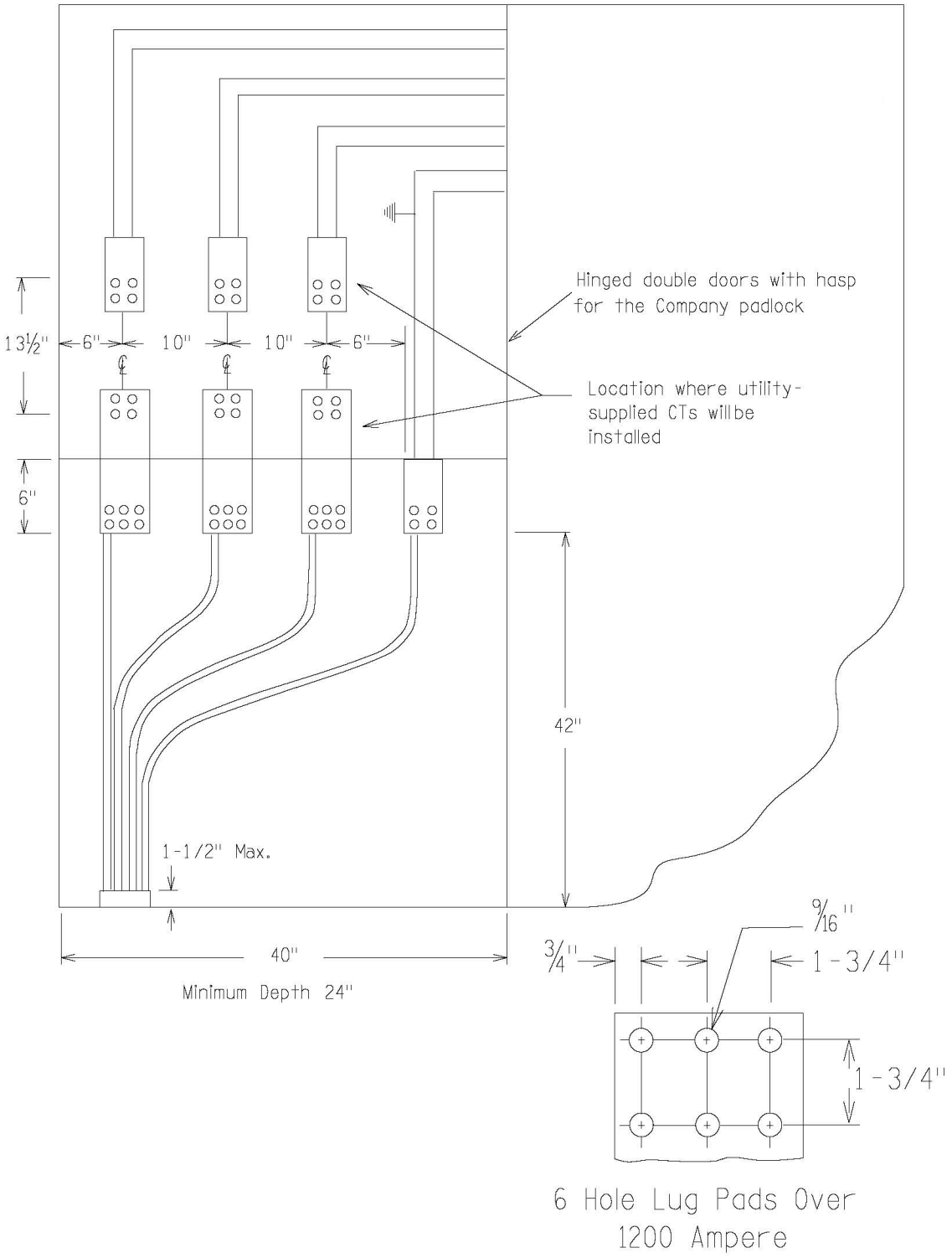
Swinging Door, Frontal & Side Clearances for Indoor Multiple Metering



Notes:

1. **All new metering installations shall be outside.**
2. All dimensions shown are minimum dimensions.
3. Meters are not to be installed on walls where they will be behind an open swinging door.
4. Meters may require protective barriers if traffic through doorway could cause meter damage. A minimum clearance of 12 in. is required from the center line of the meter-connection device to the barrier.
5. Location of electric meters must comply with dimensions shown on this sketch and meter mounting height dimensions shown on the first page of subsection 5-5.
6. A minimum of 24 inches applies when meter stacks are mounted on adjacent corner walls.
7. A minimum clearance of 3 feet must be provided in front of all metering installations. See NEC 110.26(A).
8. The Company shall be consulted concerning the location of metering equipment before metering equipment is installed.

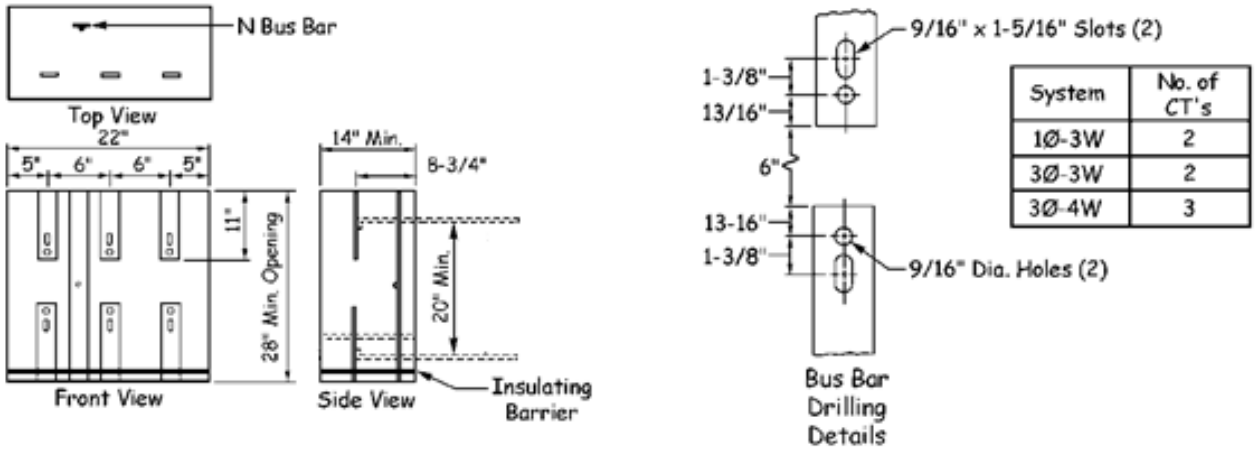
5-6 Large CT Installation, Bus Bars - 2500-3000 Amp – Metering in Switchgear



Legacy service, not available for new service.

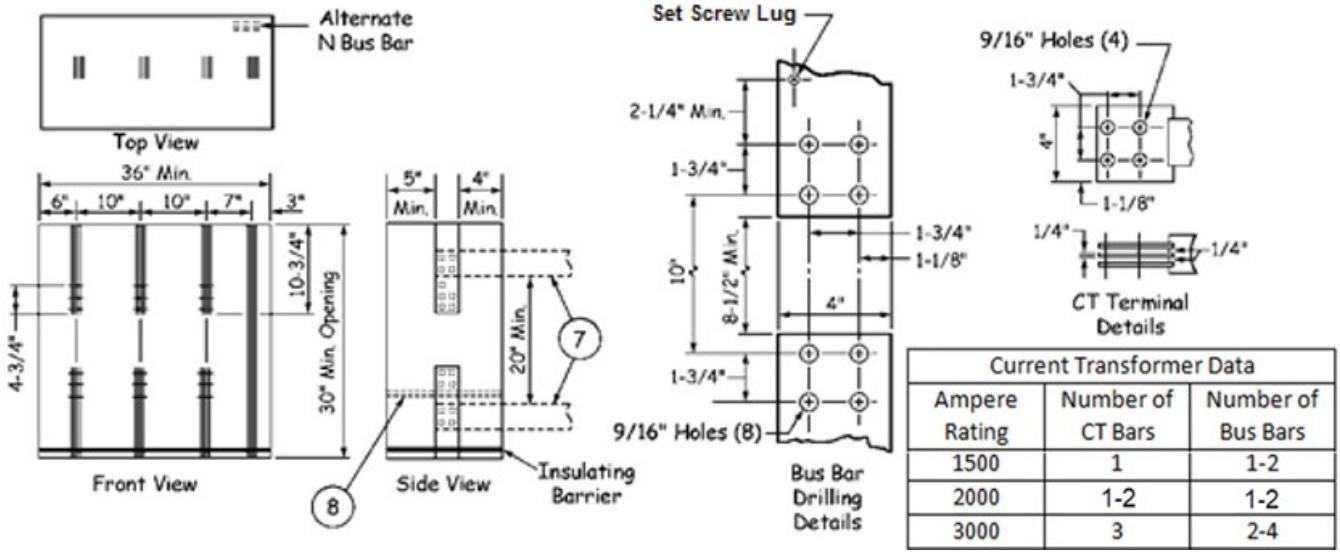
Notes:

1. **Send a copy of drawings of the switchgear termination and metering compartments to the Company job representative for acceptance prior to any construction.**
2. Instrument meter socket to be located outside and within 25 feet of CT cabinet. The conduit between the meter socket and CT cabinet shall be min. 1-1/4" diameter.
3. If a separate termination compartment with stacked terminations is supplied, a 30" minimum from the bottom of the compartment to the neutral and a 40" minimum from the bottom of the compartment to the lowest phase are required. The termination compartment and CT compartment must have a hinged door with a hasp for the Company padlock.
4. The CT compartment shall be completely enclosed; barriers between compartments shall be rigidly supported.
5. Provide a set screw lug for a #12 gauge wire in the neutral bar for a potential tap.
6. Bus supports shall have a minimum separation of 15" and shall consist of an insulating material such as Benelex or equivalent, or porcelain insulators mounted on a steel channel.
7. Neutral bus must either run through or be extended back into the CT cabinet so that it is accessible for the potential tap. Working clearance between neutral bus and any live bus in the vicinity of the CT mounting must be 6" minimum. Neutral bus must not be located closer to the front of the enclosure than any live bus.
8. Check with the Company to determine how many conductors per phase will be used and how many holes will be needed on the termination pad.
9. All metering compartments and CT compartments shall be contained within the switchgear. Conduit and wire extension from switchgear to external metering equipment is not allowed. Contact the company for acceptance prior to any construction.



System	No. of CT's
1Ø-3W	2
3Ø-3W	2
3Ø-4W	3

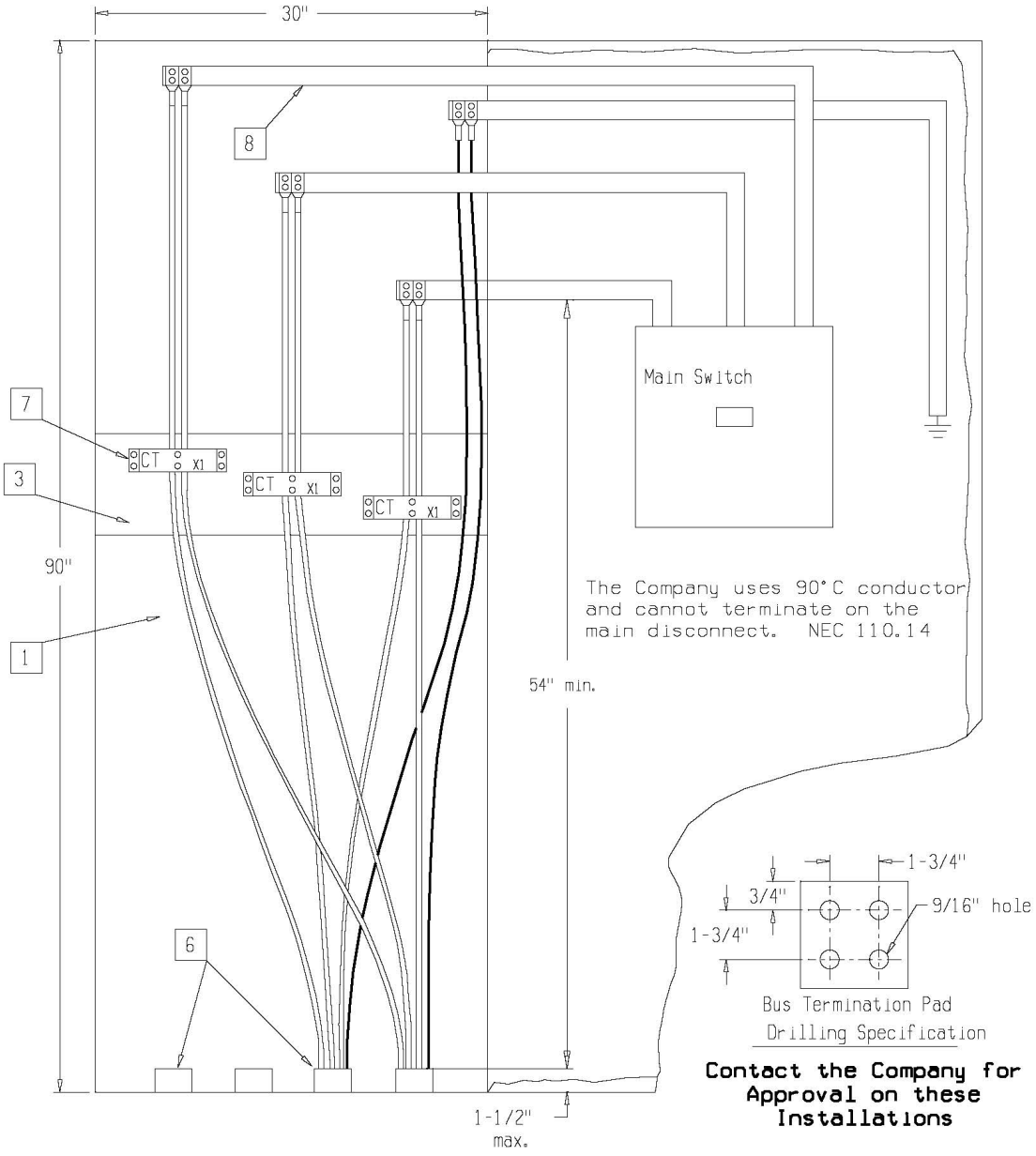
1-Phase, 120/240 Volts, 400-800 Amperes
All 3-Phase Voltages, 400-1200 Amperes



Current Transformer Data		
Ampere Rating	Number of CT Bars	Number of Bus Bars
1500	1	1-2
2000	1-2	1-2
3000	3	2-4

All 3-Phase Voltages, Over 1200 Amperes

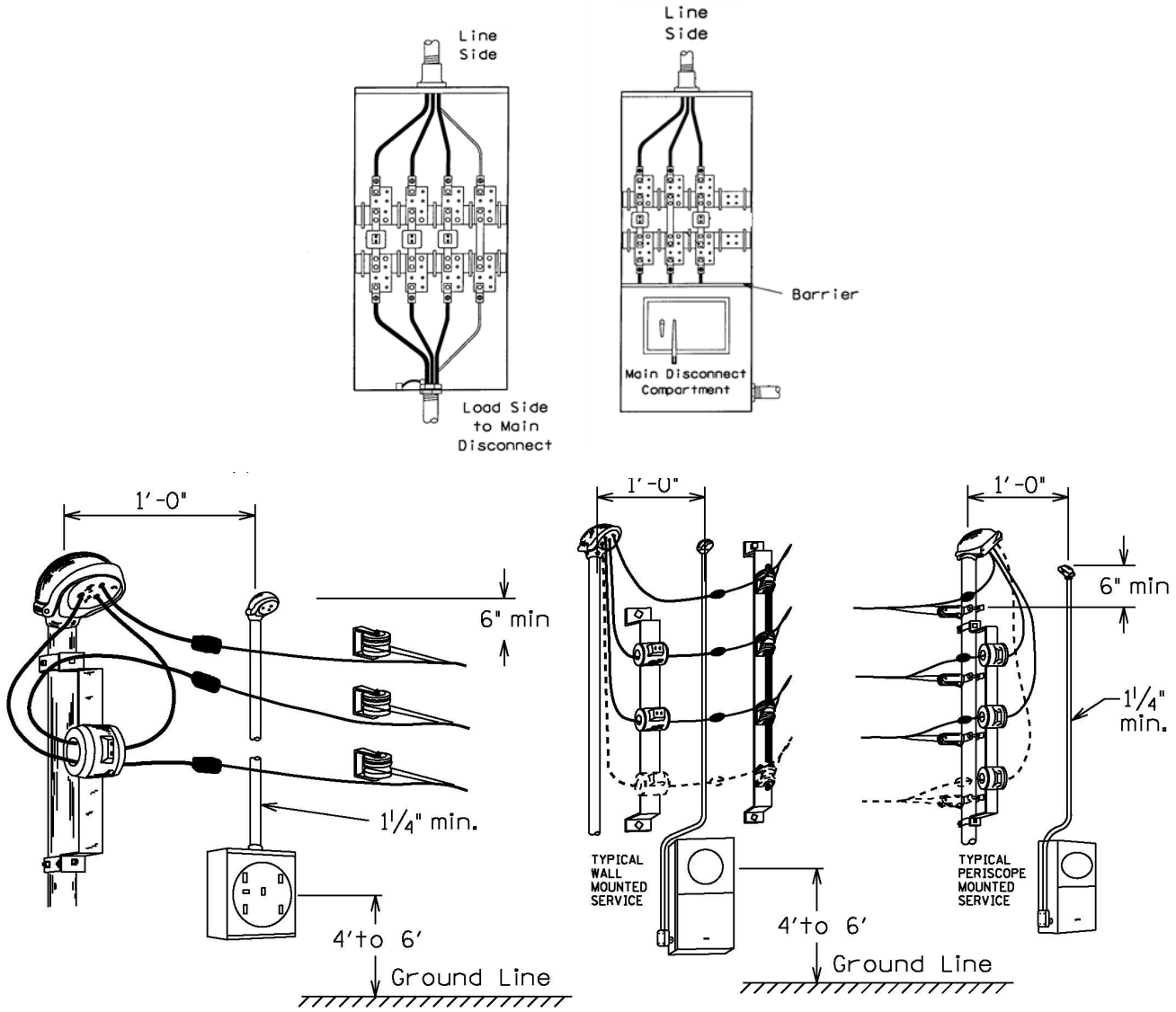
5-7 Large CT Installation, Doughnuts - 2500-3000 Amp – Metering in Switchgear



Notes:

1. Depth of current transformer compartment shall be 24" minimum.
2. CT compartment shall have hinged door and locking hasp.
3. CT mounting bracket must be adjustable for depth and height.
4. For top feed, reverse diagram configuration.
5. Customer shall furnish detailed drawings for Company approval before equipment is ordered.
6. Check with the Company to determine how many conductors per phase will be used and how many holes will be needed on the termination pad.
7. CT's shall be located approximately 18" below bus.
8. Bus shall be adequately braced to support conductors.
9. Instrument meter socket to be located outside and within 25 feet of CT cabinet. The conduit between shall be minimum 1-1/4 inch.
10. Legacy Service, not available for new services.

5-8 OH Service, CT Metering

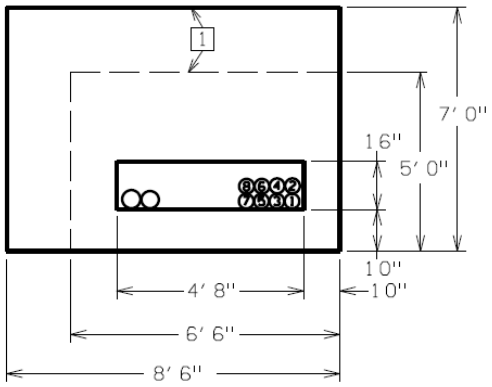


Periscope Donut CT metering is a Legacy service, not available for new service.

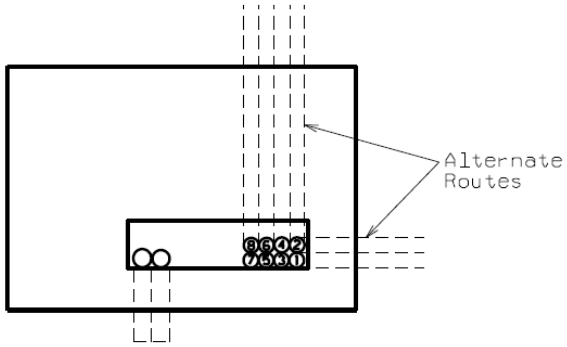
Notes:

1. Because of code clearance issues, the location of customer's service entrance and meter equipment shall, in all cases, be designated by the Company.
2. The customer shall furnish and install the transocket, if applicable. The Company will provide the CT mounting bracket for periscope installation. The Company will mount the CT mounting bracket. The Company will supply the CTs, meter and meter wiring (including the meter socket ground).
3. The transocket must be bonded per NEC 250.102.
4. Consult the Company for transocket bonding requirements on three-wire 240 volt three-phase and three-wire 480 volt three-phase installations.
5. The Company standard meter for 400 amp single phase is CT metering or a 320 class meter. Please refer to subsection 3-2 UG CT Cabinets for details.
6. The connections to the Company's service drop shall be made by the Company.
7. In four-wire 120/240 three-phase installations, the wild leg shall be identified with orange tape or other acceptable means.
8. The length of the service entrance conductors protruding from the weatherhead shall be at least 18 inches.
9. Periscopes shall be back-guyed if used for dead ending the service drop.
10. See subsection 3-11 for Fault Current information.
11. See subsection 3-2 for approved list of transockets.
12. Periscope Donut CT metering is a Legacy Service, not available for new services.

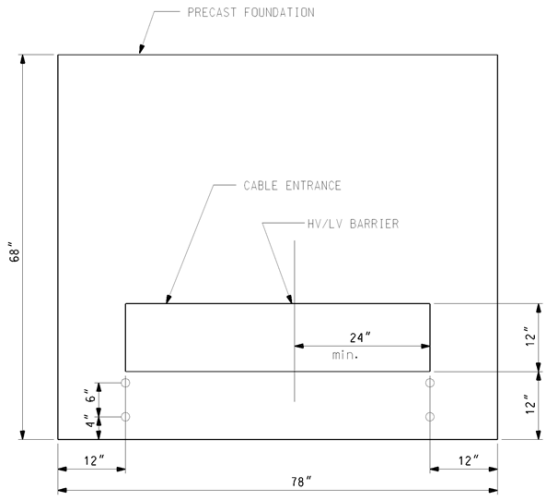
5-9 Standard Pad for 75-2500 KVA Padmount Transformers



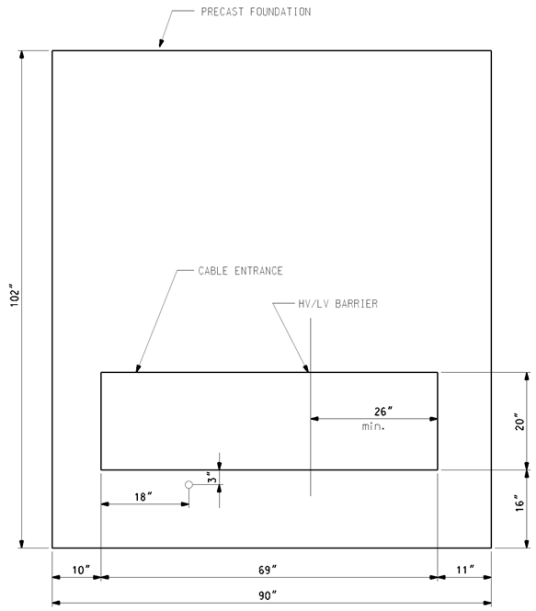
Standard Pad with Alternate Dimensions



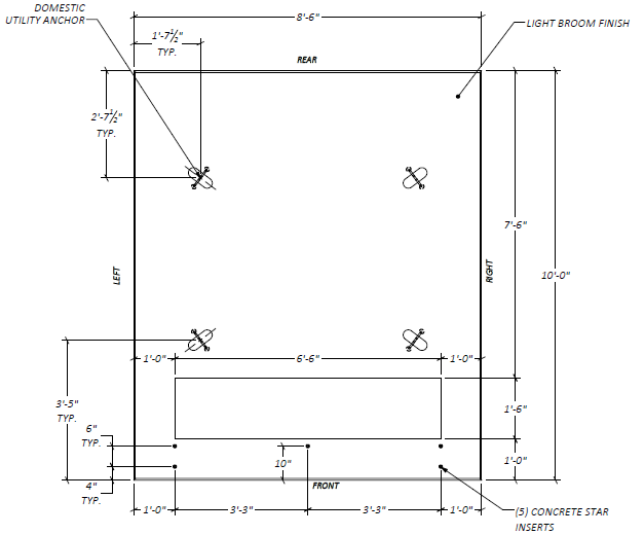
Standard Pad Conduit Arrangement & Routes



Standard Pad for 75 kVA - 500 kVA Transformers



Standard Pad for 750 kVA - 2000 kVA Transformers



Standard Pad for 2500 kVA Transformers

5-9 Standard Pad for 75-2500 KVA Padmount Transformers (Cont'd)

Table 1 -Typical Number and Size of Secondary Conduit Sweeps

Service Size	Number of Conduits	Size of Conduits	Number of Conduit Sweeps	Size of Conduit Sweeps (radius)
400	1	4"	1	36"
600	2	4"	2	36"
800	2	4"	2	36"
1200	3	4"	3	36"
1600	4	4"	4	36"
2000	6	4"	6	36"
2500	8*	4"	8*	36"
3000	8	4"	8	36"

* 2500A Service will be treated as a 3000A service

Notes:

1. The alternate dimensions of 6'6" x 5'0" can be used for transformers that will only serve one service that is 1200 amps or less. If the installation requires concrete footings because of disturbed soil, four sonnet tubes are acceptable for cases with one service of 1200 Amp or less.

2. Service conduits shall always start from the front right corner of the window and tight to each other and in numbered order. See Table 1 for the number and size of secondary conduits sweeps the Company is providing. Consult with the Company, before construction, if more conduit sweeps are needed.

3. The primary conduits shall always start from the front left corner of the window and tight to each other. There shall be two six-inch conduits. The Company will install the conduits to a minimum of one foot beyond the edge of the pad. Two conduits shall be installed for the primary cables when the pad is installed. The conduit required is based on the type of cable and/or conduit installed and when they are installed:
   - 6" PVC if conduits and pad are installed before the cables are installed.
   - CIC only if CIC is installed at time of pad installation.
   - 6" PVC if CIC will be installed after the pad is set.
   - 4" or 6" PVC if unjacketed or jacketed cable will be installed.
   - 4" PVC if 4" PVC conduit will be run to the pad.

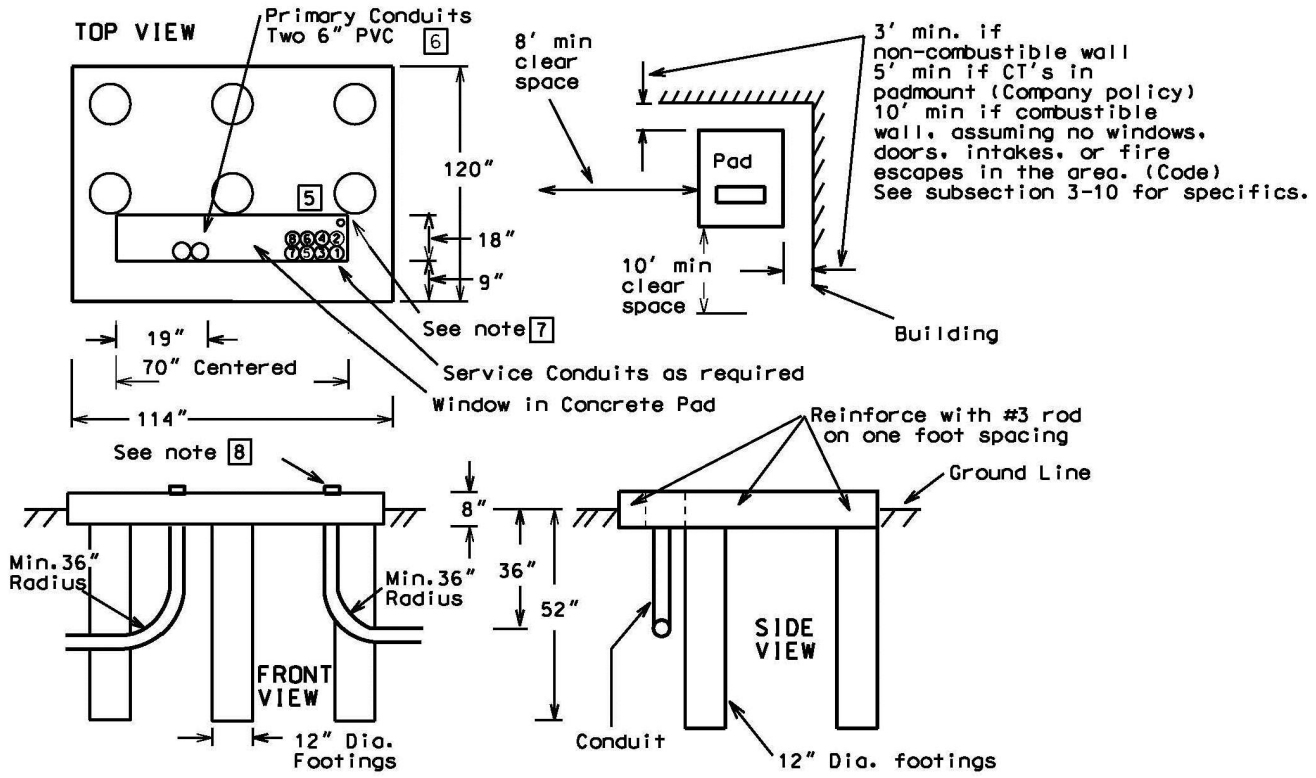
4. Typical weights on transformers are 75 kVA (2300#), 500 kVA (6000#), 750 kVA (8400#), 2500 kVA (17000#).

5. See subsection 8-3 for the Company policy on service conduits for Company-provided services.

6. See subsection 3-9 for code clearances between the padmounted transformer and the building, doors, windows, air intakes, generators, switchgear, fire escapes, etc. See subsection 3-9 for working clearances.

7. See subsection 5-10 for padmounts from 3750 to 5000 kVA.

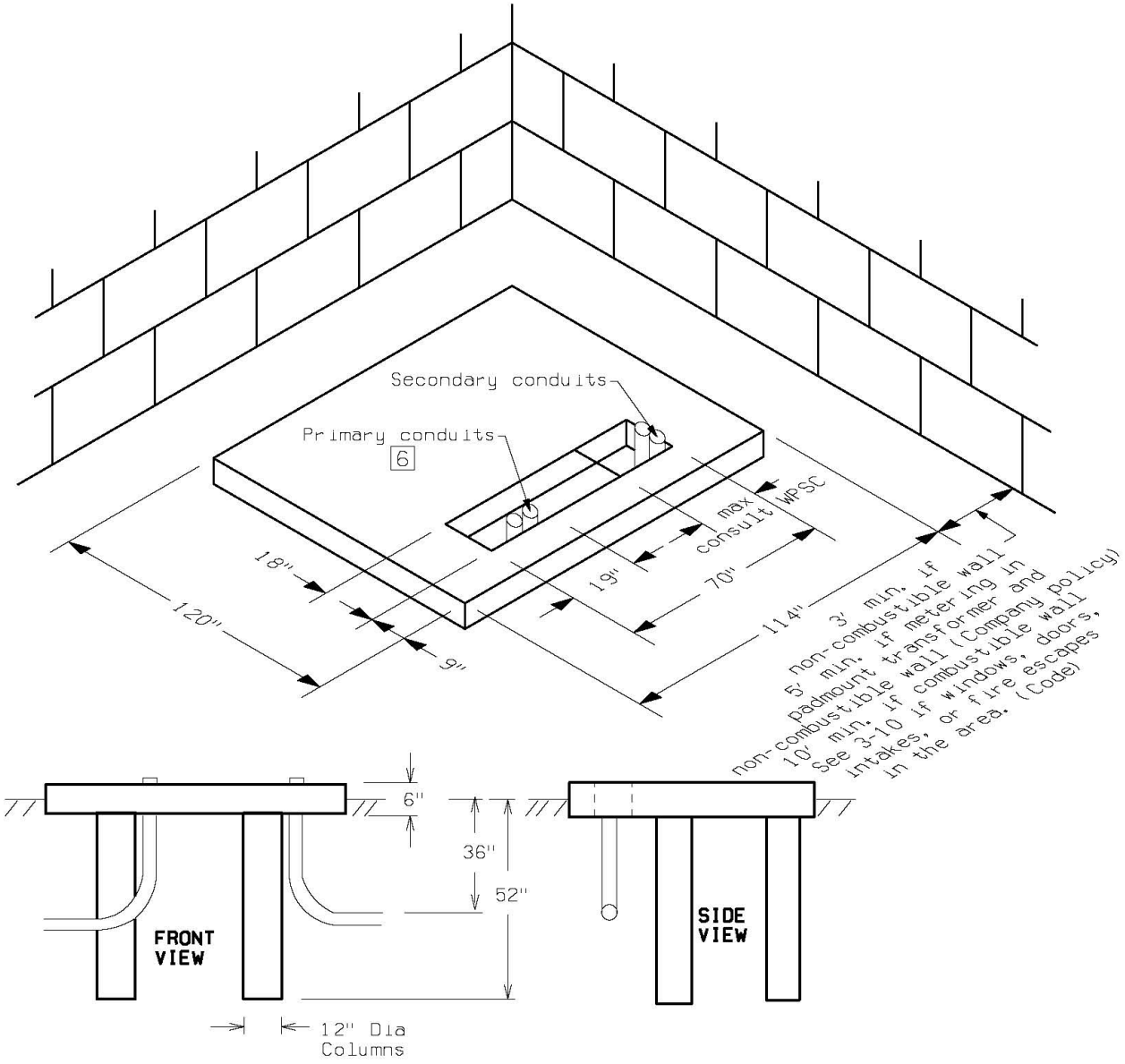
5-10 Large Concrete Transformer Pad 3750 to 5000 KVA

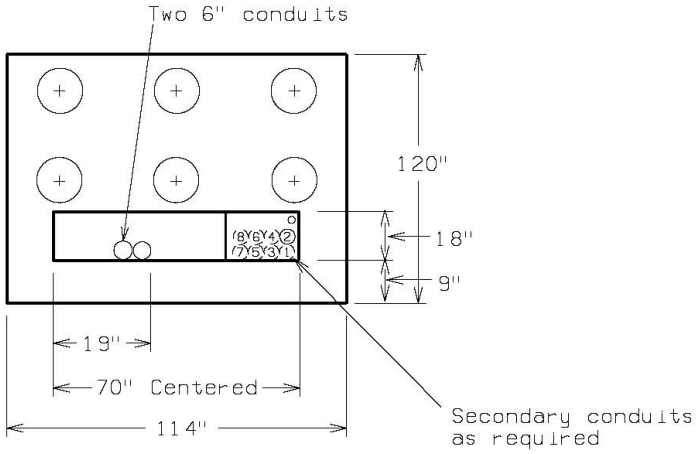


Notes:

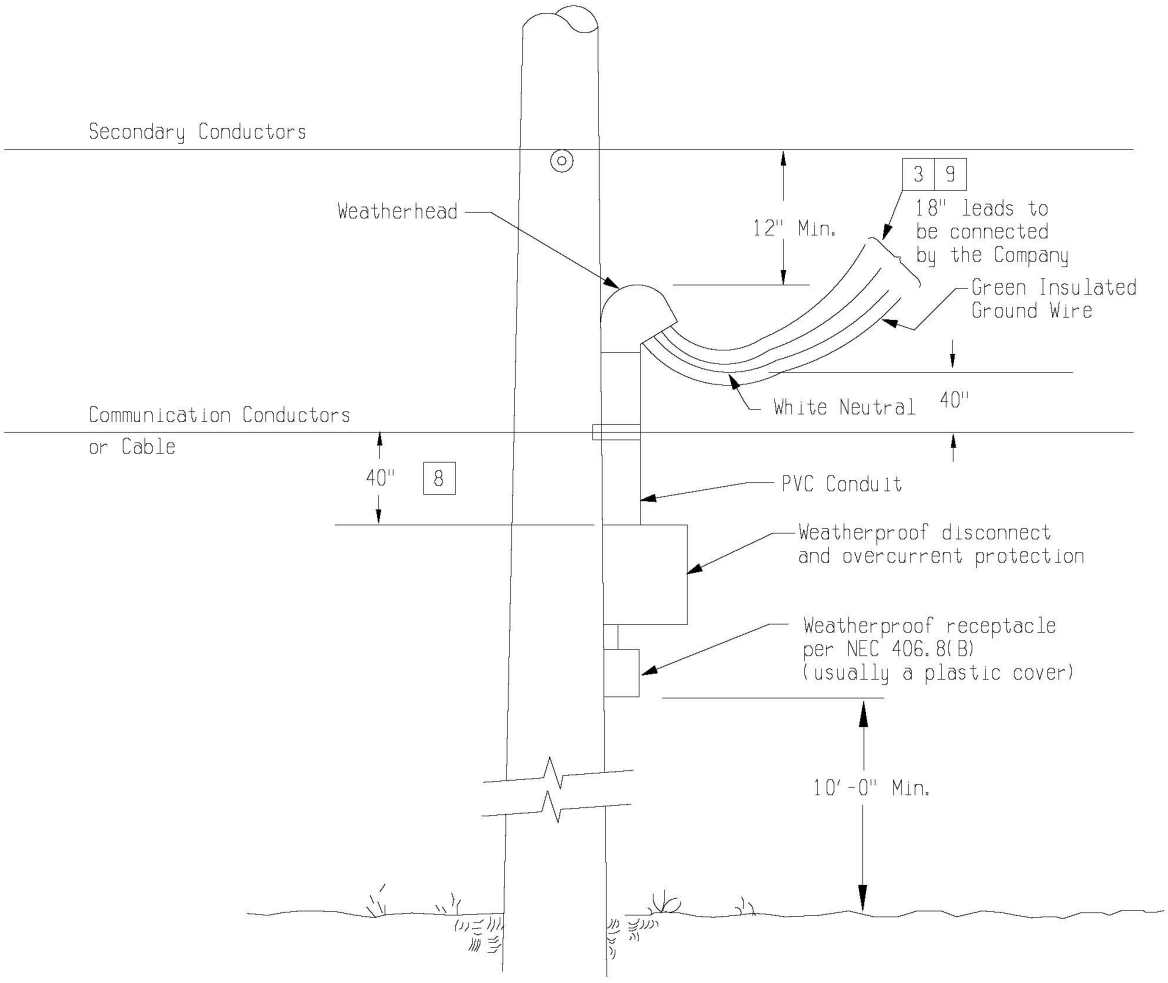
1. Concrete shall have a minimum strength of 3000 lbs. per sq. inch and contain not less than 6 bags of cement per cubic yard. Approximately one bag of fly ash may be substituted for one bag of cement per cubic yard of concrete.
2. The top of the pad shall be reinforced with #3 rods on a 1' spacing.
3. These transformers range from 20,000 to 28,000 lbs.
4. Refer to subsection 3-9 for specific details on clearances from buildings.
5. Service conduits shall always start from the front right corner of the window. The conduits must be positioned tight to the right side of the window and tight to each other and in numbered order. This is so that the conduits don't cross over into the primary side of the transformer.
6. Position primary conduits in the front of the window and 19 inches from the left side (see top view, above). Use two each, six inch conduits.
7. 1-1/4" PVC meter conduit to building wall, if required. End this 3" above pad. At the building, galvanized rigid or IMC should be used for above grade.
8. Service and Primary conduits to be just above (max. 3") pad. Service lateral conduits can be PVC for underground portion from pad to building. At the building, galvanized rigid or IMC should be used for above grade.
9. Concrete is considered fully cured in 21 days. However, the majority of the strength is obtained after 7 days. If transformers will be set in fewer than 7 days, cement should be tested to be sure it has at least 2500#/sq. in. of strength.
10. This is a Legacy Service; the Company provides concrete pads for transformers.

5-10 Large Concrete Transformer Pad 3750 to 5000 KVA (Cont'd)





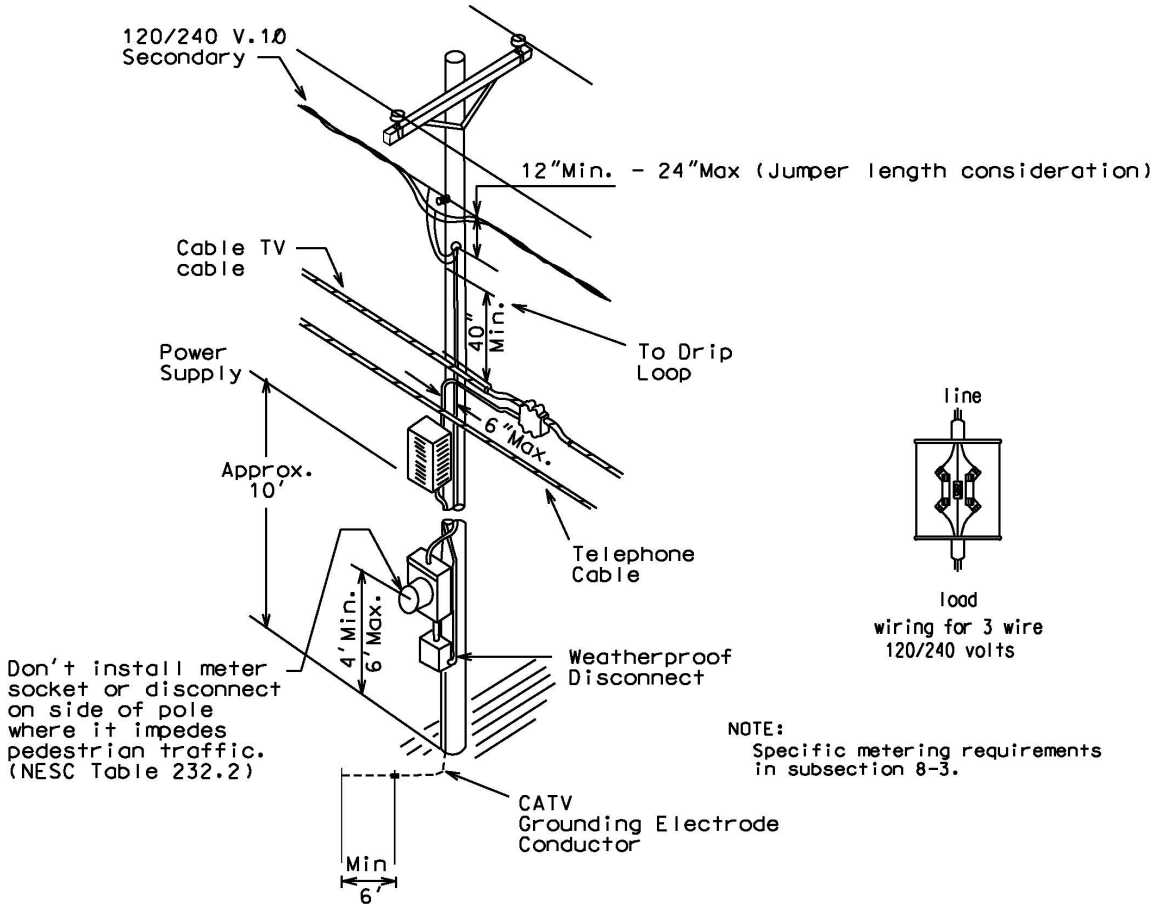
5-11 Unmetered Street Lighting Decorations



Notes:

1. The installation shall comply with code and Company requirements. The customer is required to send plans of the installation to the Company for review.
2. All materials shall be of an approved type and used in the manner intended.
3. The entrance may be 120 or 120/240 volt, depending on load requirements and availability of service on the pole, and shall be securely attached to the pole with bands or lag screws.
4. Service entrances should be avoided on transformer or switch poles.
5. A master agreement is required. The Company has the right to deny such attachments. The preferred method is to meter the usage. See subsection 5-12.
6. Decorations and festoonery shall be removed when billing is terminated.
7. Drilling of holes in poles is not permitted. Pole bands or lag screws may be used to support decorations which shall be securely attached to the pole. Decorations shall not be strung between poles.
8. If the entire installation is above the communication conductors, the receptacle shall be 40" above the communication conductors.
9. An earth ground is not required if a separate grounding wire is run from the switch box through the conduit with the service entrance conductors to be connected to the secondary neutral or the Company ground by Company crews. This ground wire shall be connected in the switch box so that it grounds switch box, receptacle and conduit. This ground should be a green insulated wire. The assumption here is that this is for a municipal government and therefore covered by the NESC. The 10-foot ground clearance is critical. Also, all work must be done by trained and "qualified personnel." See OSHA/MIOSHA/NESC definitions.
10. Non-current-carrying metal parts of decorations operating at less than 150 volts to ground can be installed as close as 20" to communication cables or 20" above and 24" below communication conductors.
11. The installation needs to have clearance of 40” below ungrounded streetlight arms.
12. Decorations are not allowed on any non-wood distribution poles.

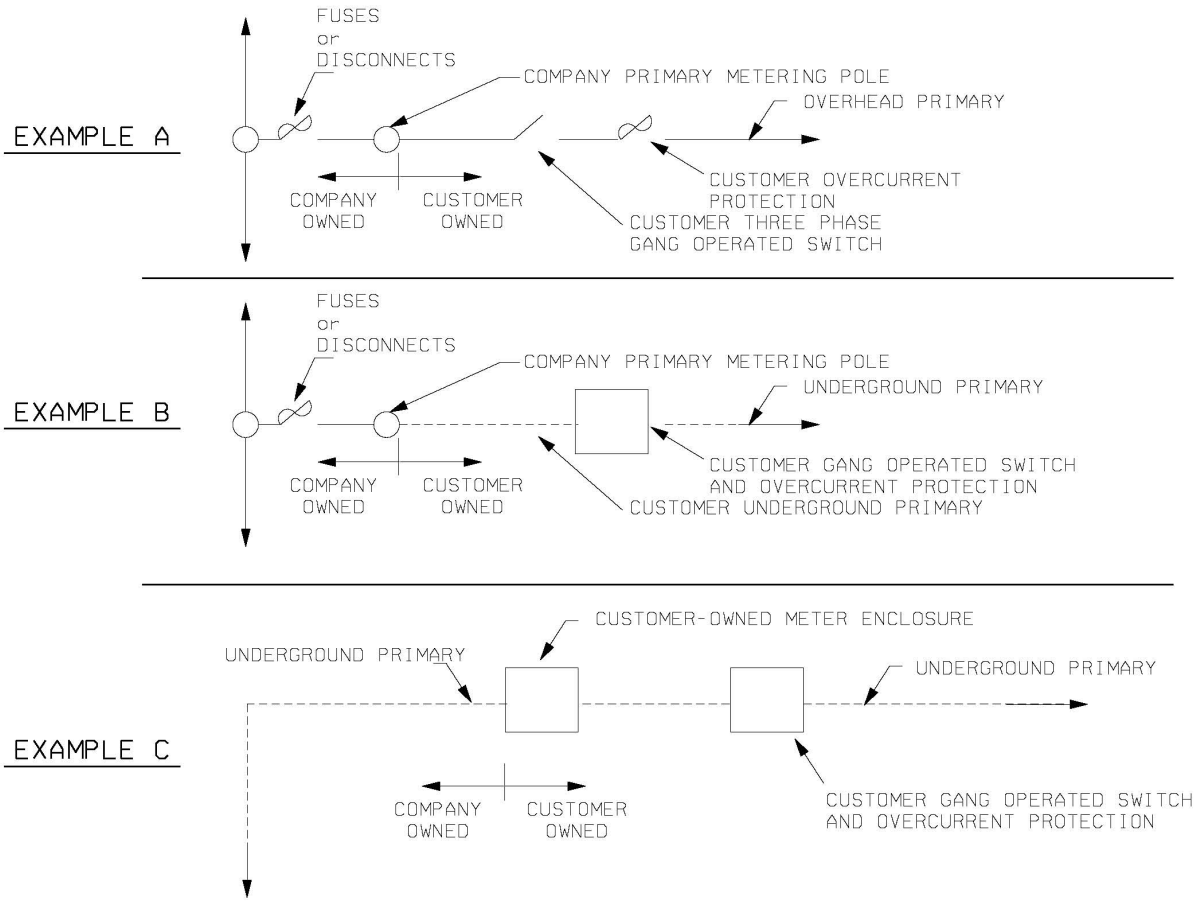
5-12 CATV Power Supplies



Notes:

1. Consult the Company before installing to ensure that 120/240 volt service is available on the pole in question.
2. All installations must conform with all applicable electrical codes and Company requirements, including requirements for clearances, climbing space and working space.
3. Only qualified and authorized personnel shall make this type of installation (See OSHA/NESC definitions). They shall be trained in and knowledgeable of the clearance requirements and working rules of the NESC (Vol.1 Wisconsin State Electric Code)(MIOSHA Rule 408.140.05). The qualified personnel shall be trained and competent in:
    A. Distinguishing exposed live parts from other parts of electric equipment.
    B. The techniques necessary to determine the nominal voltage of exposed live parts.
    C. Minimum approach distances corresponding to the voltages to which the qualified personnel will be exposed.
4. All materials, except meter, shall be furnished and installed by the CATV company.
5. The meter socket shall be a minimum of 100 amp, ringless style, with bypass horns. The service will be 3-wire 120/240 volt. Two wire 120 volt service is not acceptable.
6. The service entrance conductors shall be run in non-metallic conduit, Schedule 40. If metallic conduit is used, it shall be covered with a non-metallic covering 40" above and 72" below any communications attachments (NESC 239G.1.). The service entrance conductors shall extend 30" beyond the weatherhead and shall be rated with 600 volt insulation. The Company will make connections to its lines.
7. It is a code violation to have fused and unfused service entrance conductors in the same raceway.
8. The disconnect, power supply unit, meter socket and CATV cable shall be mounted on the same quadrant of the pole. There shall be a maximum of 6" between the service entrance conduit and CATV cable.
9. Grounding shall be in accordance with the National Electrical Code article 250. Note that code requires a separate ground down the pole and a separate double ground rod. Do not run this ground into the meter socket in Wisconsin (PSC 114.099.C).
10. When a unit contains both the service disconnect switch and the power supply, installation height shall be in accordance with applicable codes.
11. This unit may not be mounted on any pole on which there are transformers, primary risers, section cutouts, capacitors, circuit reclosers, regulators, traffic signals or similar fixtures without the consent of the Company's Field Application Engineer.

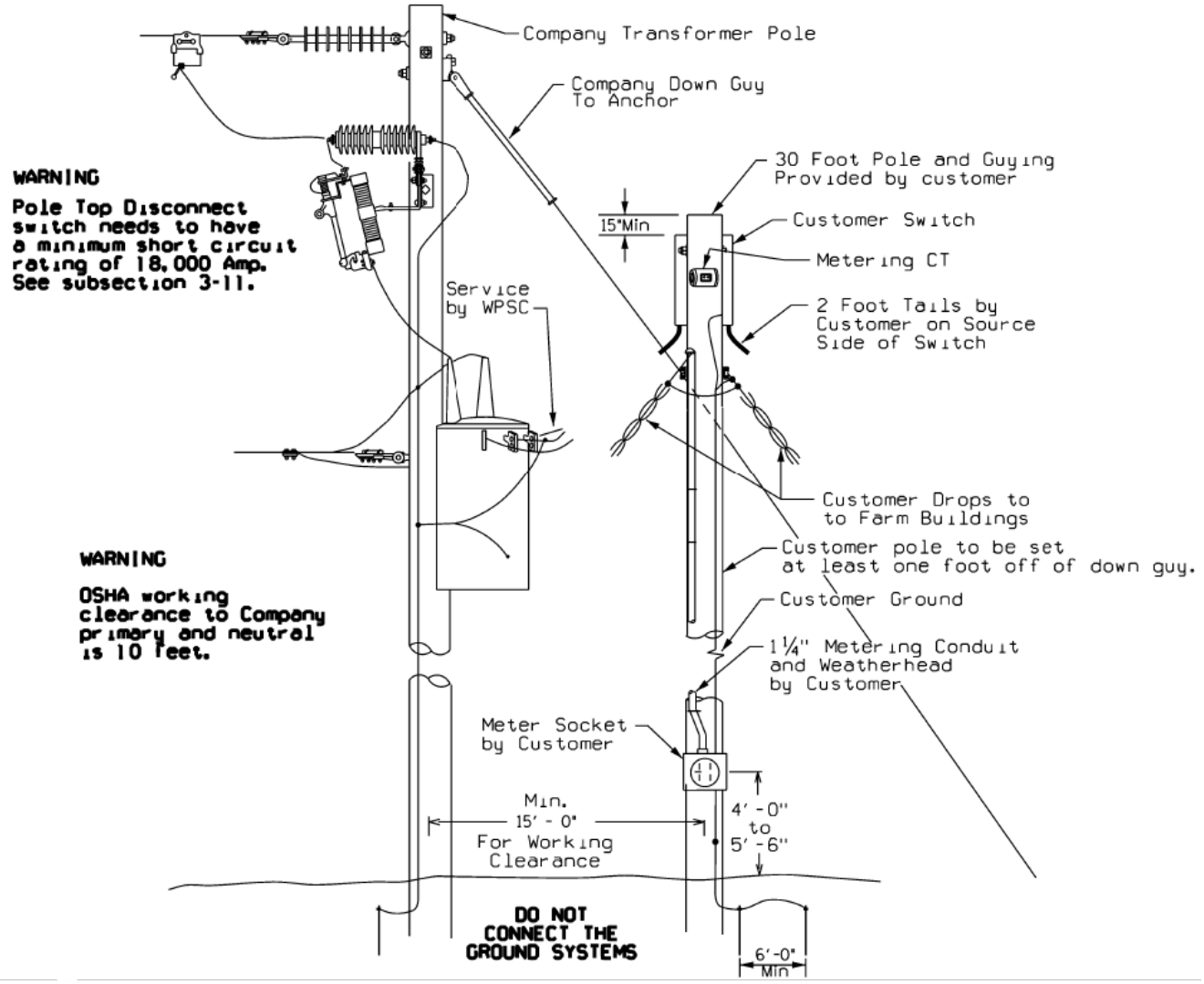
5-13 Primary Metering



Notes:

1. Consult the Company for 14.4/24.94 kV primary voltage. 14.4/24.94 kV service is available for demands over 1000 kVA.
2. A gang-operated three-phase disconnect that the customer can operate must be installed.
3. Overcurrent protection must be installed in conjunction with the three-phase gang-operated disconnect. Consult the Company on coordination issues between the customer overcurrent protection and utility protection.
4. The customer-owned facilities must comply with the state electric code &/or the NEC. If the Company is selling an existing system, changes may be necessary. This is because Company lines are built to comply with volume I of the Wisconsin Electric Code &/or the NESC.
5. Some of the key NEC requirements are in NEC 240.21, 450.3 & 695.5.
    A. Overcurrent protection must be on the primary side of each transformer setting.
    B. Overcurrent protection must be on the secondary side of each transformer setting ahead of the service, or what is now called the feeder by the NEC. This is not required if the customer determines that they have conditions of maintenance and supervision to ensure that only qualified people will monitor and service the transformer installation.
    C. If primary feed to the transformer (feeder per NEC) is outside, then the requirements for secondary overcurrent protection at the transformer are not required. The NEC does require a single main in the secondary switchgear. The six disconnect rule does not apply. Consult with the company for an approved padmount primary metering enclosure.
    D. The fire protection system has special overcurrent protection requirements.
6. Customer-owned, three-legged core transformers shall be avoided. Triplex core transformers are preferred. Grounded wye / grounded wye four or five legged core transformers will require loss of phase protection. Loss of phase and ferroresonance is a concern. Consult with the company for a full list of requirements for common core transformers.
7. Review the Company's Customer Substation Manual for primary metered services.

5-14 Farm Pole Tops



Notes:

1. The Company will provide the service conductors between the poles, meters and CTs. The customer shall provide two foot insulated conductor tails on the source side of the disconnect switch. The Company will make the connections to these tails. The Company will use one CT on 200 & 400 amp single-phase, two CTs on 600 & 800 amp single-phase and three CTs on three-phase.
2. The customer shall furnish and install the pole top disconnect. When multiple pole top disconnects are used, they shall be single lever operated. The customer shall provide and install a 30 foot pole, in good shape and with appropriate guying as is necessary for the pole top disconnect. The Company can sell and install the pole for the customer.
3. Any customer overhead service drop conductors installed on the metering pole shall be installed so as to clear all wiring and equipment on the transformer pole by a minimum of 5'-0" (accessibility).
4. This pole top style metering is acceptable for farm applications for 200 to 800 amp single phase and for 200 amp three phase.
5. The Company's standard metering is direct metering for three phase services up thru 200 amps. There is a special facilities charge for three phase CT metering for 200 amps & below.
6. The Company's standard metering is direct metering for single phase services up thru 320 amps. There is a special facilities charge for single phase CT metering for 320 amps & below.
7. The single phase 320 amp single position meter sockets are acceptable for OH and multiple UG installations, if UL listed, ringless, have a bypass lever, are capable of terminating 350 KCM Al conductor, and have no cover over the meter.
8. Any customer-owned underground feeders or branch circuits shall have the appropriate overcurrent protection installed before going underground. NEC 240.21 (State interpretation of protected)
9. Only one service is allowed for farm pole top services.
10. For legacy WPS owned pole top switches, any significant work on the pole will result in the customer taking ownership. Customer to consult with the Company in these cases.

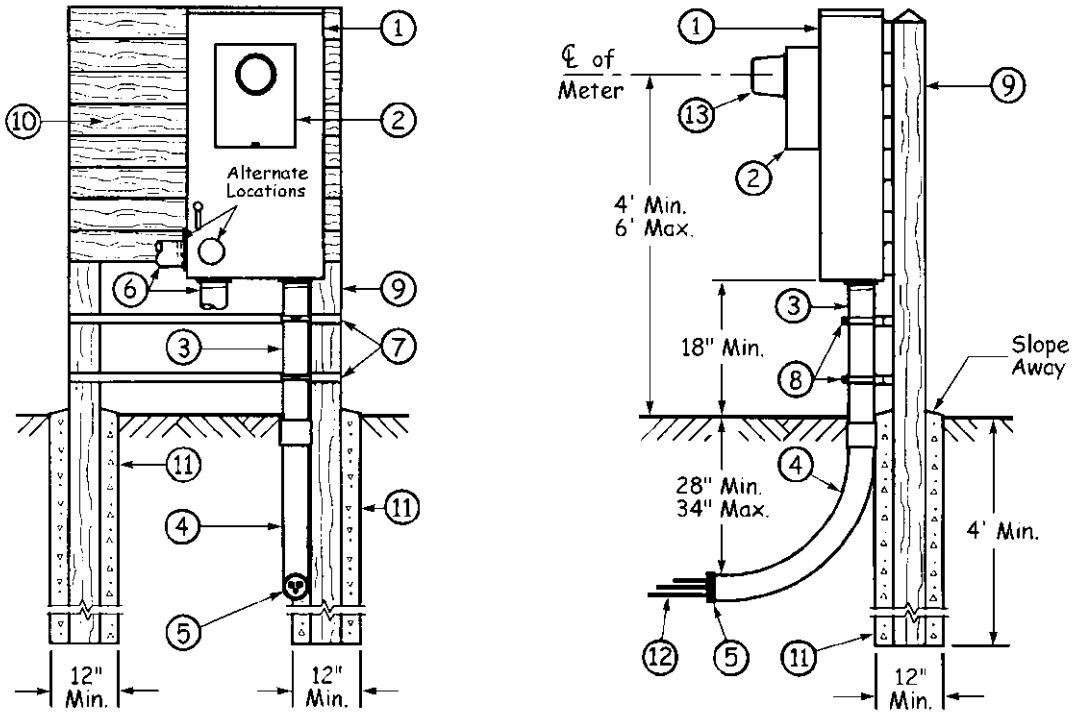
5-14 Farm Pole Tops (Cont'd)

Instrument Transformer Rated Meter Sockets (for CT installations)

5 Terminal for 120/240 single phase (400 amp farm pole tops only)

Manufacturer	
Schneider Electric	URS1004-B-HO Plus 1 ea. 8855-1
Milbank	U7487-RL-KK-TG Plus 1 ea. 5T24B
Landis & Gyr (Siemens)	UAT111-OPxx + (1) 659-0121

5-15 Freestanding Wood Frame Farm Service, 400A-800A Single Phase

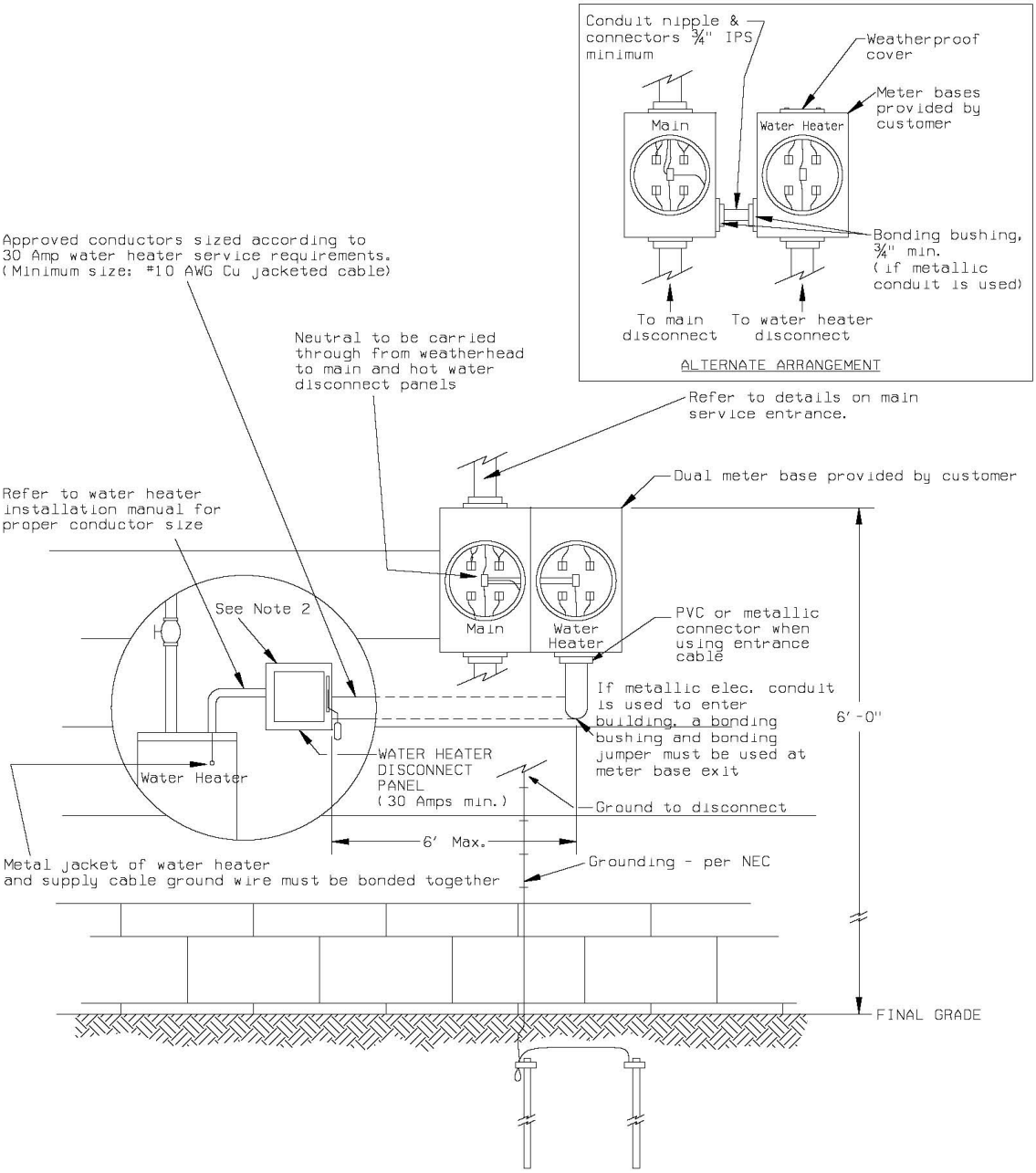


Notes:

1. The customer provides an approved transocket. See Subsection 3-3. Consult with Company for installations larger than 400 amps.
2. The customer provides an approved transformer rated meter socket.
3. A company listed raceway is preferred, raceway shall extend 18” to 27” below final grade. If not using raceway, 4” galvanized rigid, with threaded ends and threaded fittings, shall be provided. Metallic conduit to be bonded.
4. 90° galvanized rigid elbow, 24” radius, shall be provided for direct burial service and conduit to extend 28” to 34” below grade.
5. Insulated conduit bushing shall be provided. Service lateral conduit shall have a temporary waterproof end cap to prevent the accumulation of water, ice and other foreign matter from inside the conduit.
6. Customers service entrance conduit route shall exit the bottom of the transocket. Alternate routes are shown in the diagram and route must be below lowest live parts.
7. Galvanized steel framing channel, 1-5/8” x 1-5/8” x 12 gauge
8. Two conduit supports shall be attached to frame and above grade.
9. 6” x 6” pressure treated wood posts
10. Only 2X pressure treated lumber is acceptable. Plywood, particleboard or OSB is not allowed for use with this structure.
11. Concrete footings will be used to support wood frame. Minimum hole size is 12” and a minimum burial depth of 4’.
12. Only utility conductors are allowed in the service lateral entrance raceway.

5-16 Residential Electric Water Heater Service Entrance – Maintenance Only, MI Only

MICHIGAN ONLY
FOR MAINTENANCE – NO LONGER AVAILABLE



Notes:
1. Location of entrance to be determined by the Company and coordinated with customer prior to installation.
2. If the main service disconnect is grounded to the water supply line, then a minimum 10 AWG ground wire must be installed between the water heater disconnect panel and the main service panel.