

Graham County Electric Cooperative, Inc.

Service Entrance Specifications



Effective January 2001

***Graham County
Electric Cooperative, Inc.***

Office Located at:
9 West Center
Pima, Arizona

Telephone (928) 485-2451
1-800-577-9266
Fax (928) 485-9491

Effective January 2001

Table of Contents

Notes: See front of each section for detailed listing.

Abbreviations	III
Definitions	IV
General Information	1-1
Request for Service	2-1
Metering	3-1
Overhead Service	4-1
Underground Service	5-1
Trenching Requirements	6-1
Grounding and Bonding	7-1
Short Circuit Protection	8-1
Irrigation and Water Pumping	9-1

Abbreviations

G.C.E.C. - Graham County Electric Cooperative

E.U.S.E.R.C. - Electric Utility Service Equipment
Requirements Committee

N.E.C. - National Electric Code

N.E.S.C. - National Electric Safety Code

O.S.H.A. - Occupational Safety and Health Act

N.E.M.A- National Electrical Manufacturers Association

RE.A. - Rural Electrification Administration

Note: When reference is made to any of the above codes, standards, or regulations, it shall refer to the latest revision of the same.

DEFINITIONS

APPLICANT

Any person, firm, corporation or governmental body applying for electric service from the Cooperative at one specific location.

APPROVED

Acceptable to the authority having jurisdiction over the matter.

BUILDING

A structure which stands alone or which is cut off from adjoining structures by firewalls with all openings therein protected by approved fire doors.

CLEARANCE

Approval of the electrical installation by the inspection authority.

COOPERATIVE

Graham County Electric Cooperative, Inc.

CURRENT TRANSFORMER METERING - DEFINED

When consumer loads are 201 amperes and above, current transformers (C.T.'s) are connected directly into the service entrance conductors to ratio the primary current down to a secondary current which can be accurately registered on the meter.

Example: A 400 to 5 amp C.T. has a ratio of 80 to 1. The reading on the kW and kWhr scales is then multiplied by the ratio value of 80, indicated as X 80 on the face of the meter, to give the actual load in kW's or kWh's.

CONSUMER

Any person, firm or corporation, organization, governmental body, or any metered installation receiving electric service from the Cooperative.

CONSUMERS SERVICE ENTRANCE

In general, all conductors, devices, apparatus, and hardware on the consumers side of the point of delivery, except the Cooperative's meter installation.

COOPERATIVE EQUIPMENT

The service lines, meter installations, structures, devices, apparatus, hardware and other facilities installed by or on behalf of, and/or owned by the Cooperative and other transmission and distribution facilities of the Cooperative System.

FIRST FLOOR

As defined for the purposes of this manual is the floor that is closest to the elevation of ground level and above ground level.

METER

The instrument for measuring and indicating or recording the flow of electricity that has passed through it.

METER ROOM

Illuminated and ventilated room containing electric meters and electric service equipment.

POINT OF DELIVERY

Where the Cooperative terminates its electric service conductor at the line side of the meter, unless otherwise agreed upon in a written contract or agreement.

POINT OF ATTACHMENT

The location at which restraining anchoring contact is made on a building or structure to support Cooperative facilities.

SELF CONTAINED METER

A self-contained meter is one which is capable of carrying the total current and voltage of the electric service supplied to the consumer. This type of meter is connected directly to the service entrance conductors when it is plugged into the meter sockets.

SERVICE ENTRANCE SECTION

A Factory built floor standing service entrance.

SERVICE LINE

The line extending from a distribution line or transformer to the consumers premises or point of delivery.

TEMPORARY SERVICE

Service to premises or enterprises which is temporary or transitory in character and is intended to be used for a limited duration not to exceed 12 months. Service which, in the opinion of the Cooperative, is for operations of a speculative character is also considered temporary service.

GENERAL INFORMATION

Table of Contents

Service Availability	1-2
Codes	1-2
Attachments on Company Poles	1-2
Design of Consumers Equipment	1-2
Access for Cooperative Employee's	1-3
Right of Way Clearing	1-3
Diversion of Energy	1-3
De-Energizing Service Entrance	1-3
Protection of Cooperative Equipment	1-3
Working Safe Near Cooperative Facilities	1-4
Line Disturbances	1-4
Service Interruptions	1-4
Computer Protection	1-5
Emergency Generators	1-5
Motor Starting	1-5
Polyphase Motor Protection	1-6

GENERAL

SERVICE AVAILABILITY

Subject to the Cooperative's approved Line Extension Policies, service will be rendered to a consumer from the Cooperative's nearest suitable line of sufficient capacity to furnish adequate service of the phase and voltage requested and availability of easements.

CODES

These requirements are supplementary to and are not intended to conflict with the currently applicable National Electrical Code, National Electrical Safety Code, Municipal, County or State Codes, Ordinances or Regulations within the State of Arizona. *In* some instances, however, these requirements exceed these codes which are intended as minimum requirements only.

ATTACHMENTS ON COOPERATIVE POLES

The Cooperative forbids all unauthorized attachments, including meter loops, posters, and signs to its poles, equipment, or property. The Cooperative may remove all such unauthorized attachments without notice and may prosecute for such trespass.

DESIGN OF CONSUMERS EQUIPMENT

The provision for adequate electrical capacity must be made by the consumer. As a utility, the Cooperative cannot design, plan, install or maintain the consumers wiring, electrical equipment or other consumer owned facilities. An electrical engineer and/or a qualified electrical contractor should be consulted to aid the consumer in determining that his electrical installation will have adequate capacity for future use.

ACCESS FOR COOPERATIVES EMPLOYEES

Consumers shall permit authorized employees of the Cooperative safe access to premises of the consumer to obtain information concerning connected load, to measure or test the service, to read or test meters, and for other purposes incident to the supplying of electric service at all reasonable times.

RIGHT OF WAY CLEARING

It shall be the responsibility of the consumer or developer to clear the utility Rights of Way, including removal and disposal of slash and obstacles. The Cooperative will maintain the Right of Way after the initial clearing has been done.

The consumer can elect to have the Cooperative clear the Right of Way required to provide service, however, the cost must be advanced to the Cooperative by the consumer.

DIVERSION OF ENERGY

Under no circumstances shall devices or attachments be connected to Cooperative facilities in such manner as to permit the use of unmetered energy, except in emergencies when authorized and done only by authorized Cooperative employees. Under Arizona law, unauthorized diversion of electricity constitutes either a misdemeanor or felony punishable by a fine of up to \$150,000.00 and/or imprisonment for up to five (5) years.

DE-ENERGIZING THE SERVICE ENTRANCE

No person other than an authorized employee of the Cooperative or a licensed electrical contractor who has signed a letter of understanding with the Cooperative and has been issued special meter seals may break seals, move, relocate or replace meters and other equipment owned by the Cooperative. If de-energizing is needed, contact your local Cooperative office to make arrangements.

PROTECTION OF COOPERATIVE EQUIPMENT

The consumer shall be responsible for the safeguarding and protection of all Cooperative equipment and property installed in or on the consumers premises for the purpose of supplying electric service to the premises. Each consumer shall exercise all reasonable care to prevent loss or damage to the Cooperative's property excluding normal wear.

The consumer shall be billed for damages to Cooperative property caused by the consumer or the consumer's employee(s), agent(s) or family.

WORKING SAFE NEAR COOPERATIVE'S OVERHEAD FACILITIES

When a party plans to do construction or repair work where personnel or equipment will be used under or near the Cooperative's electric transmission or distribution facilities, required clearances must be observed.

O.S.H.A. prohibits the use of equipment closer to high voltage lines than ten (10) feet for voltages of 0-50,000 (phase to phase) and eleven (11) feet for 69,000 volts (phase to phase).

DETRIMENTAL EFFECTS OF CONSUMERS EQUIPMENT CAUSING LINE DISTURBANCES

The consumer shall eliminate or correct the conditions causing detrimental effects on Cooperative equipment or the integrity of it's facilities, or the Cooperative may correct the problem and bill the consumer causing the effect. The operation of welders, compressors and similar equipment having intermittent flow of large currents can sometimes interfere with other users of the electric service.

SERVICE INTERRUPTIONS

Graham County Electric Cooperative, Inc. cannot guarantee uninterrupted service, and it is not the Cooperative's policy to pay for damages that result from such interruptions, single phase conditions, or voltage fluctuations on the Cooperative's system occasioned by any cause beyond the Cooperative's reasonable care and control.

The Cooperative's system is designed to minimize potential problems, but malfunctions and other external forces do cause occasional system failures. In these instances, the Cooperative suggests the use of properly sized, installed and maintained protective devices to protect your equipment.

For information on how to protect your electrical equipment, contact an electrical contractor, equipment manufacturer, pump company or an electrical engineer.

The Cooperative may temporarily suspend service to make necessary repairs, replacements, maintenance, tests or inspections of Cooperative equipment. The Cooperative will make reasonable efforts to notify the consumer, but if necessary, may suspend service without prior notice to the consumer.

COMPUTER PROTECTION

Electronic computers are sensitive to momentary voltage fluctuations which are referred to as "Blips" or "Spikes". These may be created within the consumer's service through motor starts or other electric load turn ons. They may also occur external to the consumer's service as a result of the Cooperative's routine switching or fault clearing.

The Cooperative cannot assure a consumer that their electric service will be free of momentary voltage fluctuations. If this is a concern, it is recommended that the consumer provide an interface between the electric service and the computer to screen out unwanted voltage fluctuations.

EMERGENCY GENERATORS

Generators installed to supply part or all of the consumer's load during a power outage shall have the following requirements. The consumers generator shall be connected to the load through a double throw switch or automatic relays and switches which will disconnect the load from the Cooperative's system before the generator is connected to the load. When the Cooperative's system is re-energized, the generator will be disconnected from the load before the load is reconnected to the Cooperative's system.

MOTOR STARTING

Three phase motors rated above forty (40) horsepower shall utilize reduced voltage starting equipment and be installed by the consumer. Forty (40) horsepower and below may be either "across line" or reduced voltage starting at the discretion of the consumer.

The above quoted specification may be modified to allow the use of across the line starting devices for larger motors by specific approval of the engineering department of the Cooperative, depending on the characteristics of the motor and location on the Cooperative's system.

Starters must conform to the latest National Electric Manufacturer's Association standards and the installation must be in accordance with the latest edition of the National Electrical Code. Magnetic contactors in full voltage starters must have a coil capable of sealing in the contactor at 75% rated voltage. The Cooperative may specify the tap setting or percentage of voltage to be used on the reduced voltage starter.

POLYPHASE MOTOR PROTECTION

The following protective devices are required and shall be installed and maintained by the consumer.

The Cooperative shall not be responsible for any damage incurred if they are not installed and in good working order.

1. Three element running overload protection shall be required on all motors; i.e., one overload element in each phase in the starter or equivalent protection devices. (N.E.C. Art. 403-37).
2. All motor controllers shall be arranged so that in event of sustained loss in voltage, the motor will be disconnected from the line unless it is equipped for automatic starting after such failure.

The recommended devices listed below are strongly suggested to reduce the possibility of damage to polyphase equipment.

3. Low voltage protection is recommended on all polyphase motors.
4. Phase reversal protection is recommended in all polyphase motors and well pump motors.
5. Phase failure protection is recommended on all polyphase motor circuits.

Some manufacturers supply a different device for each type of protection, while others may offer a single device that provides complete protection.

REQUEST FOR SERVICE

Table of Contents

Request for Service	2-2
Required Information	2-2
Inspection and Control	2-3
Upgrading Existing Service	2-3

REQUEST FOR SERVICE

Consumers requesting new meter installations or relocations should contact Graham County Electric Cooperative, Inc. for an approved service and meter location prior to proceeding with any electrical installation. This location should be the most practical point on the consumer's building nearest to the existing or proposed line of the Cooperative.

By checking first, the consumer can avoid the inconvenience and delay in obtaining service by having to make service entrance relocations or pay the expense incurred by the Cooperative for additional facilities to serve unauthorized meter locations.

REQUIRED INFORMATION

Each prospective consumer desiring new service must make application for the same with the Cooperative.

The Consumer must provide the following information.

1. Applicants name, address {both mail and street)
2. Complete identification of location of new service. In the case of a subdivision, the unit number, lot number, and subdivision name, otherwise a legal description of property shall be furnished to the Cooperative.
3. Site plans and building plans showing desired meter location.
4. Estimated load-voltage and phase desired.
5. Physical address (street address) assigned to property by city or county.

LOCAL INSPECTION AND CONTROL

In Graham County and some incorporated towns, ordinances require an inspection by a building inspector and the service entrance is tagged before the Cooperative can supply electric service to a consumer.

In all instances, the service entrance, including grounding and bonding shall be in accordance with Cooperative requirements, the National Electrical Code and subject to Cooperative inspection before the service shall be energized. The consumer should check with his local inspector before undertaking any job subject to City, County, or State Inspection.

In the event that the consumer's service entrance equipment may have a "tag" inspection sticker attached to it, however, it does not meet the specifications as required, then the Cooperative shall refuse service until such time the consumer brings the service entrance equipment up to current specification.

The Cooperative shall not be under any obligation to inspect the wiring or appliances of the consumer. Where the Cooperative has reason to believe that the wiring or appliances are unsafe and do not comply with the National Electrical Code, local county, state codes or ordinances, the Cooperative may refuse or discontinue service unless required changes have been made.

UPGRADING OF EXISTING SERVICE

When a consumer plans to upgrade his service entrance equipment to provide additional capacity or correct a hazardous condition, the service entrance being upgraded must be brought up to current code and specifications.

METERING

Table of Contents

General Meter Location	3-2
Grouping of Meters	3-2
Working Spaces	3-2
Residential Meter Location	3-2
Meter Relocations	3-2
Typical Meter Locations Drawings	3-3
Commercial Meter Locations	3-5
Unacceptable Meter Locations	3-6
Meter Room Requirements	3-7
Meter Locations Requiring Enclosure	3-7
Electric and Gas Meter Separation	3-9

METER LOCATION REQUIREMENTS

Meter Locations

The Cooperative reserves the right to determine all meter and service locations. Only authorized Cooperative personnel shall determine these locations.

The Cooperative will make only one point of attachment of the service wires to a building. Exceptions will be as allowed by N.E.C. Article 230-2 or by the Cooperative's Engineering Dept.

Grouping of Additional Meters

Occasionally there is need to locate and install additional metering equipment after the originally planned service for a building is installed and energized.

The additional meter (s) must be grouped with those already in service and must be installed in conformance with applicable codes, laws and ordinances of the inspection authority having jurisdiction, and with the requirements of this Specification Manual.

Working Space

To permit access to the metering installation and to provide safety for personnel, a working and standing space entirely on the property of the consumer shall be provided in front of all metering equipment. This space shall be a minimum of 36" x 36" x 78".

Meter Locations – Residential

For single family residential buildings, meters and metering equipment shall be installed:

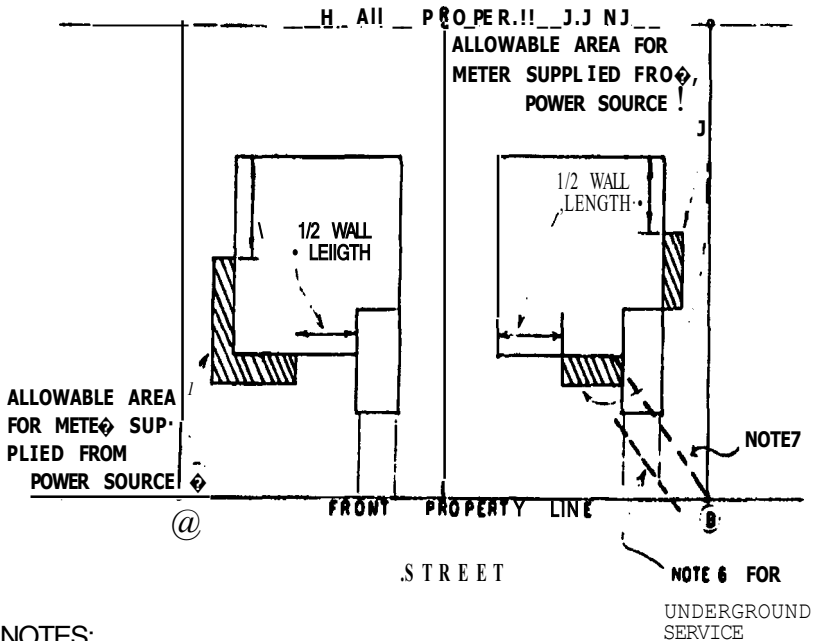
- A. Outdoors and mounted on or semi-flush in an exterior building wall, but not under a carport, breezeway, patio, porch, or any area that can be enclosed.
- B. The meter area must be readily accessible at all times for reading and testing. If access is denied or made hazardous by the presence of obstacles, dangerous animals or other conditions, electrical service may be terminated or denied until safe access is provided.
- C. The meter and main switch shall be installed outside adjacent to each other on same wall:

Meter Relocations

When the Cooperative has requested a relocation of the consumers metering facility because it has been made inaccessible, then it is the consumers responsibility for the relocation of their metering facility.

SINGLE DWELLING ELECTRIC METER LOCATIONS

(Front Property Lines)

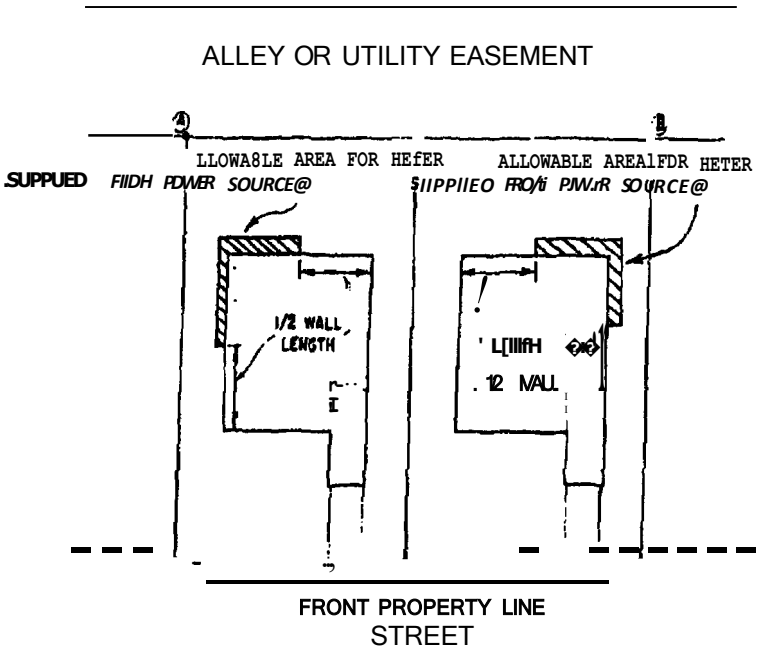


NOTES:

1. For Power line in the street, the meter shall be located within one half (1/2) the length of front or side wall nearest the designated power source.
2. The lot corner from which the meter is to be served shall be designated by a Graham County Cooperative Representative.
3. All meters shall be located on an exterior wall, but not under a carport, breezeway, patio, or area that can be enclosed with building expansion.
4. The meter shall be accessible for testing and maintenance without requiring passage through restricted private areas, locked gates or fences. Cooperative reserves the right to determine final meter location. Patio walls shall not extend above horizontal line of sight to meter.
5. In Townhouse developments where side wall locations are not available, consult with Cooperative for meter locations.
6. Overhead service wire can not cross over roof to meter location.

SINGLE DWELLING ELECTRIC METER LOCATIONS

(Rear Property Lines)



NOTES:

1. For power line in rear of lot, the meter shall be located within one half (1/2) the length of rear or side wall nearest the designated power source.
2. The lot corner from which the meter is to be served shall be designated by a Graham County Electric Cooperative Representative.
3. All meters shall be located on an exterior wall, but not under carport, patio, porch or area that can be enclosed with building expansion.
4. The meter shall be accessible for testing and maintenance without requiring passage through restricted private areas, locked gates or fences. Cooperative reserves the right to determine final meter location.
5. In Townhouse developments where side wall locations are not available, consult with Cooperative for meter location.

Meter Locations-Commercial and Industrial

1. For single occupancy commercial and industrial buildings, meters and metering equipment shall be installed:

Outdoors and mounted on an exterior wall not subject to future enclosure.

2. For multiple occupancy buildings, meters and metering equipment shall be grouped in one readily accessible central location, accessible to all occupants.

Meter sockets must be permanently and clearly identified.
(See Meter Identification Section.)

3. In large multiple occupancy buildings such as shopping centers, the Cooperative may, at its option, establish more than one meter location for groups of individual meter facilities. Consult the Cooperative's Engineering Department prior to construction for approval of service plans in these cases.

Unacceptable Meter Locations

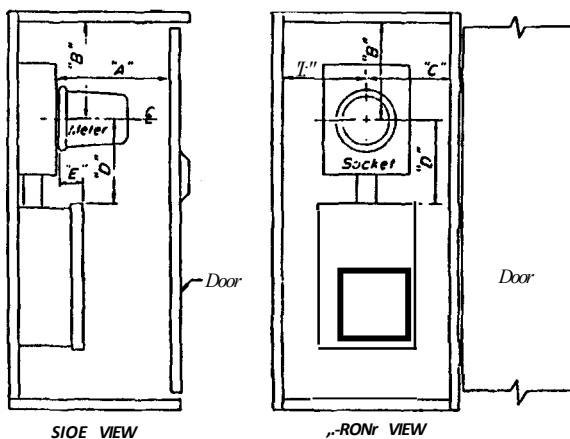
For reasons of safety, maintenance of service equipment and reliability of metering, meters shall not be installed at any of the following locations.

1. Inside any building.
2. In any location not readily accessible.
3. In any location which may be hazardous to personnel.
4. On any surface subject to excessive vibration.
5. In or accessed through any rest, bath, shower, powder, or toilet room.
6. In any location not providing a clear and continuously unobstructed working space extending a minimum of three feet from the face of the meter panel, and having a width to permit ready access to the complete metering installation.
7. In any location where moisture, fumes, or dust may interfere with the operation of the meter, or materially damage it.
8. In any basement or depressed area.
9. Within carport, porch or patio, which is or can, become enclosed.
10. Mounted on Cooperative's main line primary poles.
11. In a room containing mechanical equipment.
12. In any unsanitary areas in reference to farm animals and products.
13. Located on any mobile home.

Meter Locations Requiring Enclosures

Meters and metering equipment shall be enclosed in a protective cabinet under the conditions listed below.

1. Whenever vandalism problems exist, or
2. Whenever the meter is subjected to damage due to "everyday action" around it or where public safety is involved. When this is required EUSERC drawing No. 352 shall be consulted for required meter cabinet enclosure clearances.



Dimension "A"	7" Minimum for Residential Single-Phase	15" Maximum
	9" Minimum for Commercial Single-Phase	15" Maximum
	11" Minimum for Commercial Polyphase	15" Maximum

NOTE: Dimension "A" applies only to that portion of the cabinet enclosing door in front of the meter.

Dimension "B"	7" Minimum for Residential or Commercial Single-Phase
	9" Minimum for Commercial Polyphase

Dimension "C"	6 1/4" Minimum for either Residential or Commercial and either Single-Phase or Polyphase.
	10" Minimum when Dimension "A" exceeds 11".

Dimension "D"	8" Minimum from meter center-line to top of any protruding switch or breaker or to bottom of the enclosing cabinet. This dimension may be reduced to 6" when Dimension "E" does not exceed 1".
---------------	--

NOTES:

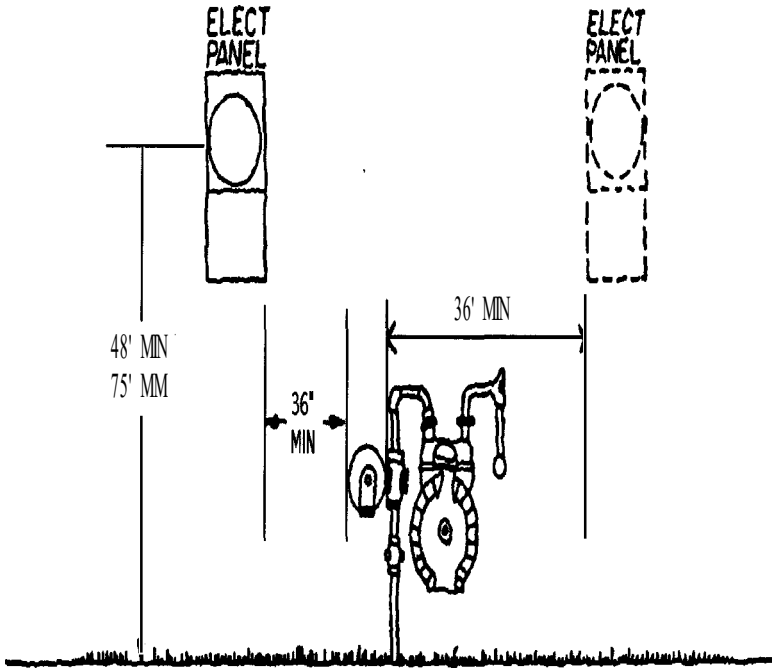
1. Meter sockets having jaws which must be tightened with a wrench shall be installed with a minimum of 6" clear space on each side to permit use of wrench.
2. Care should be exercised to design cabinet such that neither the roof nor door supports will interfere with installation of the meter. With the cabinet door open, a clear space of at least 15" directly in front of the socket is required to insert the meter into the socket.

EUSERC - DRWG #352

METER EQUIPMENT PROTECTIVE ENCLOSURE
0-600VOLTS

Electric and Gas Meter Separation

In areas where the electric and gas metering installations are installed in the same general area, minimum clearances as shown below must be maintained.



Note:

1. Size and dimensions of panels will vary.
2. Maintain 3' clear and level working space in front of electric meters.

Metering and Service Entrance Equipment

Meter Socket Enclosures	3-11
Meter and Main Switch Sequence	3-11
Main Switch Location	3-12
Main Switch	3-12
Meter Height	3-12
Metered and Unmetered Conductors	3-13
Sealing of Metering Equipment	3-13
Unacceptable Equipment in Sealed Areas	3-13
Meter Identification	3-14
Couplings and Gutters	3-14
Wiring	3-14
Power Leg Location	3-15
Single Phase Service Limits	3-15
Mobile Home Service Equipment.	3-16
Single Phase Service Wire Size Table.....	3-17
Self Contained Meter Socket Guide Drawing.....	3-18

METERING AND SERVICE ENTRANCE EQUIPMENT

Meter Socket Enclosures

Meter sockets will be used up to and including a rating of 200 amperes which is referred to as "self contained" metering. For service exceeding 200 amperes refer to "C.T. Metering".

Metering equipment furnished and installed by the consumer shall include, but not be limited to the following.

1. Meter sockets (See self contained metering guide drawing).
2. Multiple meter panels and prefabricated panels.
3. Meter enclosures.
4. Service entrance switchboards.
5. Proper wiring, bonding and grounding.

Meter and Main Switch Sequence

Meters and metering equipment shall be located ahead, or on the supply side of the consumers main service entrance switch.

When a single set of service entrance conductors supply a multi-meter installation, numbering from two to six meters, a main switch for each meter shall be located on the load side of each meter.

For multi-meter installations, numbering seven or more meters connected to a single set of service entrance conductors, electrical codes require the installation of a main service switch located on the supply side of the group of meters. In these instances, an individual main switch must also be installed on the load side of each meter.

Main Switch Location

The meter and service main switch shall be installed on the same wall adjacent to each other and accessible from the same working area.

All metering equipment must be securely mounted so that its meter jaws are in true horizontal and vertical planes and will support the meter without tilt in any direction.

Main Switch

For each meter installed on a service, the consumer shall furnish and install an external, rain-tight, fusible switch or circuit breaker. These fuses or circuit breakers must be designed to interrupt and withstand the available fault current.

METER HEIGHT

The requirements for meter height, which is the vertical distance between the center line of the meter and the standing surface, shall be as follows:

1. When meters are wall, semi-flush, or surface mounted outdoors approx 5' - 6'

For meter pedestal installations, the requirements for meter heights are:

1. If meter is exposed 42" min 75" max
2. If the meter is enclosed 36" min 75" max

Metered and Unmetered Conductors

Line side (unmetered) and load side (metered) conductors shall not occupy the same raceway or enclosure.

Exception: Meter socket and current transformer enclosures.

Sealing of Meters and Metering Equipment

All meters, meter facilities and all points of access to unmetered wiring on the consumers premises shall be sealed by the Cooperative. All cabinets, conduit fittings and equipment enclosures containing metered conductors shall be made sealable by the consumer before service will be energized.

Stud and wing-nut assembly, or sealing screws shall be used for sealing all removable panels and covers to compartments used for routing or terminating unmetered conductors.

Unacceptable Equipment in Sealed Areas

No consumer related equipment or devices shall be installed in or attached to the meter, meter socket, meter cabinet, metering compartment or pull section area of any service entrance equipment. All such equipment such as load control transformers, over current devices, transfer switches, etc. must be located in the non-sealed area.

Meter Identification

Where more than one meter for service to the consumers premises is required, then each meter and each service switch or breaker shall be clearly and permanently identified by the consumer to indicate the particular location supplied by it. **Meters will not be installed until the marking is complete.**

Examples of permanent marking are:

- (1) Identification plate attached by rivets or screws, or
- (2) Commercially available decals designed for this purpose.

Paint is not acceptable as a permanent marking.

Couplings and Gutters

When entering or leaving service entrance enclosure, an approved method shall be used. Burning of holes in the enclosure or the welding of couplings or fittings instead of using an approved hub is not permitted or acceptable.

Wiring

The conductors may be solid or stranded copper wire for overhead or underground services. Solid or stranded aluminum wire with ampacity equal to or greater than that of the required minimum size of copper for underground services only. In 3-phase, 4-wire delta installations, the polyphase leg (power or high leg) shall be sized for the connected load, but shall not be smaller than #6 AWG copper. In three-phase, 4-wire wye installations, all phase conductors shall be of equal size. All conductors in service entrances shall be insulated for 600 volts, using rubber or synthetic as insulating material. The neutral wire shall be white or gray colored or identified with permanent marking as such. Phase conductor insulation, other than the polyphase leg should be black or be identified by permanent markings to distinguish these phases from the neutral and the polyphase leg.

Neutral Conductors

For 3-wire, 120/240 V services, the neutral conductor shall not be smaller than two trade sizes than the ungrounded conductors. For 3-wire, 120/208 V single phase services, the neutral conductor shall be the same size as the phase conductors.

For all other services, the neutral conductor shall be no less than 70% of the size of the phase conductors unless supported by actual engineering calculations supplied to the Cooperative by the consumer.

Power Leg Location and Marking

In self-contained meter sockets, the wiring, whether in individual sockets or in multiple meter paneboards, shall have the power phase or "high leg" to ground in the right hand terminal.

In service entrance sections, the "B" or center phase shall be the power phase, or "high leg" to ground.

The "high leg" or phase conductor having the higher voltage to ground shall be identified by an outer finish that is orange in color or permanent tagging. This identification shall be placed at all points where a connection is made or will be made, including leads where service will be connected.

Single Phase Service Limits

Three wire 120/240 volt, single phase can utilized by most residences and small businesses for space heating, water heaters, electric ranges, dryers, etc.

Motors served from this phase and voltage shall not exceed ten (10) horsepower without utilizing "add a phase" or "Roto-Phase" type equipment.

The maximum size service which will be supplied by this type of service is 600 amperes, unless an exception is granted by the Cooperative's Engineering Departments.

For other special commercial or industrial single phase service, contact the Cooperative's Engineering Department.

Mobile Home Service Equipment

Mobile home service equipment shall be rated at not less than 100 amperes.

WIRE SIZE TABLE

THREE WIRE, SINGLE PHASE OVERHEAD SERVICE

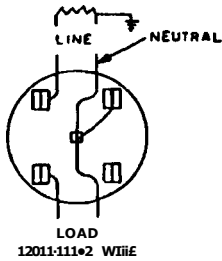
CONDUCTOR TYPES

RH-RHH-RHW-THHW-THW-THWN-THHN-XHHW-USE

SERVICE RATING N AMPS	COPPER	MINIMUM CONDUIT SIZE FOR COPPER
100A	#2	1 ¼"
150A	#1/0	1 ½"
200A	#3/0	2"
60A	#4	1"
100A	#2	1 ¼"
150A	#1/0	1 ½"
200A	#3/0	2"

NOTE:

1. THE NEUTRAL CONDUCTOR SHALL NOT BE SMALLER THAN TWO AWG SIZES THAN THE UNGROUNDED CONDUCTOR, BUT NEVER LESS THAN #6AWG.
2. WHEN USED FOR SUPPORTING THE SERVICE CONDUCTORS, THE RISER CONDUIT SHALL BE A **MINIMUM** OF 1 ½" RIGID CONDUIT.
3. UNDERGROUND SERVICE RISERS SHALL BE A **MINIMUM** OF 3" RIGID CONDUIT.



£!il

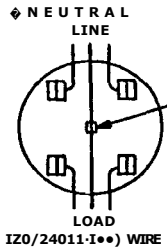


FIG. 2

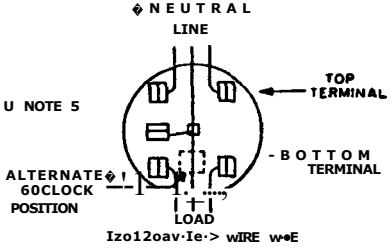


FIG. 3

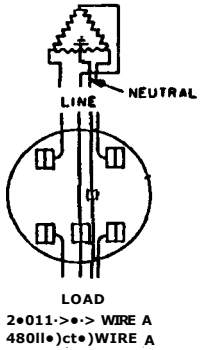


FIG. 4

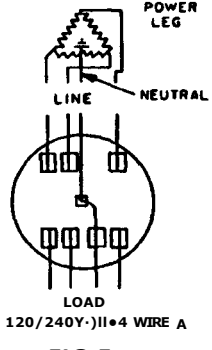


FIG. 5

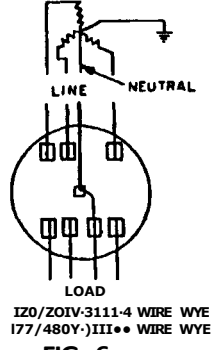


FIG. 6

FRONT VIEWS SHOWN

EUSERC
DWG#G1

NOTES:

1. Sockets for non-residential installations shall be equipped with test bypass facilities when required by the serving agency.
2. Sockets for residential installations shall not be equipped with test bypass facilities.
3. Line conductors shall be connected to the top terminals of socket and load conductors connected to the bottom terminals of the socket.
4. Potential taps, including the neutral tap, shall be located behind sealed panels.
5. Clamped or bolted connections in metering equipment enclosures shall be permitted, including the neutral connection.

INSTALLATION GUIDE DRAWING
CONNECTION DIAGRAM FOR SELF-CONTAINED
METER SOCKETS

C.T. METERING

Equipment furnished and installed by Cooperative.....	3-20
Equipment furnished and installed by Consumer	3-20
Meter Socket closing devices	3-20
C.T. Meter Sockets Drawing	3-21
EUSERC-	
(Electric Utility Service Equipment Requirements)	3-22
Metering and Equipment Approval	3-22
Switch Board Service Section	3-22
Metering Illustration Drawings	
EUSERC Drwg. #310 Underground Residential	
Combination Metering.	3-23
Semi-flush Metering Installation	3-24
EUSERC Drwg. #342- Typical Underground Multiple	
Occupancy Metering	3-25
EUSERC Drwg. #G-2- Typical Multi-Metering	3-26
EUSERC Drwg. #G-3- Typical Underground Service	
Termination Guide Drawing	3-27
Typical Mobile Home Underground Pedestal	3-28
Typical Outdoor Service Entrance Section.	3-29
EUSERC Drwg. #348-Overhead Service Termination	
For Standard Switchboard	3-30
EUSERC Drwg. #345-Underground Service	
Termination for Standard Switchboard.....	3-31
EUSERC Drwg. #349-Single phase 3W bus service ...	3-32
EUSERC Drwg. #350-Three phase 4W bus service ...	3-33
EUSERC Drwg. #319-Switchboard, C.T. Compartment	
0-1000 amps single phase 3 wire service	3-34
EUSERC Drwg. #320-Switchboard, C.T. Compartment	
0-1000 amps three phase, 4 wire service.....	3-35
EUSERC Drwg. #325-Service section with C.T.	
Compartment	3-36
EUSERC Drwg. #326-Service section with C.T.	
Compartment and filler panel	3-37
EUSERC Drwg. #332-Switchboard socket meter.	3-38
EUSERC Drwg. #354-Outdoor or raintight switchboard	
with enclosed meter panels	3-39
Typical Meter, C.T. Box & Load Gutter	3-40

C.T. METERING

All services exceeding a 200 ampere rating will require current transformer metering which must be coordinated with the Cooperative's Engineering Department.

Equipment Furnished and Installed by the Cooperative

1. All meters required for billing purposes
2. Secondary wiring to the meter socket and C.T.'s.

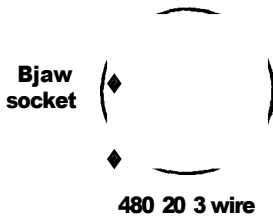
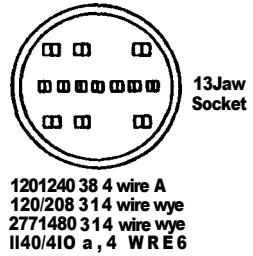
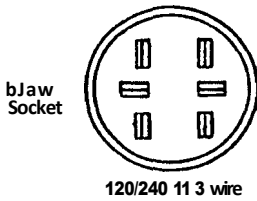
Equipment Furnished and Installed by Consumer, but not limited to the following:

1. Pre-Fabricated Panels
2. Meter Enclosures
3. Service Entrance Sections
4. Perches for Test Switches
5. Metering Transformer Cabinets
6. Meter Socket
7. Current Transformers (Metering)
8. Test Switches
9. Remote Meter Can (When Applicable)

Meter Socket Closing Devices

Meter sockets shall not be equipped with circuit closing or bypass devices which automatically close when the meter is removed from the socket.

FRONT VIEWS SHOWN



GUIDE DRAWING FOR C.T. METER SOCKETS

EUSERC = Electric Utility Service Equipment Requirements

All metering equipment approved for use in the Cooperative's Service area must be built to the standards developed by the Electric Utility Service Equipment Requirements Coordinating Committee (EUSERC).

The equipment must also be on Graham County Electric Cooperative's acceptability list of EUSERC Standards. These EUSERC Standards are available to the consumer through electric wholesale distributors.

Required Approval for Metering and Service Equipment

When a consumer proposes to install a multi-meter panel assembly or service entrance section, he shall submit drawings or prints to:

**Graham County Electric Cooperative, Inc,
9 West Center
Pima, AZ 85543**

for approval prior to the manufacturing of the equipment (4 copies required). Catalog pages are not acceptable.

Information needed on drawings: Switchgear manufacturer (name), EUSERC Drawing numbers that are applicable, ampacity of switchgear, physical dimensions, voltage, phase, buss bracing, (AIC Rating), how many disconnects, address, etc.

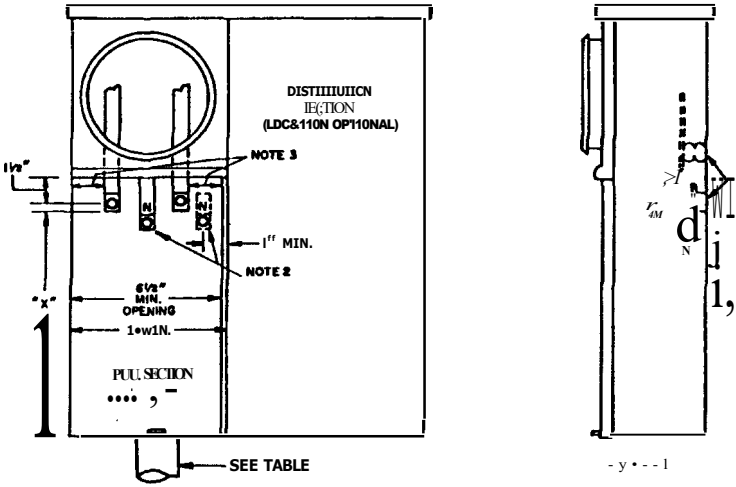
Switchboard Service Section

A standard switchboard service entrance section is a free-standing unit of switchgear which contains bussing for the termination of service entrance conductors, bussing for the connection and mounting of current transformers, panels for the installation of the test switch and meter socket, a service main disconnect switch or breaker, and in many cases distribution feeder breakers or switches.

Metering Illustrations

The following pages are inserted to illustrate the appearance of metering installations including "self contained", "C.T. metering" and "switchboard service sections".

These drawings are basically EUSERC Drawings. Service sections are shown as they would be used with overhead service entrance conductors. A pull section would need to be added alongside the service sections if underground service conductors are used.



MAXIMUM AMPACITY	"X" MIN.DIM.	"Y" MIN.DIM.	CONDUIT RANGE
100	8"	4"	3"
200	11"	5 1/2"	3"

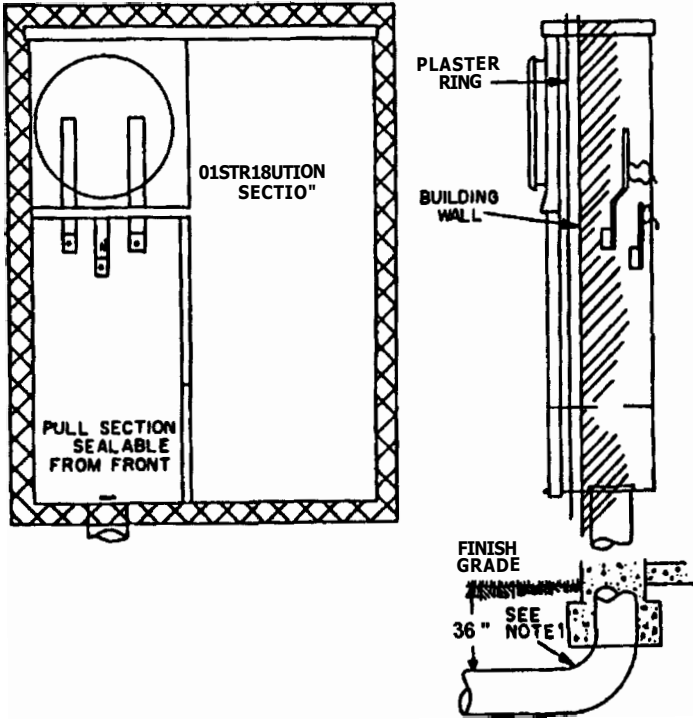
NOTES:

1. Terminals for service conductors shall be aluminum bodied range taking lugs with a range of No. 6 through 1/0 AWG for the 125 ampere device and 1/0 AWG through 250 MCM for the 200 ampere device.
2. Neutral terminal shall be a minimum dimension from the bottom of the enclosure of 6 inches for the 125 ampere device and 8 1/2 inches for the 200 ampere device. If insulated from enclosure, provide a bonding screw or jumper.
3. A minimum radial clearance of 1-1/2 inch shall be provided between hot bus terminals and ground or neutral surfaces.

EUSERC
DWG #301

SINGLE FAMILY RESIDENTIAL
UNDERGROUND COMBINATION METERING
0-600 VOLTS

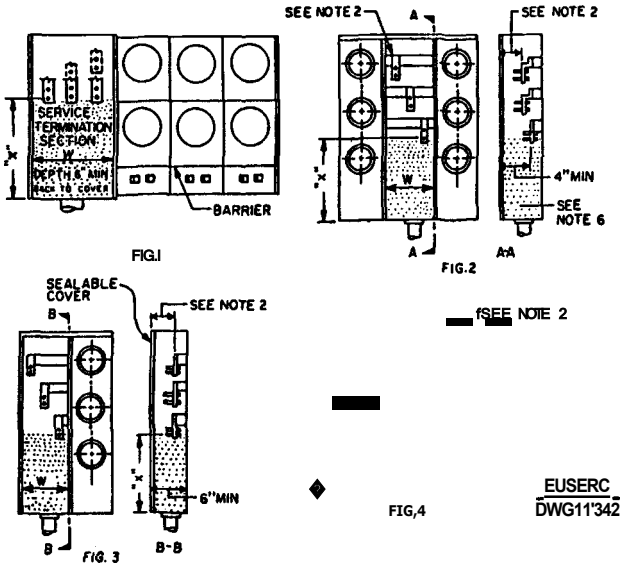
TYPICAL SEMI-FLUSH INSTALLATION



NOTE:

1. See Underground Service Section For Riser Requirements
2. See EUSERC DWG #301 For Metering Can Requirements

METER LOCATIONS SEMI-FLUSH INSTALLATION



TYPICAL ARRANGEMENT FOR UNDERGROUND SERVICE TERMINATING FACILITIES

EQUIPMENT RATING	"X" DIMENSION	SERVICE	'W' DIMENSION
0-200AMPS	18" MIN	3WIRE	10½" MIN
201 - 600 AMPS	22"MIN		

NOTES:

- Contact the serving agency for size of service supply conduit and type of lugs.
- See DWG #347 for termination clearances and for "single position" terminating facility bus and bolt details. Single position termination for 600A is applicable to this drawing only.
- The pull section cover shall be independent of any other service equipment and shall be removable without disturbing adjacent panels.
- Pull section covers shall be removable, sealable, provided with two lifting handles and be limited to 9 square feet in area. Sealing provisions shall consist of two drilled stud and wing nut assemblies on opposite sides of the panel.
- The neutral terminating facility shall be identified.
- Service supply conductors may cross over horizontal busing provided the horizontal busing is: (a) barriered, or (b) fully insulated. The shaded space (shown on drawing) which has dimensions "X" high by "W" wide is maintained for service supply conductors only.
- Terminating facilities may be inverted provided the conditions in Note 6 are satisfied and that the terminating facilities be offset to accept lugs typically installed on non-inverted terminating facilities (which are shown on DWG #347).
- Dimension "W" is the minimum width of the pull section access opening.

UNDERGROUND SERVICE TERMINATING FACILITIES FOR RESIDENTIAL
 MULTIPLE OCCUPANCY SERVICE - 6 METERS MAXIMUM. 3-WIRE, 0-600
 AMPS, 0-600 VOLTS

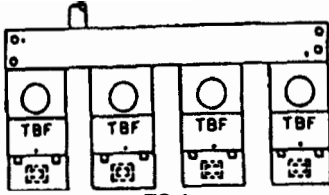


FIG. 1
COMMERCIAL

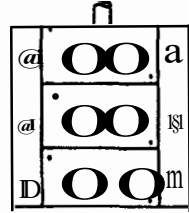


FIG. 2
RESIDENTIAL

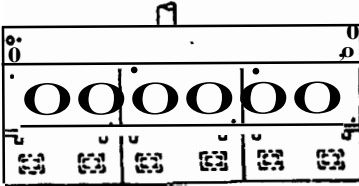


FIG. 3
RESIDENTIAL

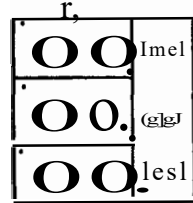
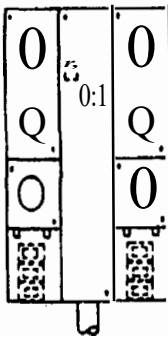


FIG. 4
RESIDENTIAL

OVERHEAD INSTALLATIONS



FK,5
RESIDENTIAL

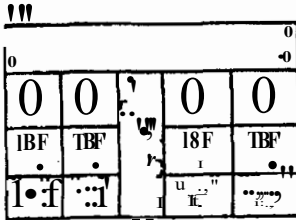


FIG. 6
COMMERCIAL

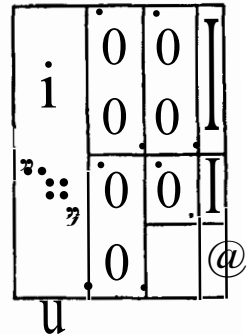


FIG. 7
RESIDENTIAL

UNDERGROUND INSTALLATIONS

TBF - TEST BLOCK FACILITIES

EUSERC
DWG#G2

INSTALLATION GUIDE DRAWING
TYPICAL MULTI-METERING ARRANGEMENTS

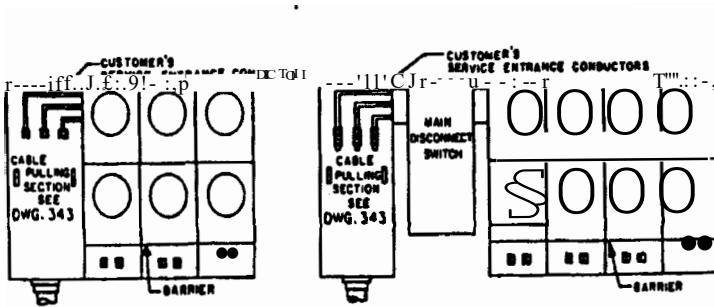


FIG. 1 TYPICAL COMBINATION SERVICE TERMINATION ENCLOSURE AND METER SOCKET PANELS FOR MULTI-UNIT RESIDENTIAL USE

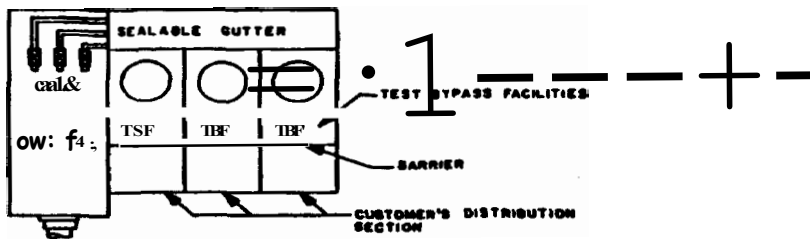
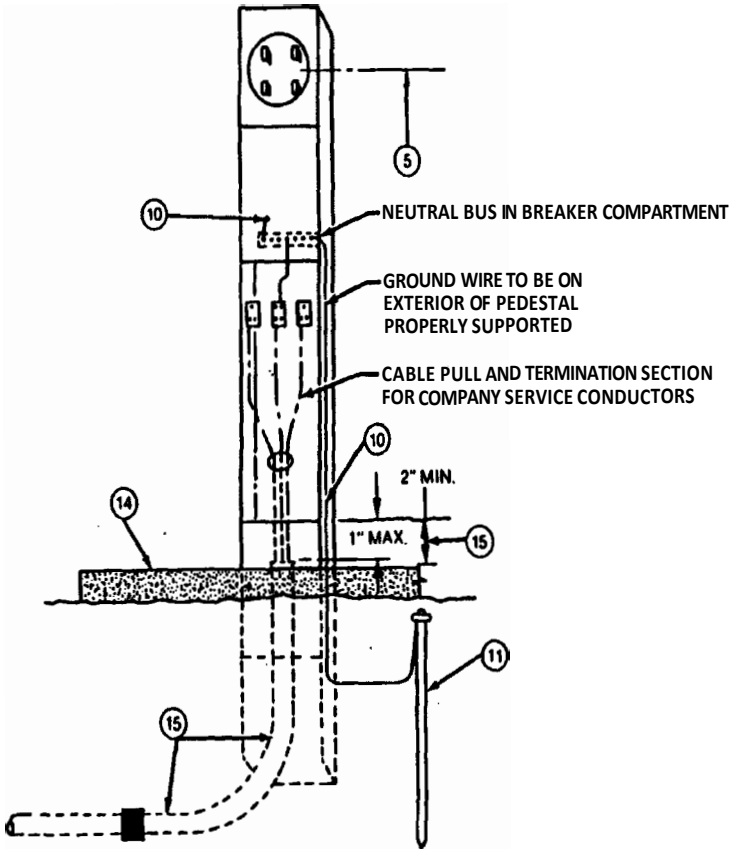


FIG. 2 TYPICAL SERVICE TERMINATION ENCLOSURE METER SOCKET PANELS FOR MULTI-UNIT COMMERCIAL USE.

EUSERC
DWG#G3

INSTALLATION GUIDE DRAWING
TYPICAL UNDERGROUND SERVICE
TERMINATION ARRANGEMENTS

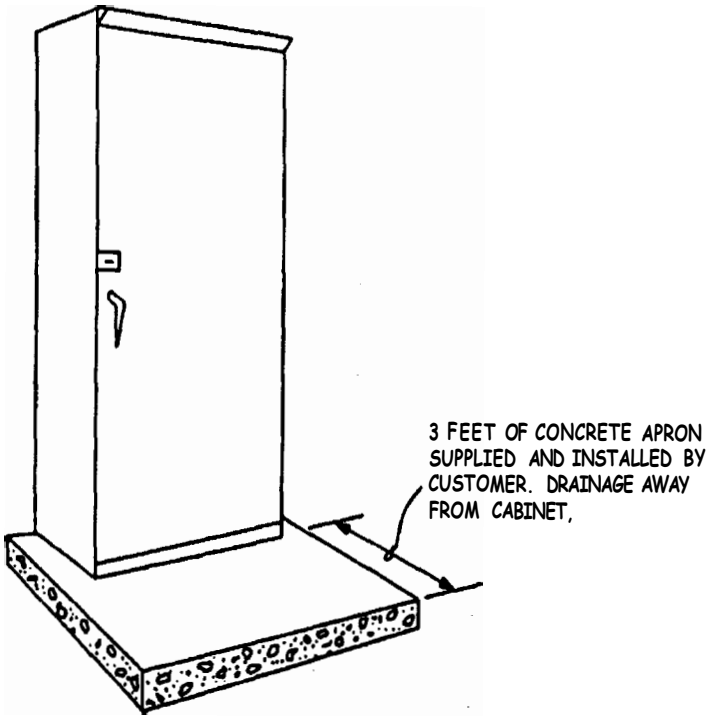
MOBILE HOME PEDESTAL 120/240 10 3 WIRE



NOTE:

SEE MOBILE HOME SERVICE AND METER PEDESTAL DRAWING IN UNDERGROUND SERVICE SECTION OF THIS MANUAL FOR IDENTIFICATION OF ITEM NUMBERS.

UNDERGROUND SERVICE MOBILE HOME SERVICE AND METER PEDESTAL



Consumer to install a locking device that will allow one lock for the consumer and one lock for the Cooperative on the door.

TYPICAL OUTDOOR SERVICE ENTRANCE SECTION

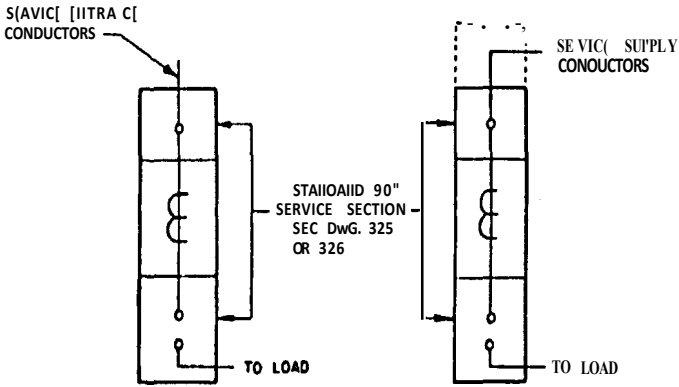


FIG. 1

FIG. 2

NOTES:

1. The service entrance conductors, Fig. 1 either cable or bus bar, are furnished and installed by the customer in the following manners:
 - A. When switchboards are served through bus bar conductors, the conductors shall enter through the top, or at the side or back in the upper 10-inch section.
 - B. When switchboards are served through cable conductors, the conductors shall enter through the top of the board only, as shown in Fig. 1.
2. When the serving agency or customer requires incoming conduits from the side or rear for the service conductors, an extension as shown in Fig. 2, or other special designed termination may be required. Consult the serving agency for the extension dimensions.
3. The direction of feed is from top to bottom in the standard switchboard service section. Load conductors shall leave below the metering compartment and may not be routed back through the current transformer compartment in order to exit the service section.
4. Service entrance conductors shall be connected to the bussing in the service section with lugs approved by the serving agency for the type conductors used.

EUSERC
DWG#348

OVERHEAD SERVICE TERMINATION
STANDARD SWITCHBOARD SERVICE SECTION
0 TO 600 VOLTS

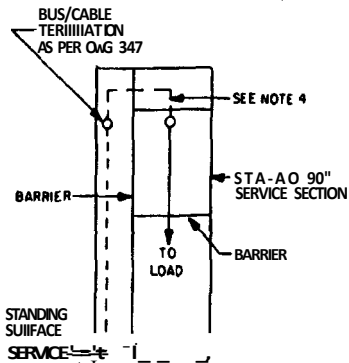


FIG. 1

SWITCHBOARD PULL SECTION

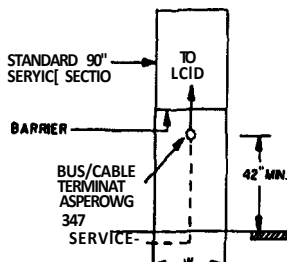


FIG. 2

BOTTOM FEED

TABLE 1-MINIMUM PULL SECTION DIMENSIONS

SWITCHBOARD RATING-AMPS	MINIMUM WIDTH "W"	
	3-WIRE	4-WIRE
BELOW 400	CONSULT SERVING AGENCY	
400-800	24"	24"
801-1200	24"	30"
1201-2000	30"	35"
ABOVE 2000	CONSULT SERVING AGENCY	

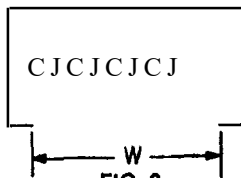


FIG. 3

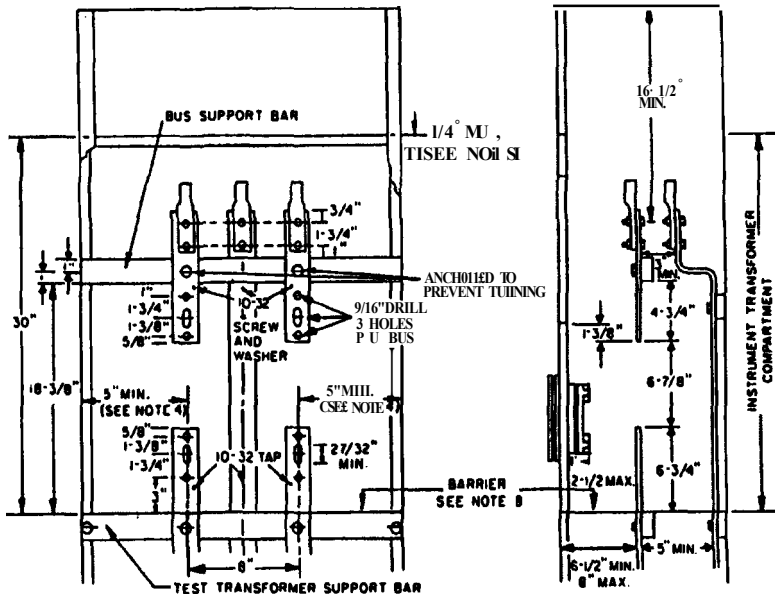
EUBERC
DWG#345

1. A switchboard pull section (Fig. 1), or a reverse feed service section (Fig. 2) shall be provided for underground service.
2. When the service section is served from a pull section, the bus or cable conductors shall enter through the side or back of the sealable section above the current transformer compartment as shown in Fig. 1, or shall enter by means of horizontal cross bussing in back of metering compartment.
3. Bus bars, with provisions from termination lugs as shown on DWG #347 are required from the pull section into the service section, when the main switch is rated above 800 amperes, or when multiple metering is to be supplied.
4. Bus bars or cables may extend from the pull section landing lugs into the service section of switchboards rated up to 800 amperes.
5. The minimum width of the pull section access opening shall be as specified in Table 1. See DWG #347 for arrangement of the cable terminating facilities in the pull section.
6. Side or rear entry of the service cable into the pull section may require a greater dimension than that shown in Table 1. Consult the serving agency.
7. Consult the serving agency for the type and size of terminating lugs.
8. All pull and terminating sections shall have full front access. Cover panels shall be removable, sealable, provided with two lifting handles, and limited to a maximum size of 9 square feet in area.

UNDERGROUND SERVICE TERMINATION
STANDARD SWITCHBOARD SERVICE SECTION
400 TO 2000 AMP - 0 TO 600 VOLTS

INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

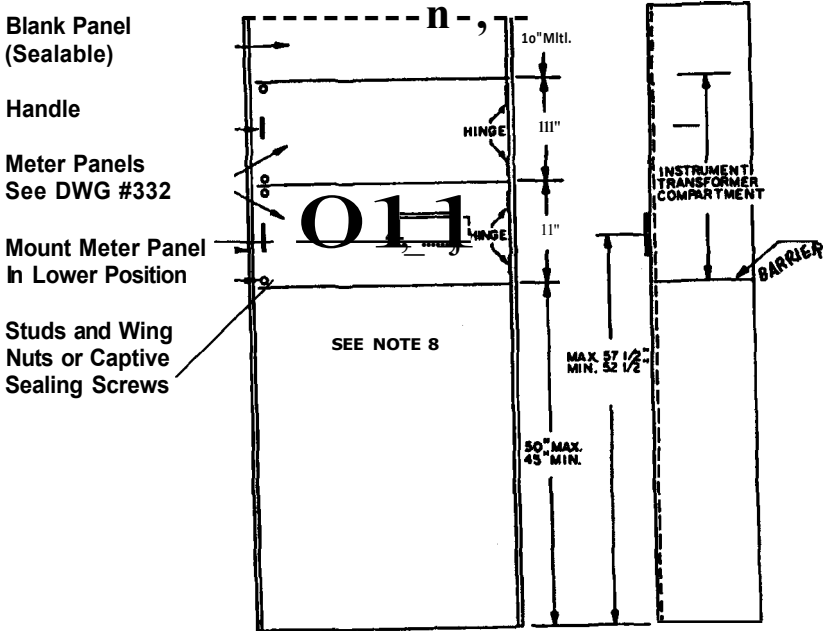


EUSERC
DWG#319

NOTES:

1. Bus arrangement and supports are required as shown above, except the neutral bus may be located on the side wall or at either side for single phase.
2. Compartment shall be on the supply side of the main switch or breaker.
3. Direction of feed may be from top or bottom. No other conductors shall pass through this compartment. A neutral bus bar extension shall be provided in the instrument transformer compartment above the lower C.T. bus support when the service section phase busses are supplied from horizontal cross bussing.
4. Clearance to side of compartment shall be increased by the amount by which the corner angle exceeds 1 inch.
5. Return flanges for lower and upper meter panel support shall not project more than 3/4 inch up or down from adjacent switch-board panels.
6. When laminated bus is used, there shall be no space between laminations in the compartment.
7. Bus dimensions: Maximum - 3/4 inch x 2 inches; Maximum - 1/4 inch x 2 inches.
8. Barrier shall be of insulating nontracking material resistant to arc tracking, be rigid, with a maximum deflection of 1/2 inch from an applied force of 25 pounds downward, be secured in place, be perforated with 3/8 inch maximum diameter holes to allow ventilation in accordance with UL Standards, be dimensioned in physical size to fit the switchboard with a peripheral gap not to exceed 3/8 inch, and contain cutouts for through bus bars with dimensions to provide a maximum gap between bus and barrier not to exceed 3/8 inch.

SWITCHBOARDS 0-600 VOLTS INSTRUMENT
TRANSFORMER COMPARTMENT 0-1000 AMPERES
SINGLE OR THREE PHASE THREE WIRE SERVICE



EUSERC
DWG#325

NOTES:

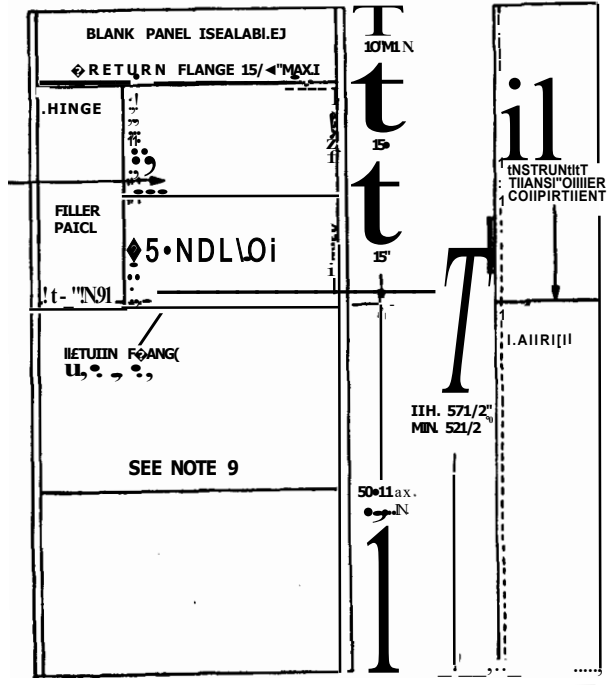
1. Instrument transformer compartments shall be bussed with rectangular bus bar.
2. The grounding connection shall be made in the main switch or breaker compartment.
3. Meter panels shall be reversible, sealable, hinged and interchangeable.
4. Meter panels shall have a handle attached at unsupported end.
5. Hinges shall be readily interchangeable, right or left, on the job site.
6. Width of meter panels may in some cases require the service section to be wider than the minimum allowable width of transformer compartment. For minimum dimensions of instrument transformer compartments refer to the following plates.

0 to 1000 amperes	See DWGs #319, #320
1001 to 3000 amperes	See DWG #322
7. All securing screws shall be captive. All panels and covers shall be sealable.
8. When used as a bottom fed service terminating section, see DWG #345. Figure 3.

STANDARD SWITCHBOARD SERVICE SECTION WITH
INSTRUMENT TRANSFORMER COMPARTMENT
0-600 VOLTS

Meter Panels
See DWG.
#332

Mount Meter
Panel in
Lower
Position



EUSERC
DWG#326

NOTES:

1. Instrument transformer compartments shall be bussed with rectangular bus bar.
2. Filler panels shall be used where switchboard width exceed meter panel width.
3. The grounding connection shall be made in the main switch or breaker compartment.
4. Meter panels shall be reversible, sealable, hinged and interchangeable and be constructed of minimum 12-gauge steel.
5. Meter panels shall have a handle attached at unsupported end.
6. Hinges shall be readily interchangeable, right or left, on the job site.
7. Width of meter panels may in some cases require the service section to be wider than the minimum allowable width of transformer compartment. For minimum dimensions of instrument transformer compartments refer to the following plates:

0 - 1000 amperes	See DWGs #319, #320
1001 - 3000 amperes	See DWG #322
8. All securing screws shall be captive. All panels and covers shall be sealable.
9. When used as a bottom fed service-terminating section. See DWG #345. Figure 3.
10. Meter panels and filler panels shall be equipped with stops to prevent inward swinging beyond the front surface of the switchboard.

STANDARD SWITCHBOARD SERVICE SECTION WITH
INSTRUMENT TRANSFORMER COMPARTMENT
AND FILLER PANEL O- 600 VOLTS

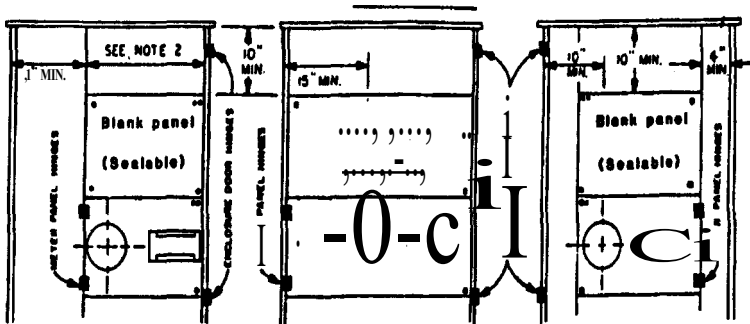
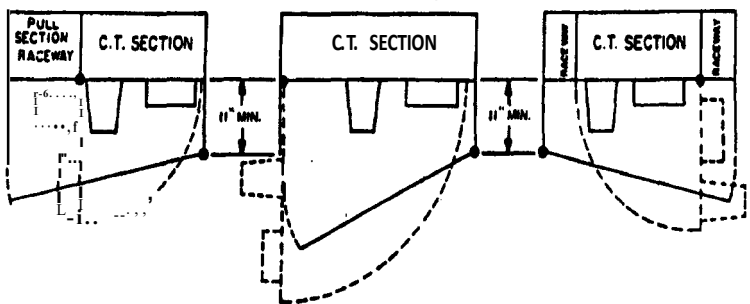


FIG. 1

FIG. 2

FIG. 3

TOP VIEWS



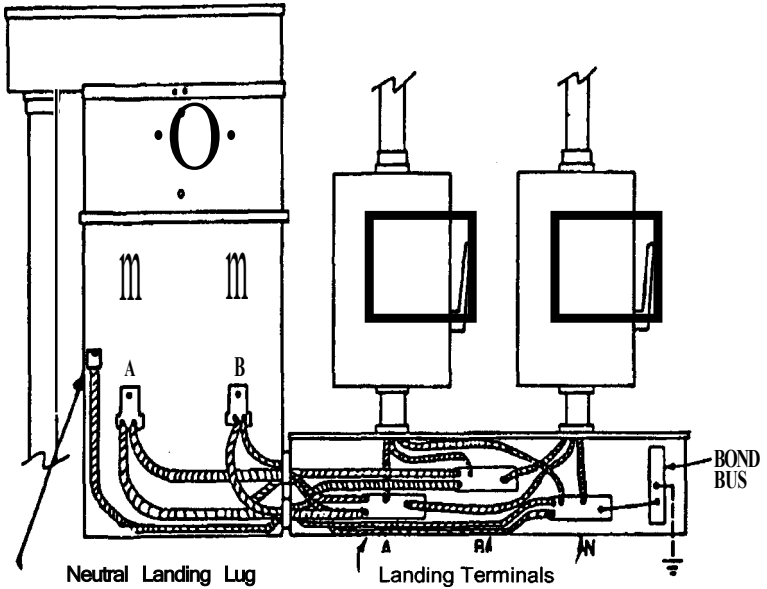
EUSERC
DWG #354

NOTES:

1. Hinged meter panels shall be capable of being opened 90 degrees with meter and test facilities in place.
2. For hinged meter panel requirements see DWG. #332. For DWG #332. Use Figure 1, 2, or 3 requirements as illustrated.
3. The edge of the meter socket or test switch slots shall be 1 inch plus the depth of the recess from the hinged side.
4. For enclosure locking provisions see typical outdoor service entrance section drawing.
5. Meter panels shall not be hinged to a filler panel.

OUTDOOR OR RAIN TIGHT SWITCHBOARDS
WITH ENCLOSED METER PANELS O- 600 VOLTS

400 AMP C.T. RATED



NOTES:

1. Landing terminals shall be supplied in gutter to split load conductors to separate disconnect switches.
2. Load gutter to be properly sized per the National Electric Code.
3. All unfused nipples and raceways to be properly bonded.
4. Combine load of disconnect switches not to exceed 400 amps.

METER, INSTRUMENT TRANSFORMER BOX
AND LOAD GUTTER 0-600 VOLTS

OVERHEAD SERVICE

Table of Contents

General Information	4-2
Maximum Service Entrance Conductor Size In Risers	4-4
Bus Duct Requirements	4-4
Identification of Conductors	4-4
Clearance Above Ground.....	4-5
Clearance Above Ground Drawing - (Residential)..	4-6
Clearance Above Ground Drawing - (Commercial And Industrial).....	4-7
Riser Attachment	4-10
Braced Riser Attachment	4-11
Typical Residential Metering Drawings	4-12
Typical Permanent Pole Mounted Service Drawings	4-14
Typical Overhead C.T./Meter Can	4-15

OVERHEAD SERVICE O- 600 VOLTS

General

1. The Cooperative reserves the right to determine all meter locations, including points of attachment.
2. The height of the point of attachment on the consumers building or structure for overhead service shall be adequate to provide vertical clearances between the service drop conductors and the ground.

In some cases the service attachment height may have to be higher than the required minimums in order to maintain the proper vertical clearance between service conductors and the ground.
3. Drip loops at the service conductors point of attachment shall have proper height above ground.
4. The service equipment riser shall be extended through the roof when the service equipment is mounted on the eave side of the building.

The riser must also be extended through the roof when the service equipment is mounted on the gable end and within ten (10) feet of the corner of the building.
5. A service support shall be provided to withstand a minimum 200 pounds of tension. The responsibility for furnishing a sufficiently substantial service support rests solely with the consumer. Lag bolts are not considered acceptable. In special cases, such as bus ducts risers, attachment tensions greater than 200 pounds may be required. (Consult Cooperative).
6. Where the service conduit riser is used as a mast for supporting the service drop, it shall be two inches minimum size rigid steel and contain no coupling or fittings which would be subject to strain by the service drop.

Exception: If necessary to use more than one ten (10) foot length of conduit, the full length (10) conduit shall be the upper conduit, thereby putting the coupling below any strain. The riser shall be supported with straps no more than thirty-six (36) inches apart.
7. In the event a mast type riser is required to attain the required height, it shall be of such construction and so supported that it will withstand the strain imposed by the service drop.
8. Service riser conduits shall be so located that the center of the point of attachment for the service drop will be within twelve (12) inches of the center of the weatherhead.

9. Risers must be constructed of rigid steel conduit. Non-metallic sheathed cables, metallic sheathed cable (BX), flexible conduit, water pipe, gas pipe, etc. will not be accepted as substitutes.
10. No foreign attachments shall be permitted on a service riser conduit such as telephone or television service drops, etc.
11. Overhead riser shall not be enclosed by any wall.
12. In no case may consumer's metered circuit be installed in the same conduit as service entrance conductors.
13. For 3-wire, 120/240 V services, the neutral conductor shall not be smaller than two trade sizes than the ungrounded conductors. For 3-wire, 120/208 V single phase services, the neutral conductor shall be the same size as the phase conductors.
14. For all other services, the neutral conductor shall be no less than 70% of the size of the phase conductors unless supported by actual engineering calculations supplied to the Cooperative by the consumer.
15. Wires from the weatherhead and from the main service switch or circuit breaker shall be properly made-up and connected to the meter socket by the consumer.
16. Wire shall be of Copper only. See Reference 4-15 #1.
17. The top of an overhead riser must be equipped with a weatherhead and have at least 24" of each conductor extending therefrom, located within 12 inches of the center of the point of attachment.
18. The roof shall be properly sealed around the service entrance riser in a raintight and workmanlike manner.

Maximum Service Entrance Conductor Size in Overhead Risers

Service Entrance conductors installed by the consumer shall be sized per National Electrical Code Requirements. Maximum size conductor shall be 500 MCM with a maximum number of two conductors per phase.

If service riser conductors are to be paralleled, they shall be paralleled in separate conduits.

Exception: Parallel conductors may be installed in one riser provided the conduit is sized properly per National Electrical Code for the total amount of wire installed. Parallel conductors must terminate on a common bus (e.g., 8 conductors in one circuit for a four wire service. 2-ABCN).

Identification of Conductors

Any neutral or delta power (high) leg of service entrance conductors, provided as required for various types of service, shall be permanently identified. The identification shall be applied on the open conductors (drip loop) extended from the weatherhead.

The neutral shall be white and the Delta Power (high) leg shall be orange.

Clearances Above Ground, Thoroughfares, Driveways, and Etc.

Service drop conductors when not in excess of 300 volts, phase to ground, shall have the following minimum clearance at the lowest point of the span. The height of the point of attachment shall be governed by these clearances.

Clearances are based on conductors supported on and cabled together with an effectively grounded messenger.

Crossing over areas accessible to pedestrians only -----14 ft.

Crossing over residential driveways ----- 14 ft.

Crossing over commercial areas, parking lots, agricultural or other areas subject to truck traffic (trucks are defined as any vehicle exceeding 8 feet in height} ----- 18 ft.

Crossing over commercial or industrial parking lots not subject to truck traffic. (Truck height must be physically restricted) ---14 ft.

Crossing over public streets, alleys, or roads in urban or rural districts and driveways on other than residential property -----18 ft.

NOTE:

In areas where oversize or elevated equipment is used or will travel, or for conditions not listed, consult with the Cooperative's Engineering Department for instructions before installing service entrance, conduit and other equipment.

CLEARANCES ABOVE GROUND INDUSTRIAL & COMMERCIAL

THESE MINIMUM CLEARANCES APPLY TO THE LOWEST POINT OF SERVICE DROP SAG

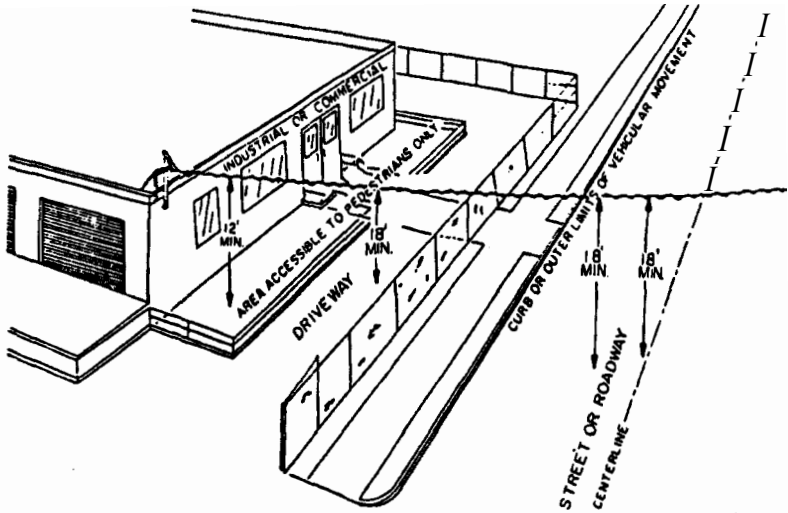


Figure 1

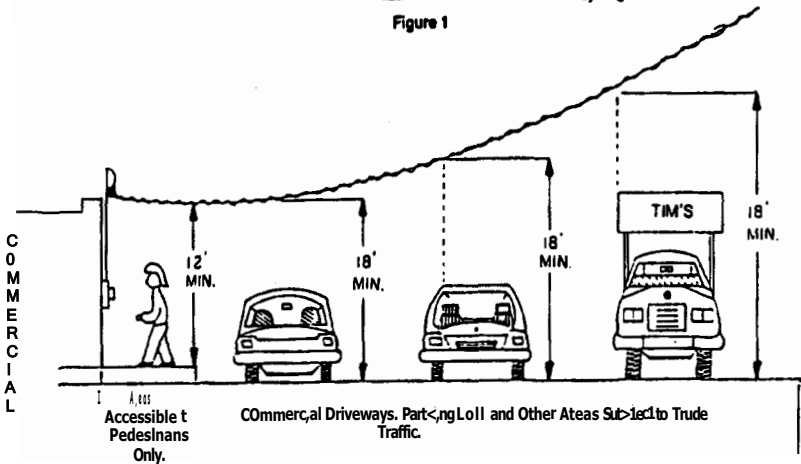
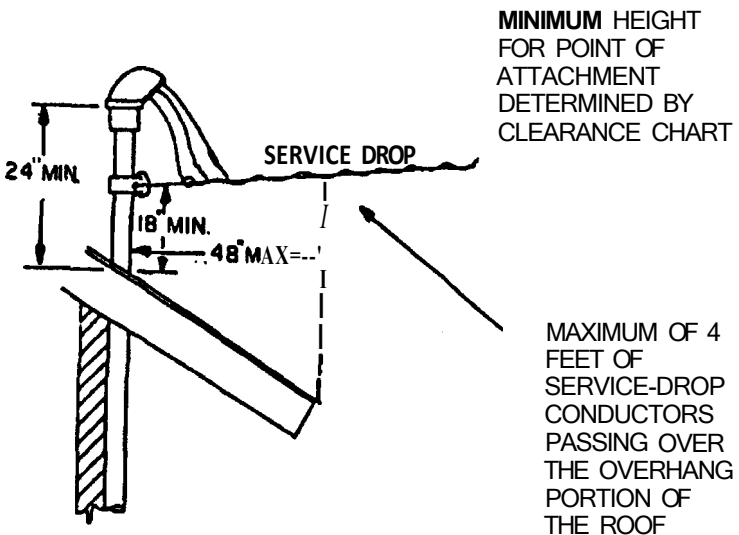


Fig. 2

OVERHEAD SERVICE 0-300 VOLTS CLEARANCES ABOVE GROUND

It is the intent of the Cooperative not to place service drops or any lines over any structure such as houses, sheds, mobile homes, etc. On new installations, the Cooperative, will require that the meter location be such that crossing over such structures will be avoided.

Exception 2: Service drop conductors of 300 volts or less which do not pass over other than a maximum of 4 feet of the overhang portion of the roof for the purpose of terminating at a (through-the-roof) service raceway or approved support may be maintained at a minimum of 18 inches from any portion of the roof over which they pass.



Service entrances shall not be located within a roofed-in area necessitating Cooperative personnel to walk on or place a ladder on roof to make attachment to riser conduit or support and to connect consumer's service.

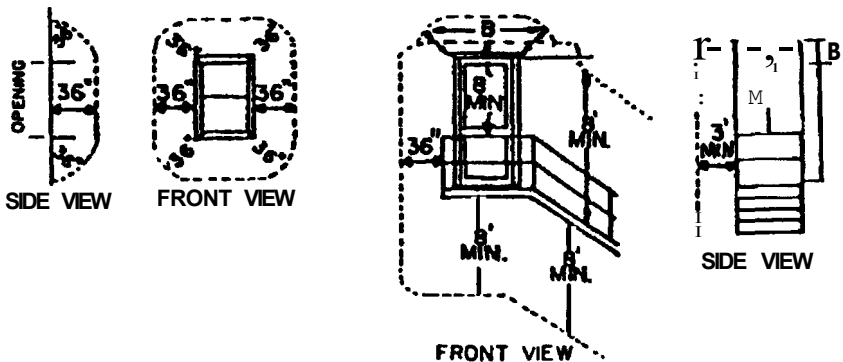
CLEARANCE FROM DOORS, EXITS, WINDOWS, FIRE ESCAPES, BALCONIES, ETC.

The vertical, horizontal and radial service drop conductor clearance from doors, exits, windows, fire escapes, and other openings, at any of which human contact might be expected, shall not be less than that specified and illustrated:

	Minimum Clearance
1. Vertically above and below surfaces of fire escapes, balconies, stairways, and walkways.....	8 feet
2. Horizontally and radially from doors, exits, windows, and other openings.....	3 feet
3. Horizontally and radially from the outer extremities of fire escapes, balconies, stairways, and walkways. . .	3 feet

CLEARANCE FROM DOORS, EXITS, WINDOWS, FIRE ESCAPES, BALCONIES, ETC.

(For Exposed Service Conductors Only - See Note 3)

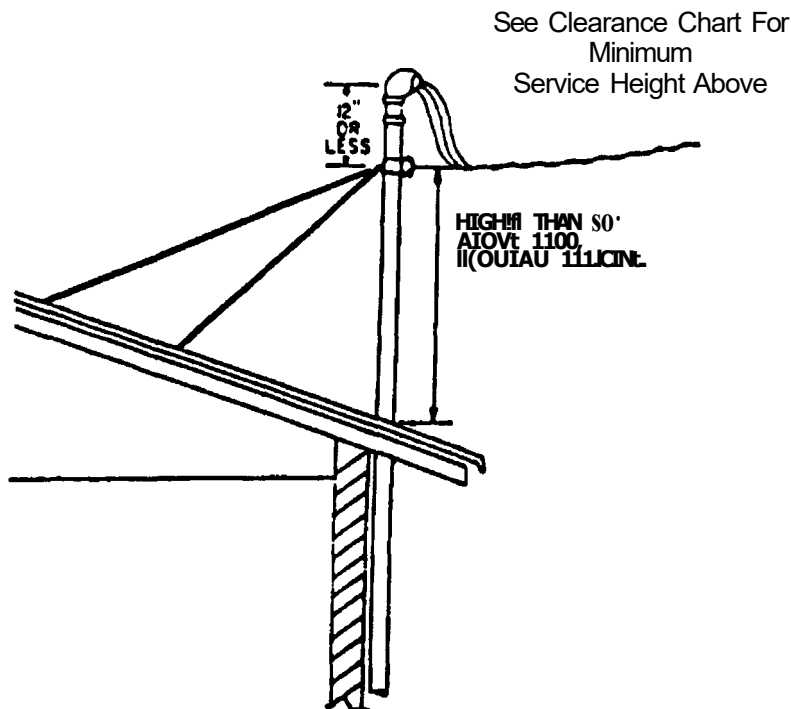


NOTES:

1. Service drop conductors not permitted within shaded zones.
2. Dimension "B" may be less than 36 inches, provided it is a minimum of 12 inches above opening and the minimum 8 foot vertical clearances shown are obtained.
3. Conduit and meter cans may be inside shaded areas. Service conductors, drip loops or any wire may not be inside shaded areas.

INTENTIONALLY LEFT BLANK

Braced Riser Attachment



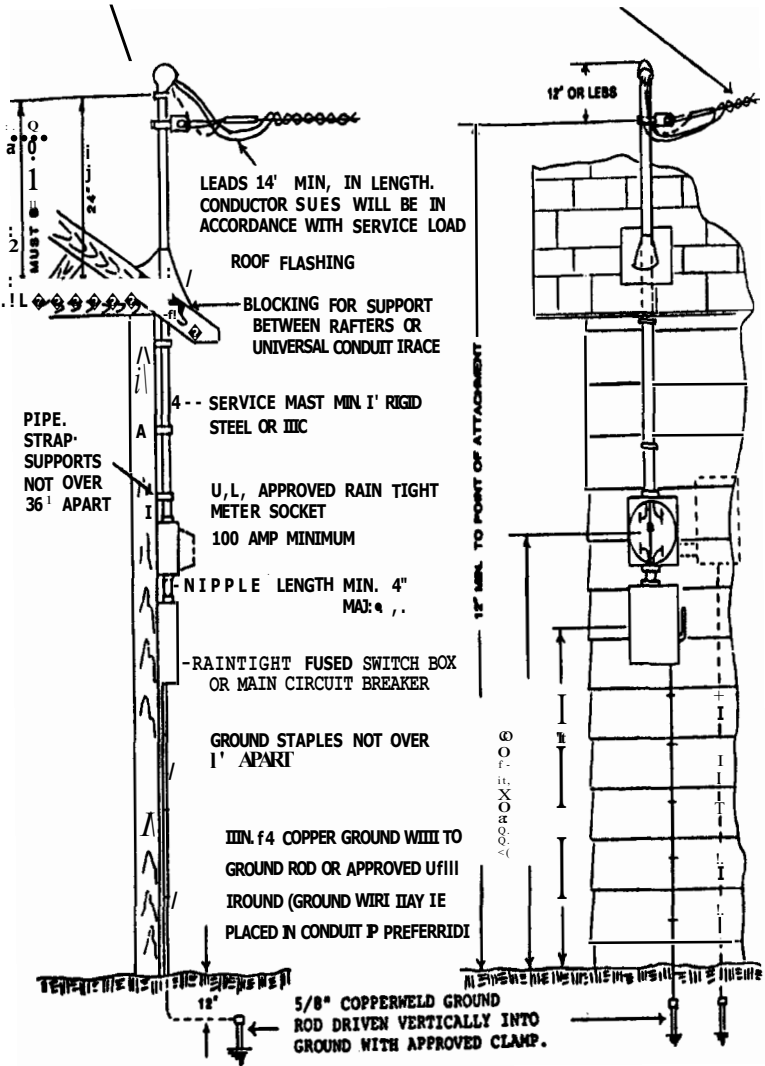
Risers that are required to be braced shall be braced against the pull of the service drop conductors. Bracing shall consist of two steel members installed at approximately a 90 degree spread. Minimum size braces shall be $\frac{3}{4}$ " rigid galvanized steel pipe or 1- $\frac{1}{4}$ " x 1- $\frac{1}{4}$ " x $\frac{1}{8}$ " steel angle.

Exception:

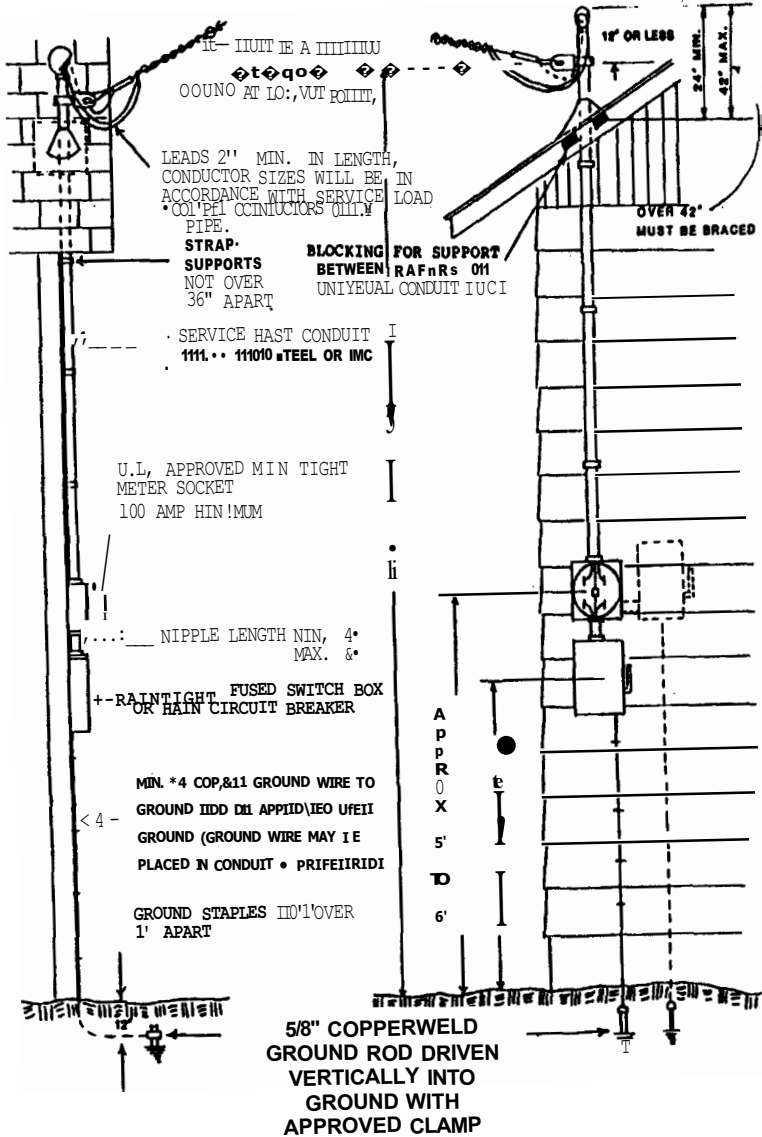
Residential and Commercial, 200 ampere service or less: $\frac{3}{4}$ " electrical metallic tubing (EMT) may be used for braces if used to pull against the load as shown in the braced riser attachment drawing.

MUST BE A MINIMUM OF 12' ABOVE GROUND AT LOWEST POINT

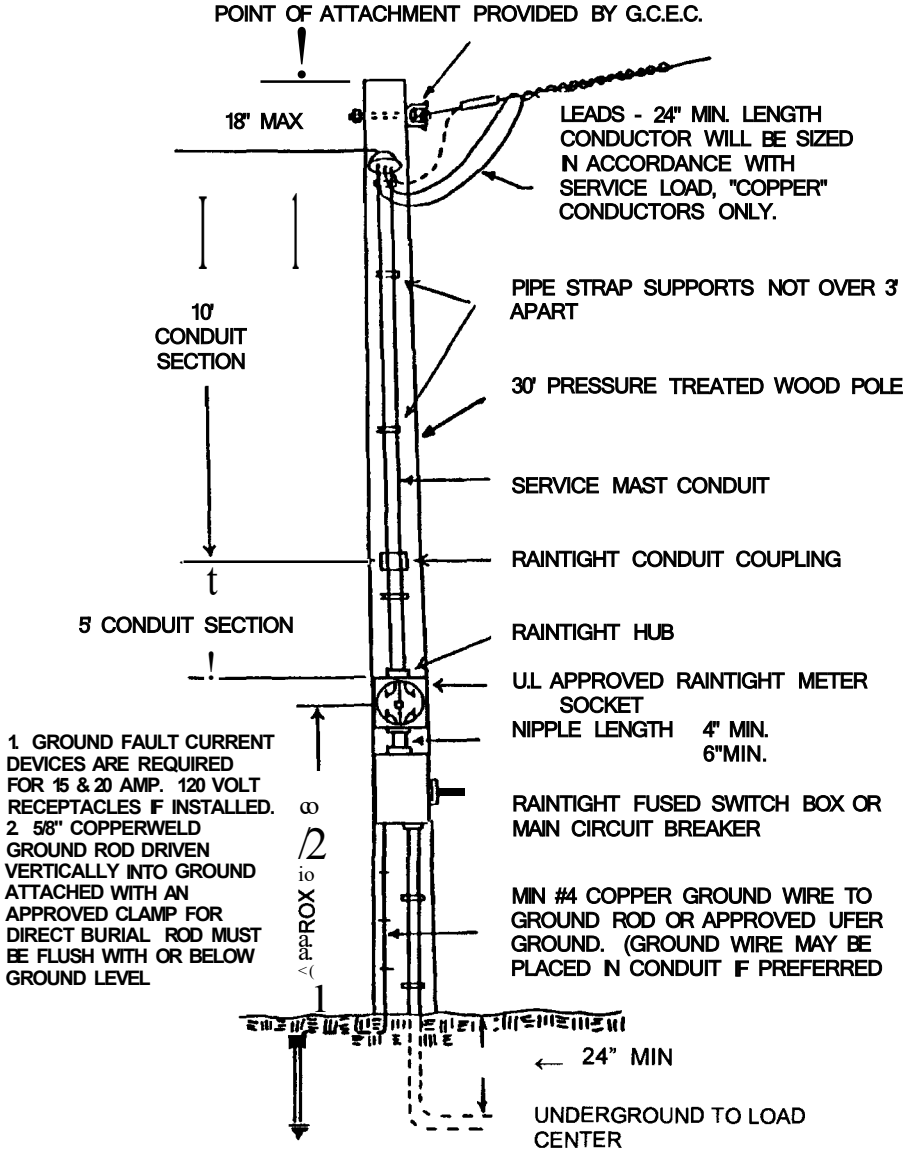
RAINTIGHT WEATHERHEAD



120/240 VOLT SINGLE PHASE 3-WIRE SERVICE METER LOOP WITH CONDUIT THRU EAVE, CONDUCTORS MUST BE "COPPER", NO ALUMINUM



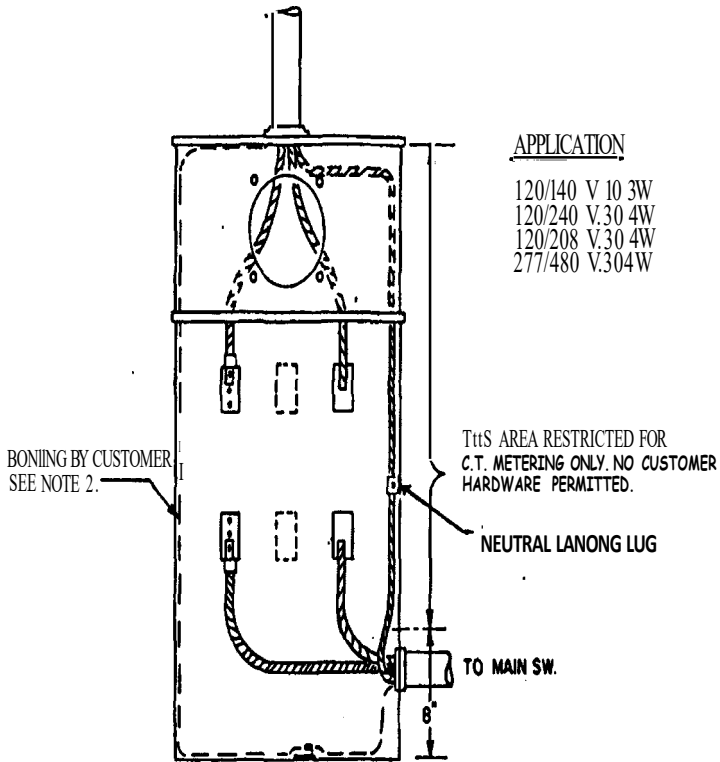
120/240 VOLT SINGLE PHASE, 3-WIRE SERVICE
 METER LOOP FOR GABLE END ONLY,
 CONDUCTORS MUST BE "COPPER", NO ALUMINUM.



- 1. GROUND FAULT CURRENT DEVICES ARE REQUIRED FOR 15 & 20 AMP. 120 VOLT RECEPTACLES IF INSTALLED.
- 2. 5/8" COPPERWELD GROUND ROD DRIVEN VERTICALLY INTO GROUND ATTACHED WITH AN APPROVED CLAMP FOR DIRECT BURIAL ROD MUST BE FLUSH WITH OR BELOW GROUND LEVEL.

120/240 VOLT SINGLE PHASE, 3-WIRE SERVICE, 30' FOOT POLE MOUNTED PERMANENT SERVICE INSTALLATION "COPPER" CONDUCTORS MUST BE USED, NO ALUMINUM

OVERHEAD 400 AMP C.T. METER CAN



(10 3W And Customer Wiring Shown)

NOTES:

1. Wire and conduit sizes shall be per N.E.C. Requirements. Wires shall be of Copper only.
2. When approved bond bushings are used, bond wire may be eliminated.
3. The Cooperative furnishes and installs the C.T.'s test switch and meter socket.
4. When used for 3 0 4 wire delta service, high phase shall be on the right hand side and properly identified.

OVERHEAD SERVICE
TYPICAL OVERHEAD 400 AMP
CT/METER CAN

UNDERGROUND SERVICE
Table of Contents

General Information	5-2
Riser Material	5-3
Optional Riser Material	5-3
Metallic Riser Coating	5-4
Underground Riser Requirements (Conduit Systems)	5-4
Risers for Services Installed In Conduit Drawings	5-5
Material for Service Conduit	5-8
Steel Conduit	5-8
Bends and Sweeps	5-8
Table of Approved PVC Service	5-8
Usability Of Conduit	5-9
Conduit Pull Line	5-9
Riser Requirements (Direct Buried Service)	5-10
Typical Residential Underground Service Entrance	5-13
Typical Commercial 3 Phase, 4 Wire Underground Service Entrance	5-14
Typical Mobile Home Service and Meter Pedestal	5-15
Typical Underground C.T./Meter Can	5-17
Temporary Underground Service	5-18
Typical Temporary/Permanent Service Drawing.	5-18
Typical Temporary Service Pedestal Drawing	5-19
Typical Temporary Service on Wood Pole Drawing	5-21

UNDERGROUND SERVICE

GENERAL

In areas in which the Cooperative has provided for underground (URD) primary facilities, the Cooperative will run an underground service under its present policies.

The consumer must install an approved underground type service entrance which provides a pull section or is bussed for bottom connections.

In cases where the consumer requests the Cooperative to install an underground service from existing overhead lines, such installations will be made provided the existing overhead facility has space available for underground termination equipment.

The consumer should check with the Cooperative's Engineering Department prior to planning a service of this type. The Cooperative will furnish and install service drop conductors to the consumers service entrance equipment.

The Cooperative reserves the right to determine meter location(s) and which padmount transformer or secondary pedestal the meter will be served from.

The consumer must provide all trenching work as specified in the Trenching Portion of this manual.

The consumer will be required to furnish a concrete pad poured in place including necessary conduits for all installations requiring a three phase pad-mounted transformer, per specifications supplied by the Cooperative.

If the consumer prefers to install service conduit in order to expedite backfilling of the trench for landscaping or other purposes, the type of conduit and depth of burial must be inspected and approved by an authorized Cooperative Representative prior to the backfilling. The Cooperative's Engineering Office should be consulted prior to any work being undertaken.

If service conductors in conduit are to be paralleled, they shall be paralleled in separate conduits. Paralleling underground conductors in one conduit is not allowed.

UNDERGROUND RISER REQUIREMENTS

RISER MATERIAL

Underground risers shall be of rigid metallic and listed or rated for their intended use. Only true round cross section risers will be acceptable.

Riser shall not be cut with a torch, welded or brazed.

NOTE:

Underground Risers that are inside a structural wall must be rigid metallic conduit.

METALLIC RISER COATING

Rigid metallic risers, conduits and fittings installed underground or in concrete shall be factory coated or half wrapped to a minimum 40 mil thickness with an approved 20 mil plastic tape suitable for direct burial to a minimum of 6 inches above grade.

UNDERGROUND RISER REQUIREMENTS

RESIDENTIAL SINGLE PHASE U.G. RISER SIZE

<u>SES Rating</u>	<u>Riser Trade Size</u>
100-200A	3'
*400A	3'
*600A	4"

*Includes multi-meter paks for multi-family residential installations

COMMERCIAL SINGLE PHASE U.G. RISER SIZE

<u>SES Rating</u>	<u>Riser Trade Size</u>
100-200A	3'
400A	4"
600A	3" - 4"

COMMERCIAL AND RESIDENTIAL THREE PHASE U.G. RISER SIZE

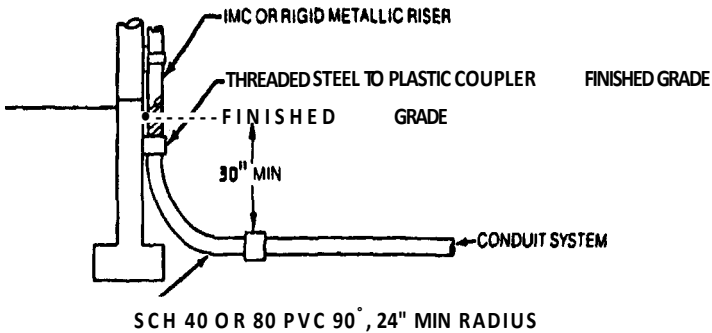
<u>SES Rating</u>	<u>Riser Trade Size</u>
100 - 200A	3'
400A	4"
600A	2 - 4"
800A	2 - 4"
1000A	3 - 4"
1200A	3 - 4"
1600A	4 - 4"
2000A	5 - 4"
2500A	6 - 4"
3000A	7 - 4"

RISERS FOR SERVICES INSTALLED IN CONDUIT

When service conduit is extended away from the service riser sweep, there are three methods of making the vertical to horizontal transition. They are listed in order of preference:

METALLIC RISER WITH SCH 40 OR 80 RIGID PLASTIC 90 DEGREE SWEEP

1. No portion of plastic sweep, including fittings, will be above finished grade.
2. A threaded steel to plastic fitting is installed at bottom of riser so that it will be below finished grade.
3. Where sweep runs horizontal, it shall have 30" minimum cover.
4. Sweep will have 24" radius as a minimum and shall be of Sch. 40 or 80 grade rigid plastic conduit.
5. Metallic riser sized per underground riser requirements.



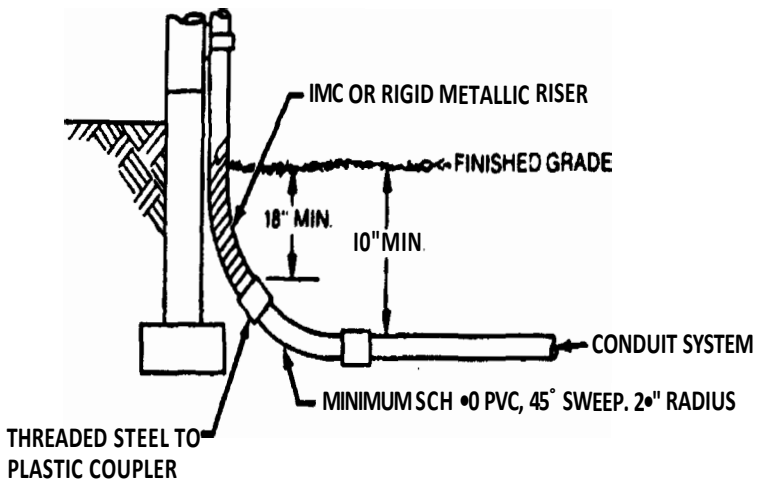
METALLIC RISER COUPLED TO SCH 40 OR 80 PVC 90° BEND
FOR CONDUIT SYSTEM
(Preferred Method)

METALLIC RISER WITH 45° SWEEP AND SCHEDULE 40 RIGID PLASTIC 45° SWEEP

1. A threaded steel to plastic fitting is installed to make transition from steel riser to approved rigid plastic 45° sweep.

Metallic 45° sweep and plastic 45° to be a 24" radius. Where sweep runs horizontally there shall be a minimum of 30" of cover.

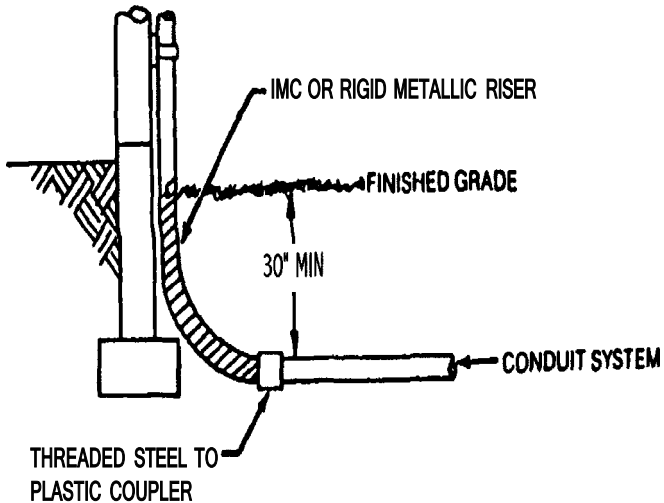
2. Metallic riser sized per underground riser requirements.



METALLIC RISER WITH 45° BEND COUPLED TO A PVC CONDUIT SYSTEM

METALLIC RISER WITH 90° SWEEP

1. A threaded steel to plastic fitting installed at bottom of metallic sweep to make transition from metallic to approved rigid plastic conduit. Where sweep runs horizontal, it shall have 30" minimum cover.
2. Metallic riser sized per underground riser requirements.



24" MIN RADIUS, METALLIC RISER WITH 90° BEND COUPLED TO A PVC CONDUIT SYSTEM

SERVICE CONDUIT REQUIREMENTS

MATERIAL FOR SERVICE CONDUIT

Material for Service Conduit shall be electrical conduit, labeled for wires rated 90 degrees C. Acceptable material shall be either schedule 40 or 80 PVC conduit and when specified, rigid metallic conduit taped or coated for direct burial.

STEEL CONDUIT

All rigid conduits and fittings shall be Hot-Dipped galvanized. Rigid conduit shall be installed with threaded couplings and joints made up tight.

BENDS AND SWEEPS

Factory bent sweeps are preferred; however, field bent sweeps are acceptable if done properly.

- A. Metallic — One Shot bending. Specified radius maintained. Internal diameter of conduit not effectively reduced.
- B. Non-Metallic — Use of plugs at both ends. No direct flame heating. No evidence of scorching. Specified radius maintained.

TABLE OF APPROVED
NON-METALLIC SERVICE CONDUIT

Application	Acceptable Product Material	Conduit Marking Requirements
Straight Conduit	PVC SCH 40 or SCH80	Mfg. Name, PVC, SCH 40, or SCH 80 Size, NEMA TC-2 90° C wire code.
Bends, Sweeps, and Elbows	PVC SCH 40 or SCH80	Mfg. Name, PVC, SCH 40, or SCH 80 Size, NEMA TC-2, radius, degree of curvature, 90° C wire code.
Fittings	PVC SCH 40 or SCH80	Mfg. Name, PVC, SCH 40 or SCH 80, size, NEMA TC-2 (marking may appear on package material)

USEABILITY OF CONDUIT

All conduit shall be free of obstructions, dirt, rock, etc. The conduit shall be clean and useable at the time the Cooperative installs conductors.

In all cases, the consumer is responsible for the usability of the conduit at the time the Cooperative installs conductors.

CONDUIT PULL LINE

The consumer will be required to install a 3/16" minimum polypropylene or polyethylene pull line in all conduit runs containing one or more sweeps.

Exception: Sweep and riser conduit for a direct buried service.

INTENTIONALLY LEFT BLANK

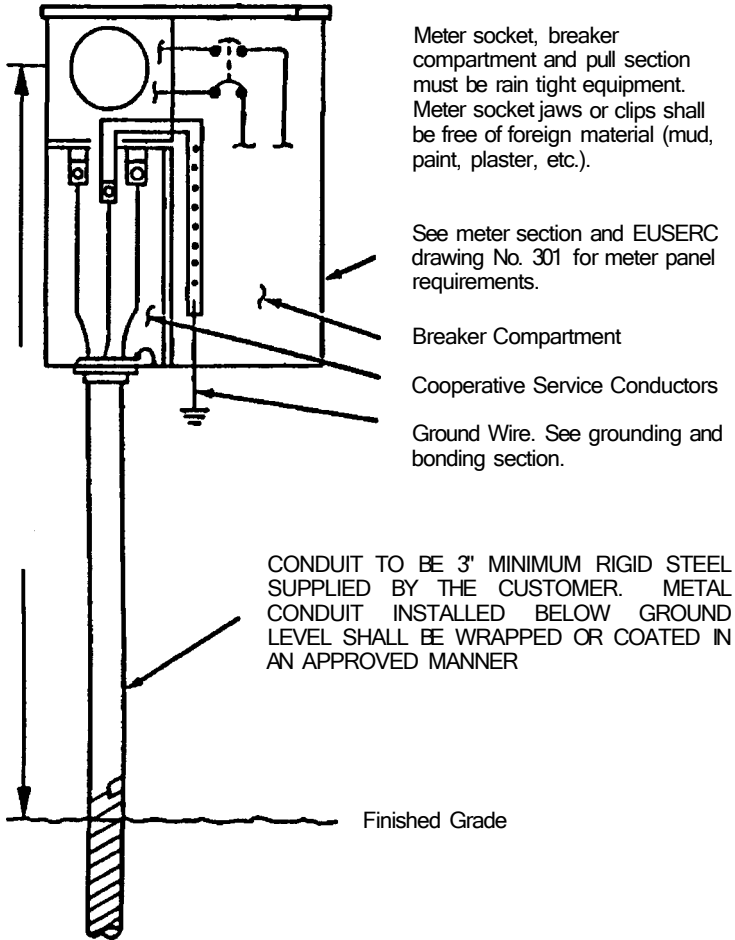
INTENTIONALLY LEFT BLANK

INTENTIONALLY LEFT BLANK

TYPICAL SERVICE ENTRANCE INSTALLATIONS (U.G.)

100 AMP - 200 AMP SINGLE PHASE THREE WIRE
(RESIDENTIAL)

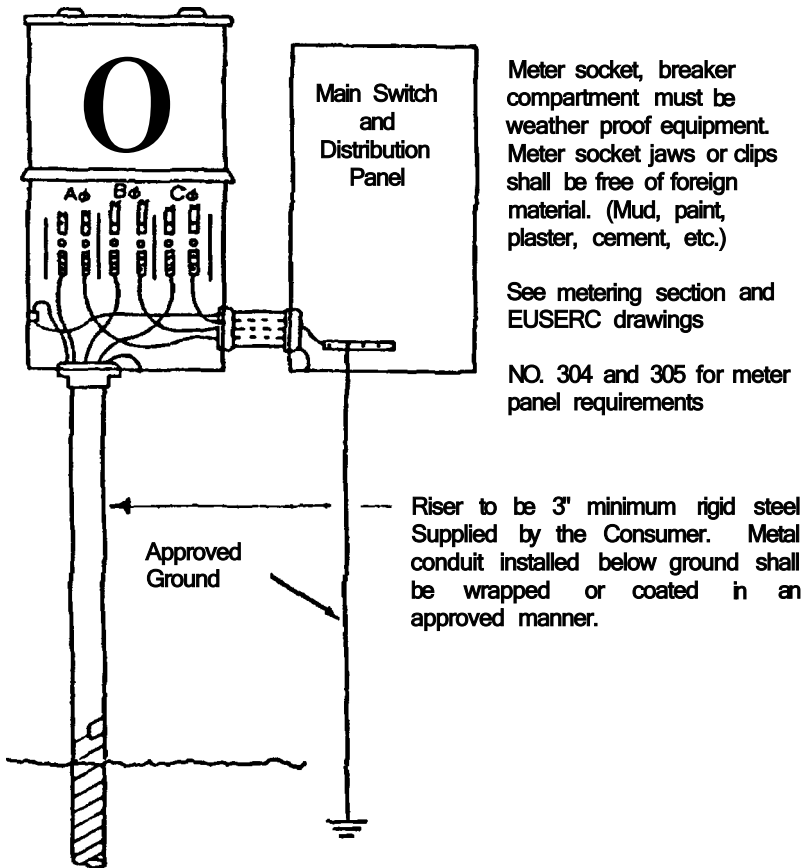
FRONT VIEW



NOTES:

Underground service conductors and connections to service terminals provided by Co-operative. This is the preferred installation for single family residential applications.

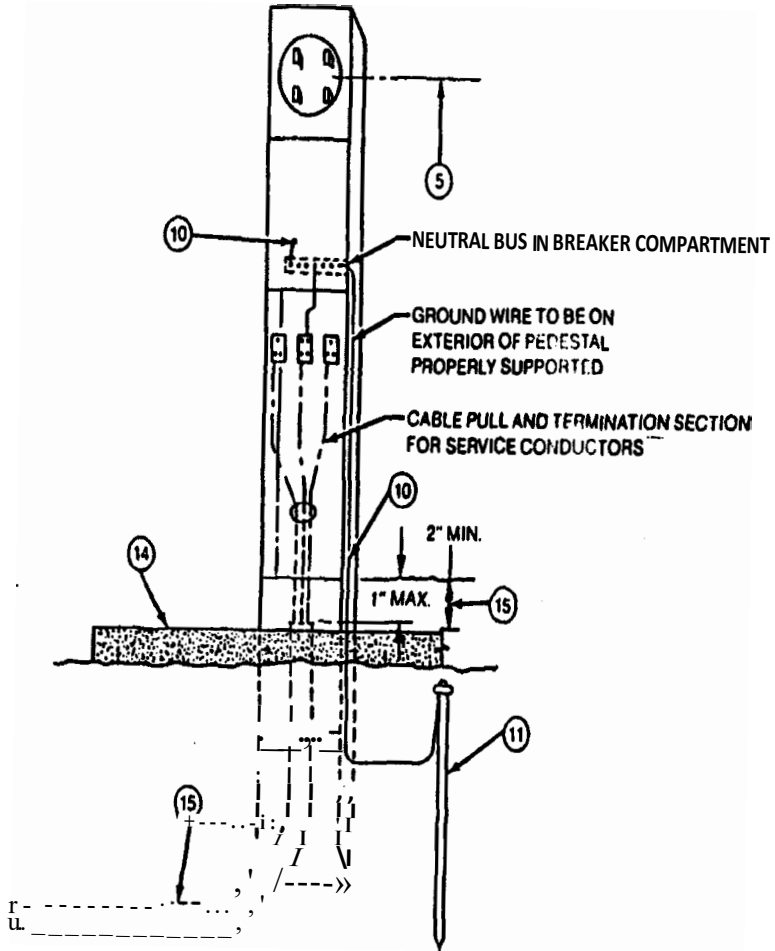
100 A, 200 A THREE-PHASE, 4-WIRE COMMERCIAL



NOTES:

1. Neutral conductor from customer's distribution panel shall be code sized and shall extend into meter cabinet and be terminated on neutral landing lug.
2. Underground service conductors are provided by the Cooperative.
3. All wire and equipment shall comply with the national electrical code.
4. For a 30 4-wire delta service, the power phase (high leg) must be installed in the right hand (C9) test block and meter socket position and identified by an outer finish that is orange in color.

MOBILE HOME PEDESTAL 120/240 10 3-WIRE

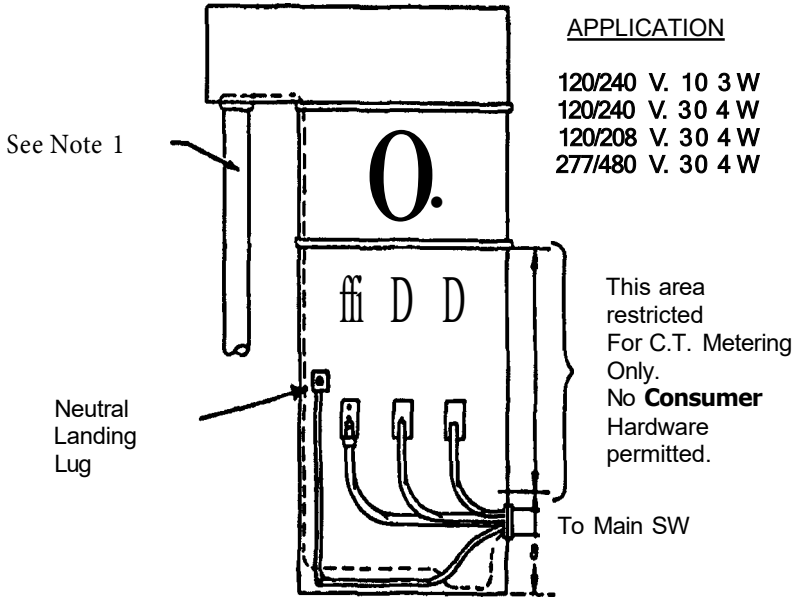


SEE FOLLOWING PAGE FOR NOTES AND SPECIFICATIONS

MOBILE HOME PEDESTAL 120/240 3-WIRE

1. Pedestal shall be UL Listed and EUSERC approved. May be used for temporary for construction.
2. Material of construction and corrosive-resistant finish shall be approved by a recognized testing laboratory.
3. Pedestal and meter socket shall have a minimum rating of 100 amperes. The socket shall be sealable and ring-type.
4. The socket shall be factory-wired with the conductors in a separate or barriered wireway from the service termination lugs to the meter socket. The conductors which extend to the meter socket shall be connected at the service termination lugs independent of the connections for the service lateral conductors.
5. Minimum meter height shall be 36" when enclosed or 42" when exposed. If the meter is enclosed, the enclosing cover shall be hinged for ready access. The metering cover shall have a demand reset cover which shall be hinged, lockable and constructed of steel with minimum dimensions of 6 inches wide by 6 inches high.
6. Pedestal and power outlet section shall be rated 10,000 A.L.C. minimum.
7. Service cable pull and termination section shall be covered with a sealable removable panel or panels, extending from 2' above grade, and when removed, give full access to the service termination lugs. Access to the service termination lugs may be either the front or the rear of the pedestal. (See note 18.)
8. Service termination lugs shall be twin #2 to 350 **MCM** aluminum bodied pressure type for in and out connection of the service conductors.
9. Insulation barriers shall be required when spaces between the termination lugs are less than 1 ½" or less than 1" to the sides of the pedestal.
10. The grounding electrode conductor shall be continuous to the neutral landing block in breaker compartment and shall not pass through the service termination section or meter compartment. Bare copper conductor may be used if properly supported. Connect pedestal bond lug as shown.
11. Grounding shall be provided by the Customer in compliance with the N.E.C. Made electrodes shall have a resistance to ground of not more than 25 ohms.
12. The pedestal at grade line shall have a minimum cross sectional dimension of 4" x 8". A fixed panel for the final grade and concrete pour shall extend 2' above grade a minimum of 6" below grade.
13. The minimum depth of the pedestal in the ground shall be 24" with openings at the base to permit the service lateral conduit and/or conductors to sweep into the pedestal.
14. Poured concrete slab shall be 24" x 24" min. size and have a 3 ½" min. thickness.
15. Provide and install 3' rigid PVC conduit and sweep. A 24" radius is required if service to pedestals will be cascaded, two 2' conduit bends are required; consult the Cooperative to determine if service will be radial or cascaded. Conduit shall extend to 1' below top lip of pour panel.
16. The Customer shall be responsible for the location and final grade of the utility island and the included electric meter pedestal.
17. That portion or pedestal buried in concrete and earth shall be coated with an approved corrosion restraint material such as zinc, cadmium, or enamel to withstand all deterioration.
18. Receptacle plugs, cords, or "hard-wire" connections shall not block access to panel(s) covering service cable and termination pull section.(See Note 7)

TYPICAL UNDERGROUND 400 AMP WALL MOUNT
C.T./METER INSTALLATION



1. Riser to be a minimum 3" for 1 phase residential applications. Riser to be a minimum 4" for 1 phase and 3 phase commercial applications---Refer to Riser Specifications.
2. The consumer furnishes the C.T. 's, meter socket and test switch.
3. Bendable vertical layin, double neutral lug must be provided in the C.T. enclosure which will accommodate up to 500 MCM conductor.
4. When used for 3 phase - 4 wire delta service, high phase shall be on the right hand side and properly identified.

TEMPORARY UNDERGROUND SERVICE

When temporary service for construction purposes is required in an area served solely by underground primary facilities, upon proper application by the consumer, the Cooperative will provide temporary service under one of the following methods.

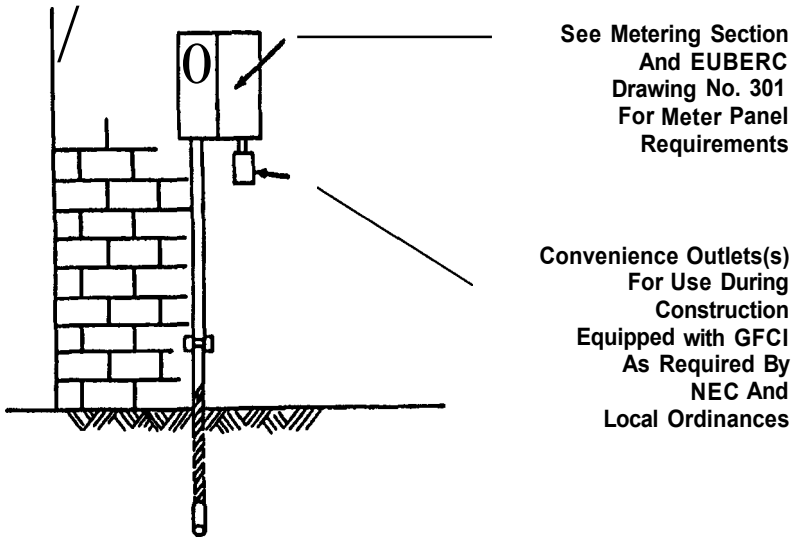
1. (PREFERRED METHOD)

Consumer shall install service equipment on partially completed wall or on a temporary "Batter Board" in a permanent location.

Cooperative will install underground service to entrance equipment on a permanent basis.

Consumers service entrance equipment and installation shall be approved by the Inspection Agency.

Partially Completed Corner Walls of Residence



See Riser Requirements For
Conduit or Direct Buried Service.

TYPICAL TEMPORARY/PERMANENT SERVICE ENTRANCE

Consumer shall install a self contained mobile home type meter pedestal no further than ten (10) feet from the Cooperative's Service Pedestal or Transformer. Approved direct burial service wire (type UF, USE, or equivalent) shall be installed by consumer and extended to within 3 feet of the Cooperative's facilities.

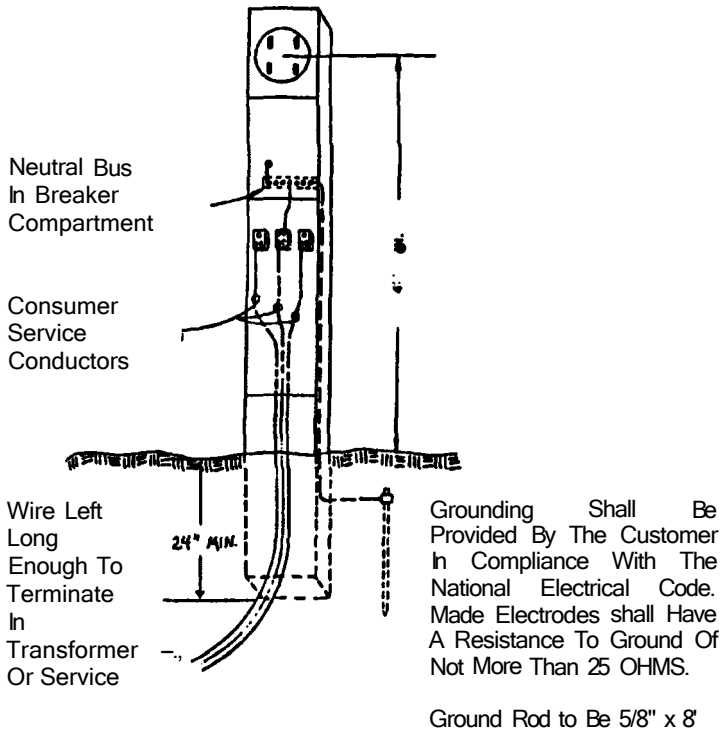
A sufficient coil of wire to reach the secondary terminals of the transformer Q1.service pedestal must be left.

The Co-operative will extend wire into transformer or service pedestal and make the service connection.

All wires and equipment shall be per N.E.C. and local codes.

CAUTION

Before digging or driving ground rod be sure to contact Blue Stake and arrange for a cable location.



TEMPORARY SERVICE METER PEDESTAL

- 2 Consumer shall set a temporary pole and metering equipment as shown herein no further than ten (10) feet from the Cooperative's Service Pedestal or Transformer.

The Cooperative reserves the right to determine which service pedestal or transformer shall feed the temporary service.

Approved direct buried service wire (type UF, USE, or equivalent) shall be installed by the consumer and extended to within 3 feet of the Cooperative's Facilities

sufficient coil of wire to reach the secondary terminals of the transformer or service pedestal must be left.

The Cooperative will extend wire into transformer or service pedestal and make the service connection. All wires and equipment shall be per N.E.C. and local codes.

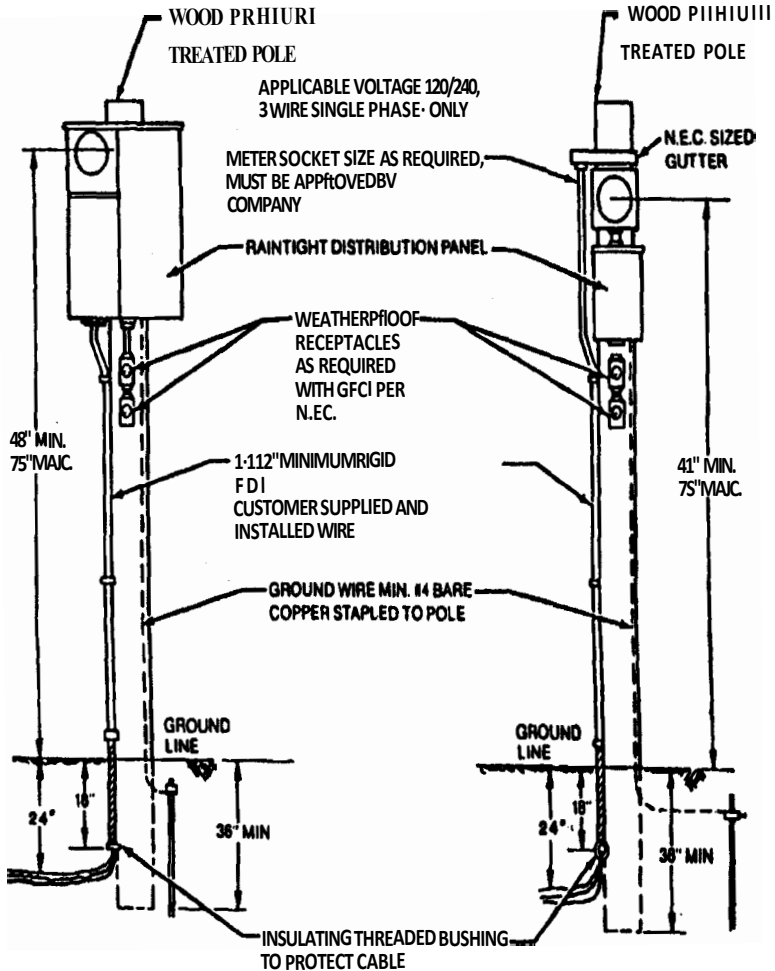
CAUTION

Before digging or driving ground rod, be sure to contact Blue Stake and arrange for a cable location.

TEMPORARY SERVICE FEE

The consumer will be required to pay the appropriate installation and user charges in effect at the time.

Check with the Cooperative's Service Representatives for these charges.



TRENCHING REQUIREMENTS

Table of Contents

General Trenching Requirements	6-2
Conduit System Depth and Bedding Requirements .	6-5
Inspection of Consumer's Work	6-6
Typical Service Trench Drawing	6-7

TRENCHING REQUIREMENTS

Before You Dig

To comply with state law and OSHA, you must check with all utilities who may have underground facilities in your excavation area.

You can save time, money and avoid hazards, prevent interruption of utility service and eliminate construction delays by getting underground utilities marked in your excavation area prior to any digging.

Graham County Electric Cooperative is a participant in the Arizona Blue Stake Center. Call the Blue Stake Center at 1-800-STAKE-IT at least (2) days in advance of your excavation starting date.

GENERAL TRENCHING REQUIREMENTS

The consumer must provide all the excavating, backfilling, compacting and clean-up of their service trench.

The consumer shall provide easements for the trench route and be responsible for securing all necessary permits required by local municipalities and/or governing bodies.

The consumer shall dig the trench in straight lines between turning points and shall confine the trench to the easement and/or rights of way. Unnecessary deviations of service trench, such as trenching around temporary above ground obstructions, vehicles and construction materials is not acceptable.

Any area which will be subject to a grade change such as, but not limited to streets, easements strips, alleys, parking areas, landscape areas, building site areas, etc. (including the side slopes and drainage or "bar" ditches) which are to contain Graham County Electric Cooperative, Inc. facilities must be within six inches @ 1" of finished grade prior to excavation of trench.

Trenches must be of minimum depth and width as shown on the trench cross section detail. Trench depth is measured from grade provided at time of installation on low side of trench.

NO ALLOWANCE WILL BE MADE FOR PROPOSED OR FUTURE GRADES.

If subsequent to construction, the grade is changed in such a way as to require relocation or change of the underground facilities, or results in damage to such facilities, the cost of such relocation, change, and or resulting repairs shall be borne by the contractor/consumer responsible for the grade change.

Crossing of other underground facilities (water lines, drainage structures, sewer lines, fuel lines, communication lines, or structures etc.) must maintain, at the minimum, a twelve-inch (12") vertical clearance from the electrical lines. The vertical separation may be above or below the facility being crossed if the required depth as specified on the trench cross section detail is maintained on the electrical line.

In general, Graham County Electric Cooperative, Inc.'s preference is to cross below any other facility.

If electric service lateral cable runs parallel to a sewer pipe, the horizontal distance between sewer and electric must be a minimum of 24".

Consumer may place water service in same trench as electric service lateral cable, but must maintain a 12-inch separation either vertically or horizontally. If vertical option, then the water line must be above the electric service lateral cable.

Gas pipe shall not be installed in the same trench where Graham County Electric Cooperative, Inc.'s facilities have been installed (unless pre-approved from Graham County Electric and Utilities Engineering Departments). A separate trench is required, with a minimum horizontal separation of 24" from service cable.

During trenching operations, property pins should not be disturbed and, if so, are the responsibility of the consumer to have them replace.

The minimum depth and width of the service trench shall be 36 inches by 12 inches with the bottom smooth and clean.

In general, if there is a question on acceptability of bedding material, contact the Cooperative. Banking bedding material to one side of the trench is not acceptable.

No boulders of a size larger than those that could be manually removed from the trench in case of a faulted cable shall be used to backfill the trench. Generally boulders no larger than 10 inches in their greatest dimension may be used.

The service trench may be machine dug only to within three (3) feet of the Cooperative's service pedestal or transformer. The last three (3) feet must be either hand or machine dug by the consumer or his contractor under the supervision of a Cooperative Representative to prevent damage to the existing underground facilities.

CONDUIT SYSTEM DEPTH AND BEDDING REQUIREMENTS

The consumer may prefer to install conduit in order to expedite excavation problems such as solid rock or other purposes.

The minimum cover required for the installation of PVC conduit is 36 inches.

Trench depths needed to meet the above minimum cover requirements will vary depending on the size of conduit used.

The type of conduit and depth of burial must be inspected and approved by an authorized Cooperative representative prior to the backfilling of the trench.

The trench bottom in which conduit will be placed shall be smooth, flat and without surface irregularities and three inches of bedding material shall be installed to provide the required bedding surface.

The consumer shall provide and install 6 inches of approved bedding material over all electrical conduit. The material used for bedding shall be 1" minus material. Sand is also acceptable. Native material is acceptable provided it contains no rocks larger than 1 inch in their greatest dimension.

SERVICE CONDUIT SYSTEM

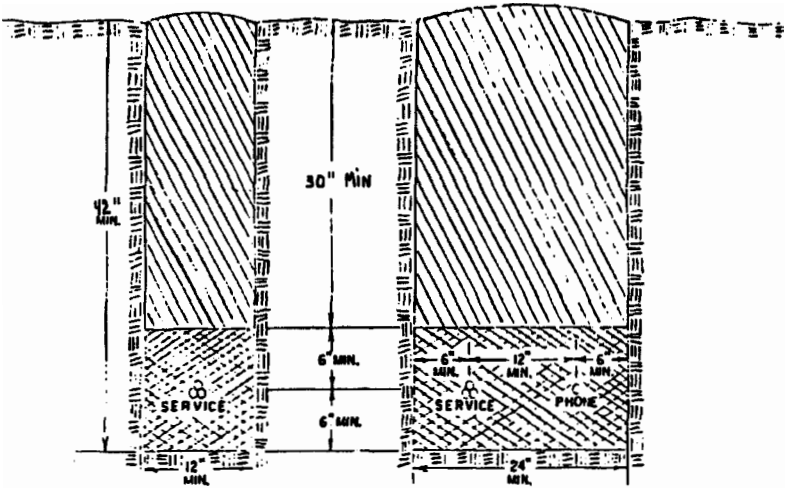
The consumer should refer to specifications for service conduit systems and risers for services installed in conduit in the underground service section of this manual.

Inspection of Consumers Work

The Cooperative reserves the right to inspect all and every part of the consumer's work during or after completion of installation of conduit, trenching, trench bottom bedding or shading, backfill or compaction.

If all or any part of the work has not been done per Cooperative Specifications, the consumer, at his own expense shall take corrective action.

Neither inspection of the work by the Cooperative, nor lack of same shall relieve the consumer of his responsibility to provide and perform the work per Cooperative Specifications.



WHEEL COMPACTED BACK-FILL



APPROVED BEDDING SAND OR CLEAN SOIL
(3/8" Minus)
(CINDERS ARE NOT ACCEPTABLE)

UNDISTURBED EARTH

NOTE:

1. Trenching, bedding and back-filling is the responsibility of the Consumer.
2. Hold Machine digging of trench at 3' from transformer or pedestal.

Dig remaining 3' with Cooperative Representative present on job site.

TRENCHING SPECIFICATIONS FOR UNDERGROUND SERVICE WIRES

GROUNDING AND BONDING

Table of Contents

Grounding	7-2
Bonding	7-3
Minimum Size Bonding, Equipment Grounding, Grounding Electrode Conductor Table	7-4
Typical Residential Service Grounding and Bonding Drawing (Overhead)	7-5
Typical Residential Service Grounding and Bonding Drawing (Underground)	7-6
Typical Mobile Home Meter Pedestal Grounding and Bonding Drawing	7-7
Proper Grounding and Bonding Drawing	7-8

GROUNDING

The ground electrode conductor shall be bare. Ground electrode conductors shall be a minimum size of No. 4 copper (solid or stranded) and must be securely fastened to the building or structure with approved fastening devices. The spacing of such devices shall not exceed 2 feet. Aluminum wire is not acceptable to be used as the grounding conductor.

When a ground rod is used as the grounding electrode, it shall be a minimum 5/8-inch x 8-foot copper clad ground rod driven vertically into the ground.

Where a rock bottom is encountered, the ground rod shall be driven at an oblique angle not to exceed 45 degrees from the vertical or shall be buried in a trench that is at least 2 ½ feet deep.

The ground rod shall be installed so that at least 8 feet of rod is in contact with the soil.

The ground rod connector shall be of a type approved for direct burial. Not more than one conductor shall be connected to the grounding electrode by a single clamp, unless the clamp is listed for multiple conductors.

The grounding electrode shall have a resistance to ground of 25 OHMS or less. Where the resistance exceeds 25 OHMS, two or more electrodes in parallel not less than 6 feet apart shall be used to obtain the necessary resistance to ground.

When a concrete enclosed electrode (UFER Ground) is used, it shall be encased by at least two (2) inches of concrete foundation or footing that is in direct contact with the earth, consisting of at least 20 feet or more of bare solid copper conductor not smaller than No. 4 AWG.

When a UFER Ground is used, it must be inspected by either the inspector within whose jurisdictional boundary it lies or if in an area not requiring such inspection, by an approved Cooperative employee, prior to being encased in the concrete.

The grounding electrode conductor shall contain no splices from the equipment it is intended to ground to the grounding electrode it is connected to.

A water, natural gas, or liquid propane gas line shall not be used as a grounding electrode.

BONDING (Unfused Areas)

Bonding is required on all enclosures, equipment, raceways, and fittings which contain unfused service conductors.

Nipples and bushings installed with eccentric or concentric lock nuts must be bonded with ground bushings, wedges, or other approved devices.

Bond conductor size shall be determined by the ampere rating of the service entrance equipment as shown on the grounding and bonding table.

Bonding jumpers shall be installed around any section of non-metallic duct, pipe, device or fitting that will break the continuity of the ground.

Self bounding hubs (Myers or equivalent) shall not be used on multi-centric knockouts, unless the largest knockout is used.

All metallic parts of an irrigation system which are not intended to carry current must be permanently bonded to an unfused and unswitched ground conductor which extends back to the transformer bank secondary ground. It is not satisfactory to merely bond the equipment to a driven ground rod or well casing if that ground rod or casing is not interconnected with the transformer ground by metallic conductor. This means that in all cases, the consumer's wiring must consist of four wires. These wires are the three current-carrying phase conductors and a fourth wire called a grounding conductor. A grounding conductor is one which is not intended to carry load current, but instead, provides the interconnection between the transformer bank ground and all grounds on the consumer's equipment and shall be sized as shown in N.E.C. 250-94.

Insulated bonding conductors shall have a green insulation.

MINIMUM SIZE OF BONDING EQUIPMENT GROUNDING/ GROUNDING ELECTRODE CONDUCTORS AND GROUND BUS

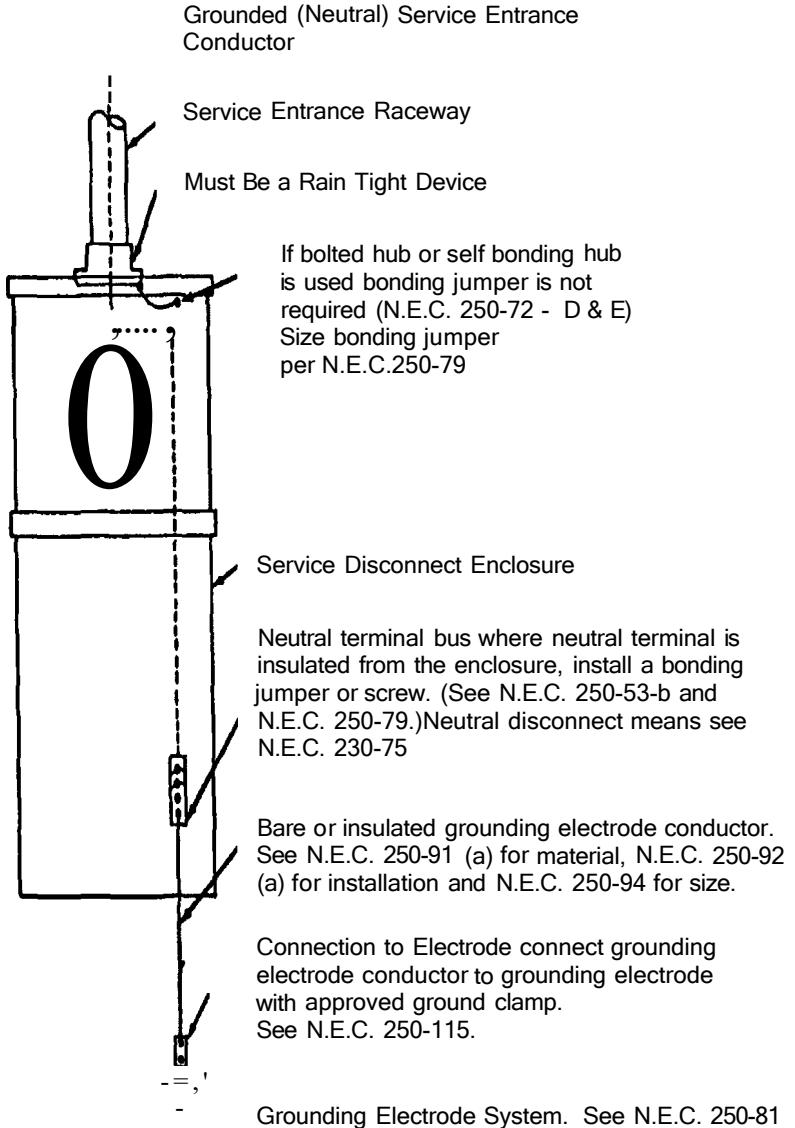
Maximum Ampere Rating	Size of Equipment Grounding or Bonding Conductor Minimum (AWGorMCM) NEC 250-95 See Note 1		Size of Grounding Electrode Conductor Minimum (AWGorMCM) NEC 250-94 See Note 2 & 4	Size of Main Bonding Jumper, Minimum (AWGorMCM) NEC 250-79 See Note 3	
	<u>Copper</u>	<u>Aluminum</u>	<u>Copper</u>	<u>Copper</u>	<u>Aluminum</u>
20	12	10	--	--	--
60	10	8	--	--	--
90	8	6	--	--	--
100	8	6	4	6	4
150	6	4	4	6	4
200	6	4	4	4	2
300	4	2	2	2	1/0
400	3	1	1/0	1/0	3/0
500	2	1/0	1/0	1/0	3/0
600	1	2/0	2/0	2/0	4/0
800	1/0	3/0	2/0	2/0	4/0
1000	2/0	4/0	3/0	3/0	250
1200	3/0	250	3/0	250	250
1600	4/0	350	3/0	300	400
2000	250	400	3/0	400	500
2500	350	500	3/0	500	700
3000	400	600	3/0	600	750
4000	500	800	3/0	750	1000
5000	700	1200	3/0	900	1250
6000	800	1200	3/0	1250	1500

NOTES:

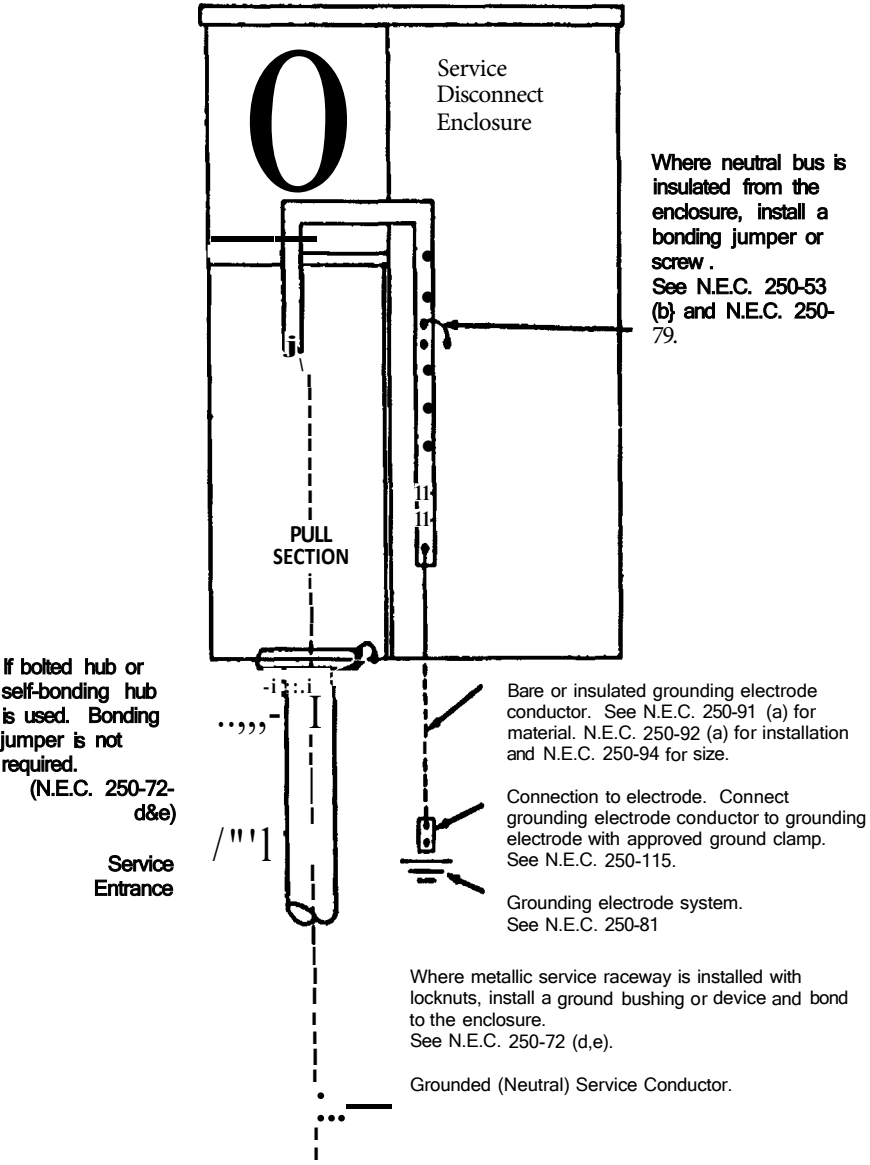
1. For sizing bonding conductor for gas line, per NEC 250-95. For sizing any bond conductor required on The Load Side of Fuses or Circuit Breakers.
2. For sizing water bonds per NEC 250-94.
3. For sizing main bonding jumper from equipment grounding bus to neutral bus, per NEC 250-79. For sizing conductor used for bonding unfused nipples and equipment.
4. Grounding electrode conductors need not be larger than #4 copper. If there is only one connection between the concrete encased electrode or man made electrode (example - ground rod) & grounded system conductor (neutral conductor), per NEC 250-94 ex. 1-a and b.

GROUNDING AND BONDING TABLE

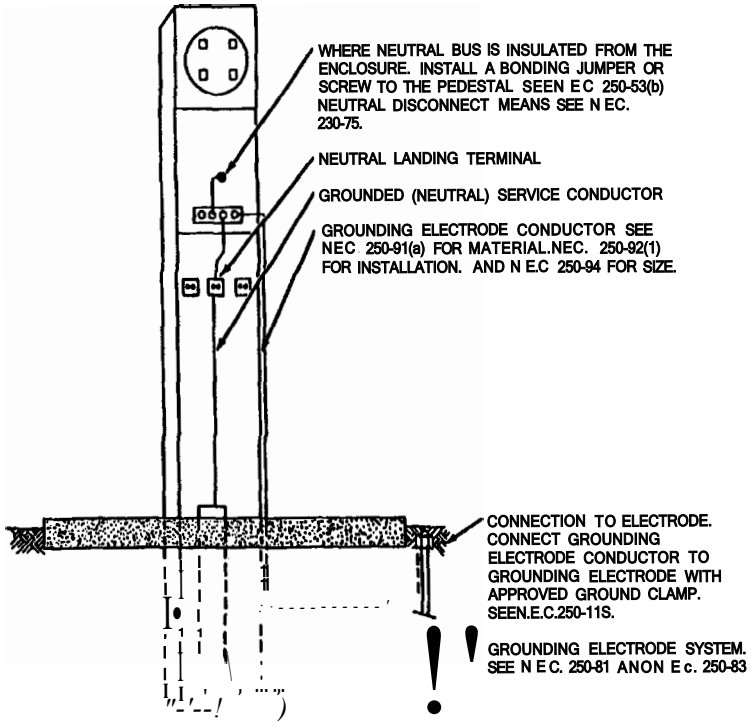
**GROUNDING AND BONDING
TYPICAL RESIDENTIAL OVERHEAD SERVICE - ALL IN ONE
(SINGLE FAMILY) MAX 200 AMP - SINGLE PHASE**



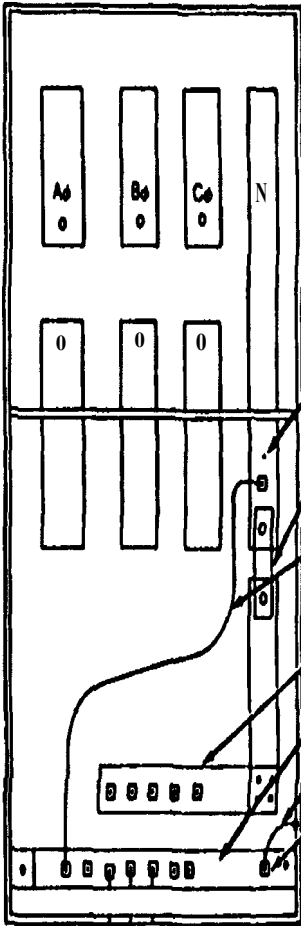
**GROUNDING AND BONDING
TYPICAL RESIDENTIAL UNDERGROUND SERVICE (SINGLE
FAMILY) MAX 200 AMP SINGLE PHASE**



GROUNDING AND BONDING SINGLE PHASE METER PEDESTAL



PROPER BONDING AND GROUNDING



Connection for main bond jumper
Ahead of neutral disconnect link.

Neutral Disconnect Link

Main Bonding Jumper(s)
N.E.C. 250-53 N.E.C. 250-79
Size Per N.E.C. 250-79

All Neutral Wires to be placed on neutral
bus

All bond wires N.E.C. 250-53-b.
To be placed on bond bus

Enclosure grounded
N.E.C. 250-32-79

(A wire may not be necessary if grounding
Busbar has been installed on a cleaned
Surface of the frame with bolts of adequate
size and strength.)

SHORT CIRCUIT PROTECTION

The National Electric Code, State, County, and Municipal Codes and/or regulations require that service entrance equipment shall be suitable for the short circuit current available at its supply terminals.

It is the responsibility of the consumer to install service entrance equipment and protective devices (fuses or circuit breakers) capable of interrupting and withstanding the available fault current.

RESIDENTIAL

The Cooperative will design its facilities, where practicable, so that the maximum fault current will not be greater than 10,000 amperes-symmetrical at new single-family residences having service entrances nominally rated at 200 amperes or less. (There may be exceptions to this rule due to size and location of transformers, and also when serving townhouses, condominiums, and apartments. Consult with the Cooperative in such cases.)

COMMERCIAL INDUSTRIAL (600 AMPS BELOW)

Table No. 1 Specifies THE MINIMUM INTERRUPTING RATING OF SERVICE ENTRANCE EQUIPMENT THAT SHALL BE INSTALLED. In some cases, the available fault current may exceed these values and higher rated equipment may be required when the company elects to serve from a large multiple service transformer. (See Table No. III)

TABLE NO. I

CURRENT VALUES SHOWN ARE SYMMETRICAL AMPERES AT THE SECONDARY TERMINALS OF THE TRANSFORMERS.

SERVICE ENTRANCE AMPACITY		MINIMUM SHORT CIRCUIT RATING (AMPS)						
		SINGLE PHASE			THREE PHASE			
		120/240 V		120/208 V		277/480 V		120/240 V
POLE	PAD	POLE	PAD	POLE	PAD	POLE	PAD	
200 or LESS	13,000	10,700	13,000	21,700	11,300	12,400	11,300	N/A
400	26,000	20,000	26,000	21,700	22,500	23,600	22,500	N/A
600	41,000	31,300	39,000	41,800	35,500	24,300	34,000	N/A

N/A NOT AVAILABLE


COMMERCIAL INDUSTRIAL (800 AMPERES & ABOVE)

Sometimes it is necessary to order switchgear before sufficient design data is available to make a detailed fault study. For this reason, the Cooperative lists maximum fault tables that should permit the proper sizing of pre-ordered switchgear. Care must be exercised in using these tables. Table No. II gives maximum faults at the secondary bushing of the transformer. Table No. II may be used only when the Cooperative will serve the section with a **single transformer installation.**

EXAMPLE: A commercial enterprise has had a facility designed and the electrical engineer has determined that the SES will be 1,000 amps and the voltage will be 120/208 3 0. From TABLE NO. II it can be found that the short circuit available is 52,100 for pole type transformers and 54,400 for pad type transformers.

TABLE NO. II

Current Values shown are symmetrical amperes **at the secondary terminals** of transformers.

Service Entrance Equip. Capacity	Assumed SES Loading At 80% Capacity	3 0 120/240 V		3 0 120/208 V		3 0 277/480 V	
		POLE	PAD	POLE	PAD	POLE	PAD
800	640	45,000		39,000	41,800	35,500	24,300
1,000	800	66,100		52,100	54,400	47,500	24,300
1,200	960	70,800		81,700	56,100	47,500	24,300
1,600	1,280	70,800		81,700	56,100	54,700	24,300
2,000	1,600	95,000		81,700	56,100	75,300	31,500

COMMERCIAL AND INDUSTRIAL

Table 11 shall be used when the Cooperative serves the customer from a transformer with multiple services. This table can be **used only when the ultimate size of the transformer is known.** (Consult with the Cooperative for that decision)

EXAMPLE: A commercial enterprise is being built in an existing shopping center where the electrical facilities are already established. The requirements are for a 400 amp SES 277/480 V 3 0. Verification with the Cooperative reveals that a 500 KVA pad mounted transformer is already serving adjacent businesses and could accept this load. From Table No. III, after 500 KVA transformer, find the utility short circuit current available to be 24,300 amps.

TABLE NO. III

Current Values are symmetrical amperes at the secondary terminals of the Transformers.

Transformer Bank KVA 1 0 or 3 0	1 0 120/240V		3 0 120/240 V		3 0 120/240 V		3 0 277/480 V		3 0 240/480V
	POLE	PAD	POLE	PAD	POLE	PAD	POLE	PAD	POLE
	25	•	•	N/A	N/A	N/A	N/A	N/A	N/A
37½	•	•	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50	13,000	13,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75	19,500	19,500	11,300	N/A	13,000	10,420	•	•	•
100	26,000	26,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
112½	N/A	N/A	16,900	N/A	19,500	21,700	•	•	•
150	N/A	N/A	22,600	N/A	26,000	28,500	11,300	12,400	11,300
167	40,900	40,900	N/A	N/A	N/A	N/A	N/A	N/A	N/A
225	N/A	N/A	33,800	N/A	39,600	41,800	16,900	18,100	11,900
300	N/A	N/A	45,100	N/A	52,100	54,400	22,500	23,600	22,500
500	N/A	N/A	71,000	N/A	81,900	56,100	35,500	24,300	35,500
750	N/A	N/A	95,000	N/A	**	**	47,500	24,300	47,500
1000	N/A	N/A	N/A	N/A	**	**	54,700	24,300	54,700
1500	N/A	N/A	N/A	N/A	**	**	75,400	36,100	75,400

* Available short circuit current 10,000 amps or less

** Consult with the Cooperative

*** 3 0 Transformer Installations assume three equal size transformers. If transformers are not equal in size, use larger transformer and Table for 3 transformers of that size.

N/A NOT AVAILABLE

IRRIGATION AND METER PUMPING

Table of Contents

General.	9-2
Consumers Control Equipment.	9-3
Typical Service Entrance Supports for Service Equipment Drawing.....	9-4
Typical Irrigation/Meter Pumping Installation Drawing.	9-5

THREE PHASE IRRIGATION AND WATER PUMPING

GENERAL

All pump control panels, main disconnect, and metering panels shall be weatherproof.

The main switch shall be immediately adjacent to the meter panel. Meters and metering equipment shall be located ahead or on the supply side of the consumers main disconnect.

All main disconnects shall simultaneously open all ungrounded conductors of the circuit. All ungrounded conductors shall be fused in the main disconnects.

A three pole circuit breaker which will interrupt all three phases may be substituted for the main fused disconnect switch provided it is properly sized for the equipment and can safely interrupt the available fault current.

If for any reason the total actually operating load current, excluding motor starting current exceeds the rating of the consumer's service equipment, either at the time of installation or thereafter, the consumer shall install facilities consisting of an approved meter/C.T. box or an approved switchboard to accommodate current transformer metering.

CONSUMERS CONTROL EQUIPMENT

Three element running overload protection shall be required on all motors.

EXAMPLE: One overload unit in each phase in the starter.

Undervoltage, phase failure and phase reversal protection, time-delay backspin relays, surge capacitors and lightning arresters are strongly recommended for the protection of motor installations.

All reduced voltage starters shall be automatically switched from start to run mode of operation. Manual transfer is not acceptable.

All reduced voltage starters must conform to the latest National Electric Manufacturers Association Standards and the installation must be in accordance with the National Electrical Code.

Consumers switch and motor control equipment shall be of proper horsepower and voltage rating and shall be weatherproof.

Consumers switch and motor control cover shall be effectively locked or sealed if the enclosure contains accessible electrically energized parts.

