MEDINA ELECTRIC COOPERATIVE, INC.

Your Touchstone Energy® Cooperative

# THREE PHASE

# WIRING SPECIFICATIONS


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1.0 **SCOPE**. This specification establishes the design requirements for electrical services. Beginning at the point of contact (i.e., service entrance conductors) wiring is the Member's responsibility. The Cooperative is not required to provide service to an installation until it has been assured that the wiring is properly and safely installed. Upon notification of a completed meter loop, the Cooperative will inspect and verify that the meter loop meets Medina's standards. Then a meter will be installed.
**Any exceptions or deviations from these specifications shall require prior approval from Medina's Engineering Department**.

1.1 **Service Voltages**. The following are the only approved secondary voltages supplied by the Cooperative:

a. 120/240 volt single-phase.
b. 240/480 volt single-phase.
c. 120/240/208 volt four-wire delta.
d. 120/208 volt four-wire wye.
e. 277/480 volt four-wire wye.

The standard service for three-phase loads is a 4-wire wye with grounded neutral (types d and e above) or a combination of single-phase and three-phase loads (type c above).

2.0 **APPLICABLE DOCUMENTS**. The following documents form a part of this specification to the extent specified herein.

National Fire Protection Association, National Electric Code 2008, One Batterymarch Park, Quincy, MA 02169-7471

2.1 **Conflict Resolution.** All consumer electrical wiring shall comply with the latest edition of the National Electrical Code (NEC). This specification is not intended to be a substitute for the NEC. Where there is a conflict between Medina's specification and the NEC the most stringent requirement shall apply. Members shall contact the Cooperative for help resolving any conflicts. Medina reserves the right to make the final determination.

3.0 **DEFINITIONS**. See Appendix A for a definition of important terms used in this specification. See also Figures 1 and 2, for illustration of these terms.

4.0 **DESIGN AND CONSTRUCTION REQUIREMENTS**. All meter loop equipment shall be weatherproof and be installed by the Member's electrician. No consumer-owned meter loops should be installed on Cooperative transformer poles.

4.1 **Meter Pole**. Permanent meter poles will be set by the Cooperative. Meter poles are part of the construction cost and remain the property of the Cooperative. Meter poles shall not have more than two meter loops. The meter loop shall be mounted directly on the pole. A wood backing is not allowed on the meter pole. All mobile homes must use a permanently installed meter pole. Temporary meter poles for construction are the consumer's responsibility.

4.2 **Service Riser**.

Pole Installation - The meter socket shall have a minimum clearance of no less than 63" and no more than 72" from ground level. The service riser shall extend to within 4' of the top of the pole and must be 2" or greater (EMT or RIGID) conduit for meter loops equal to or greater than 125 amps. For installations where the rated meter loop is less than 125 amps, the conduit shall be a minimum of 1-1/4" The riser must also be continuous except for necessary couplings. See Figure 1, (MEC Standards)

Building Installation – Where a service riser rises above roof level it shall extend beyond that point a minimum of 36" and not to exceed a maximum of 48" measured from the top of the conduit. Where the service riser stops below roof level, a minimum of 10-ft vertical clearance is required measured from ground level to the lowest point on the drip loop (See Figure 1). Risers extending above roof level shall consist of at least 2" diameter rigid metallic conduit. (MEC Standards)

4.2.1 **Clearances**.
*Overhead Service-Drop Clearances*

**(A) Building Clearance**
Service conductors shall have a clearance of no less than 3 feet from windows that are designed to be opened, doors, porches, balconies, ladders, stairs, fire escapes, or similar locations. (NEC 230.9.A)

**(B) Vertical Clearance from Ground**
Service-drop conductors shall have the following minimum clearances from the final grade.

10-ft (3.05 m) – at the electric service entrance to buildings, also at the lowest point of the drip loop of the building electric entrance, above areas or sidewalks accessible only to pedestrians and where voltage does not exceed 150 volts to ground. For other voltages see (NEC 230.24 B2)

12-ft (3.7 m) – over residential property or driveways and those commercial areas not subject to truck traffic where the voltage does not exceed 300 volts to ground. For other voltages see (NEC 230.24 B3)

15-ft (4.5 m) – for those areas listed for voltage that exceeds 300 volts to ground over residential property or driveways and those commercial areas not subject to truck traffic. (NEC 230.24 B3)

18-ft (5.5m) – over public streets, alleys, roads, state highways and parking areas subject to truck traffic, driveways on other than residential property, and other land such as cultivated, grazing, forest, and orchard. (NEC 230.24 B4)

**(C) Above Roofs**

Conductors shall have a vertical clearance of not less than 8 ft above the roof surface. (NEC 230.24 A)

EXCEPTON (1): If a roof surface is subject to pedestrian or vehicular traffic then the clearance requirements shall comply with sections 4.2.1 A and B (NEC 230.24 A Exception 1)

EXCEPTION (2): If the voltage between conductors does not exceed 300 volts, measured phase to ground, and the roof has a slope of 1:3 (1 vertical unit to 3 horizontal units) or greater, a reduction of roof clearance to 3ft is allowed. (NEC 230.24 A Exception 2)

EXCEPTION (3): If the voltage between conductors does not exceed 300 and the conductors do not cross more than 4 ft of the overhanging portion of the roof and are terminated at a through-the-roof raceway or approved support a reduction in clearance to 18 inches shall be permitted. (NEC 230.24 A Exception 3)

4.3 **Service Entrance Conductors**. The size of service entrance conductors is determined by the service equipment disconnecting means name plate rating. If the name plate is missing or not legible, contact Medina prior to installation. See Table 1, of single-phase services and Table 1, of three- phase services. (NEC TABLE 310.15(B)(6), 310.16)

4.3.1 *Parallel conductors*. Service entrance conductors of size 1/0 and larger, comprising each phase, polarity, neutral, or grounded circuit conductor shall be permitted to be paralleled on single-phase and three-phase services (NEC 310.4). Conductors in parallel are subject to ampacity reduction factors required in NEC 310.15 B2a. The service disconnecting means must have provisions for terminating paralleled conductors. No double lugging of conductors shall be permitted on the meter base or service equipment.

4.3.2 *Neutral Reduction.* The grounded service conductor (neutral) shall not be reduced on single-phase services (MEC). The neutral may be reduced on three-phase services where the load served consists only of three-phase motors. (See NEC 220.61, NEC 250.24 C 1 & 2))

4.4 **Phasing.** Phase markings are to be the correct in color in accordance with the NEC. For all service connections, the grounded service conductor (neutral) must be properly marked with phasing tape. (NEC 200.6 B3) On a 4-wire delta service the high-leg must be permanently marked with orange phasing tape or some other means. (NEC 110.15)

4.5 **Metering**. A meter socket will be provided by the Cooperative and installed by Member for all Services 200 amp and below and motors below 100 Hp. For other services the Cooperative will provide and install metering current transformers and a meter socket that are separate from the Member's service entrance equipment.

4.6 **Service Disconnecting Means**. The service disconnecting means shall be installed at a readily accessible unobstructed location outside a building or structure with the meter base, unless otherwise approved by Medina's personnel prior to installation. Location shall be accessible to Medina's personnel at all times. There shall be no more than six disconnects or breakers per service grouped in any one location in lieu of a single main disconnect. (NEC 230.71) If multi- breaker is located more than six (6) feet from the meter, the consumer shall have a main disconnect. Each service disconnect shall be permanently marked to identify it as a service disconnect. (NEC 230.70B) Only breakers designed, manufactured, and approved for use as main disconnects will be permitted to be used as a main disconnect.

4.6.1 **Minimum Disconnect Rating.** The service disconnect shall have a rating no less than that of the calculated load or for the type of installation. (NEC 225.39)

(A) One-Circuit Installation. The disconnection means shall be no less than 15 amps. (NEC 225.39A)

(B) Two-Circuit Installation. For installations consisting of not more than two 2 wire branch circuits, the feeder or branch circuit disconnect means shall have a rating of not less than 30 amps. (NEC 225.39B)

(C) Single Family Dwelling. The 3-wire service disconnect for a one family dwelling shall be no less than100 amps. (NEC 225.39C)

(D) All Other Installs. For any other type of installs, the means of disconnect shall not be less than 60 amps. (NEC 225.39D)

4.7 **Overcurrent.** A fuse or an overcurrent trip unit of a circuit breaker shall be connected in series with each ungrounded conductor. (NEC 240.15A) Each ungrounded conductor shall have overcurrent protection. An overcurrent device shall not exceed the allowable ampacity of the conductor. (NEC 230.90) Use NEC Table 310.15 B6 for single phase service or NEC table 310.16 for 3-phase service.

4.8 **Circuit Breaker as Overcurrent Device.** Circuit breakers shall open all ungrounded conductors of the circuit, single wire or multiwire, both manually and automatically.(NEC 240.15 B)

4.8.1 *Multiwire Branch Circuit.* Except where limited by 210.4(B), individual single-pole circuit breakers, with or without identified handle ties, shall be permitted as the protection for each ungrounded conductor of multiwire branch circuits that serve only single-phase line-to-neutral loads.

4.8.2 *3-Phase and 2-Phase Systems.* For line-to-line loads in 4-wire, 3-phase systems or 5-wire, 2-phase systems having a grounded neutral point and no conductor operating at a voltage greater than rated, individual single-pole circuit breakers with identified handle ties shall be permitted as the protection for each ungrounded conductor.

4.9 **Grounding**. A grounding electrode or grounding electrode system shall be furnished and installed by Member at each service. See Figure 1 and 2 attached for illustrations details.

4.9.1 *Grounding Electrode*. A grounding electrode shall be installed at each service. The grounding electrode shall consist of a 5/8" diameter by 8' long copper clad ground rod. Rods shall be driven to a depth of 12" below ground level in undisturbed soil. Where rock bottom is encountered ground rods may be driven at an angle of 45 degrees from the vertical or shall be buried in a trench that is not less than 2 ½ feet deep. (NEC 250.53 G)

4.9.2 *Grounding Electrode System*. If available on the premises at each building or structure served, each item (a) through (d) below as well as the grounding electrode required in 4.8.1 shall be bonded together to form the grounding electrode system. Member must consult NEC 250.53 for installation details.

a. Metal Underground Water Pipe
b. Metal Frame of Building
c. Concrete Encased Electrode
d. Ground Ring

4.9.3 *Grounding Electrode Conductor*. The grounding electrode conductor shall be copper and sized according to NEC Table 250.66 with #6 being the minimum size allowed by the Cooperative. The grounding electrode conductor shall be continuous. (NEC 250.64 C)

4.9.4 *Service Disconnect Grounding*. The grounding electrode conductor shall be connected to the grounded service conductor (neutral) at the terminal or bus to which the grounded service conductor is connected at the service disconnecting means (neutral bus). A main bonding jumper shall bond the service equipment enclosure (ground bus) to the neutral bus (NEC 250.24 A-D). The main bonding jumper shall be connected by screw only identified with a green finish. A copper conductor sized according to NEC Table 250.66 or a bus jumper can be used as a suitable main bonding jumper. (NEC 250.28)

4.9.5 *Equipment Grounding Conductor*. All equipment shall be grounded to the service ground by means of an equipment-grounding conductor. The equipment-grounding conductor shall be sized according to NEC Table 250.66

4.9.6 *Grounding Mobile Homes*. Grounding of both electrical and non-electrical metal parts in a mobile home shall be through connection to a grounding bus in the mobile home distribution panel board. The grounding bus shall be grounded through the green-colored insulated conductor in the supply cord or the feeder wiring to the service ground in the service-entrance equipment located adjacent to the mobile home location. Neither the frame of the mobile nor the frame of any appliance shall be connected to the grounded circuit conductor (neutral) in the mobile home. Provisions of NEC 550.33(A) requires that the feeder assembly for a mobile home consist of a listed cord or four color-coded insulated conductors, one of which is the grounded conductor (white) and one of which is used for grounding purposes (green). Thus, the grounded and grounding conductors are kept independent of each other and are connected only at the service equipment (at the point of connection of the grounding electrode conductor). Grounding of both electrical and nonelectrical metal parts, including the frame of the mobile home or the frame of any appliance, is accomplished by connection to the equipment grounding bus [never to the grounded conductor (neutral bus)]. The purpose of this requirement is to prevent incidental contact between the grounded conductor and non-current-carrying metal parts of electrical equipment. Without the separation of the grounded and grounding conductors, this contact could result in the metal structure or metal sheathing of the mobile home becoming a parallel path for the neutral current. Bonding screws, straps, or buses, which bond the grounded (neutral) circuit conductor to the non-current-carrying metal parts in the mobile home panelboard or to the metal frame of an appliance (ranges, clothes dryers), must not be installed or, in the case of ranges and clothes dryer, must be removed. In general, new ranges and clothes dryer have a factory-installed bonding jumper. Removal of the factory-installed bonding jumper does not compromise or void the listing of the product, because isolation of the metal appliance frame from the grounding circuit conductor is required by the Code. There is limited application in existing branch circuits of conventional or "site-built" construction where the factory-installed bonding jumper can remain intact. *Excerpts* from NEC 2008 Handbook pages 882-883. Connecting the equipment-grounding conductor to the grounding bus shall be the responsibility of the consumer's electrician. (NEC 550.16)

4.10 **Motors**. Single-phase motors in excess of ¾ Hp shall be 240 volt. Motors having a rated capacity in excess of 10 Hp must be three-phase. Motors 100 Hp and over shall be required to have a split winding or reduced-voltage type starter, including the replacement of existing motors.

4.11 **Motor Overcurrent Protection**. An overcurrent trip device shall be rated for no more than 125% of the full load rating for motors marked with a temperature rise of less than 40 C or a service factor of 1.15 or greater. All other motors shall have an overcurrent device that is rated for no more than 115% of the full load. (NEC 430.32)

4.12 **Interconnected Electric Power Production Sources**. This includes any installation of one or more electric power production source operating in parallel with a primary source of electricity. (NEC 705.1)

4.12.1 *Equipment Approval*. All utility interactive systems shall be approved and listed for interconnection service. (NEC 705.4) The output of interactive systems shall be connected phase to phase.(MEC)

4.12.2 *Interactive System Disconnecting Means.* Means shall be provided to disconnect power production equipment, such as utility interactive inverters or transformers associated with a power production source, from all ungrounded conductors of all sources of supply.(NEC 705.21) The disconnecting means for ungrounded conductors shall consist of a manually or power operable switch or circuit breaker with the following features: (NEC 705.22)

1. Located where readily accessible (NEC 705.22.1)
2. Externally operable without exposing the operator to contact with live parts and, if power operable, of a type that could be opened by hand in the event of a power supply failure (NEC 705.22.2)
3. Plainly indicating whether in the open (off) or closed (on) position (NEC 705.22.3)
4. Having ratings not less than the load to be carried and the fault current to be interrupted. For disconnect equipment energized from both sides, a marking shall be provided to indicate that all contacts of the disconnect equipment might be energized (NEC 705.22.4)
5. Simultaneous disconnect of all ungrounded conductors of the circuit (NEC 705.22.5)
6. Capable of being locked in the open (off) position (NEC 705.22.6)

4.12.3 *Overcurrent Protection.* Conductors and overcurrent devices shall be sized to carry no less than 125 percent of the maximum calculated current. (NEC 705.60.B.1)

4.12.4 *Grounding.* Interconnected electric power production sources shall be properly grounded. (NEC 705.50)

4.12.5 *Ground-Fault Protection.* Here ground-fault protection is used. The output of an interactive system shall be connected to the supply side of the ground-fault protection. (NEC 705.32)

4.12.6 *Loss of Primary Source.* Upon loss of primary source, one or more phases for 3-phase service, an electric power production source shall be automatically disconnected from all ungrounded conductors of the primary source and shall not be reconnected until the primary source is restored. A listed utility-interactive inverter shall be permitted to automatically cease exporting power upon loss of primary source and is not required to automatically disconnect all ungrounded conductors from the primary source. A utility-interactive inverter shall be permitted to operate as a stand-alone system to supply loads that have been

disconnected from electrical production and distribution network sources. (NEC 705.40 & NEC 705.42)

4.12.7 *Unbalanced Single Phase Interconnections.* Single-phase inverters shall not be connected to 3-phase power systems unless the interconnected system is designed so that significant unbalanced voltages cannot result. (NEC 705.100 A)

4.12.8 *Unbalanced Three Phase Interconnections.* Three-phase inverters and 3-phase ac modules in interactive systems shall have all phases automatically de-energized upon loss of, or unbalanced, voltage in one or more phases unless the interconnected system is designed such that unbalanced voltages will not result. (NEC 705.100 B)

# MEC Three Phase Non-Power and Light

| **THREE PHASE** **Y&Δ** | THHN CONDUCTOR (Already adjusted per NEC 310.15 B2a) | | Parallel Copper Conductors and Conduit (NEC 310.4) 2 - Separate Conduits | | Single Conduit EMT or Ridgid (NEC Annex C Table C.8(A)) | |
|---|---|---|---|---|---|---|
| SIZE OF LOOP (AMPS) | Non-Power and Light THHN Copper | Non-Power and Light THHN Aluminum | Non-Power and Light Parallel Copper | Non-Power and Light Parallel Conduit EMT or Ridgid | Single Conduit Size for Copper | Single Conduit Size for Aluminum |
| 60 | #6 | #4 | - | - | 1.25" | 1.25" |
| 70 | #4 | #3 | - | - | 1.25" | 1.25" |
| 100 | #2 | #1 | - | - | 1.25" | 1.25" |
| 125 | #1 | #2/0 | - | - | 2" | 2" |
| 150 | #1/0 | #3/0 | - | - | 2" | 2" |
| 175 | #2/0 | #4/0 | - | - | 2" | 2" |
| 200 | #3/0 | 250 MCM | 2-1/0 | (2)2" | 2" | 2" |
| 225 | #4/0 | 300 MCM | 2-1/0 | (2)2" | 2" | 2" |
| 250 | 250 MCM | 400 MCM | 2-1/0 | (2)2" | 2.5" | 2.5" |
| 300 | 350 MCM | 500 MCM | 2-1/0 | (2)2" | 2.5" | 2.5" |
| 350 | 500 MCM | 700 MCM | 2-2/0 | (2)2" | 3" | 3" |
| 400 | 600 MCM | 800 MCM | 2-3/0 | (2)2" | 3" | 3" |
| 600 | 2-500 MCM | - | 2-350 MCM | (2)2.5" | 4" | - |
| 800 | - | - | 2-600 MCM | (2)3" | - | - |
| 1000 | - | - | 2-900 MCM | (2)3" | - | - |

# Three Phase Power and Light

| **THREE PHASE** Δ | THHN CONDUCTOR (Already adjusted per NEC 310.15 B2a) | | Parallel Copper Conductors and Conduit (NEC 310.4) | | Single Conduit EMT or Ridgid (NEC Annex C Table C.8(A)) | |
|---|---|---|---|---|---|---|
| SIZE OF LOOP (AMPS) | Power and Light THHN Copper | Power and Light THHN Aluminum | Power and Light Parallel Copper | Power and Light Parallel Conduit EMT or Ridgid | Single Conduit Size for Copper | Single Conduit Size for Aluminum |
| 60 | #4 | #3 | - | - | 1.25" | 1.25" |
| 70 | #3 | #2 | - | - | 1.25" | 1.25" |
| 100 | #1 | #2/0 | - | - | 1.25" | 2" |
| 125 | #2/0 | #3/0 | - | - | 2" | 2" |
| 150 | #3/0 | 250 MCM | 2-1/0 | (2)2" | 2" | 2.5" |
| 175 | #4/0 | 300 MCM | 2-1/0 | (2)2" | 2" | 2.5" |
| 200 | 250 MCM | 350 MCM | 2-1/0 | (2)2" | 2.5" | 2.5" |
| 225 | 300 MCM | 500 MCM | 2-1/0 | (2)2" | 2.5" | 3" |
| 250 | 400 MCM | 600 MCM | 2-2/0 | (2)2" | 2.5" | 3" |
| 300 | 500 MCM | 750 MCM | 2-3/0 | (2)2" | 3" | 3.5" |
| 350 | 700 MCM | 1000 MCM | 2-4/0 | (2)2" | 3.5" | 4" |
| 400 | 900 MCM | - | 2-250 MCM | (2)2.5" | 4" | - |
| 600 | - | - | 2-500 MCM | (2)3" | - | - |
| 800 | - | - | 2-900 MCM | (2)4" | - | - |

## GROUNDING ELECTRODE CONDUCTOR FOR AC SYSTEMS

### FROM NEC TABLE 250.66

| SIZE OF LARGEST SERVICE ENTRANCE CONDUCTOR OR EQUIVALENT AREA FOR PARALLEL CONDUCTORS | | SIZE OF GROUNDING ELECTRODE CONDUCTOR | |
|---|---|---|---|
| COPPER | ALUMINUM OR COPPER-CLAD ALUMINUM | COPPER | ALUMINUM OR COPER-CLAD ALUMINUM |
| 1/0 OR SMALLER | 2/0 OR 3/0 | #6 | #4 |
| 2/0 OR 3/0 | 4/0 OR 250MCM | #4 | #2 |
| OVER 3/0 THRU 350MCM | OVER 250MCM THRU 500MCM | #2 | 1/0 |
| OVER 350MCM THRU 600MCM | OVER 500MCM THRU 900MCM | 1/0 | 3/0 |
| OVER 600 THRU 1100 MCM | OVER 900MCM THRU1750MCM | 2/0 | 4/0 |
| OVER 1100MCM | OVER 1750MCM | 3/0 | 250MCM |

# Definitions List

Ampacity - The current, in Amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Bonding (Bonded) – The permanent joining of metallic parts to form an electrically conductive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed.

Current Carrying Conductor – Any conductor, grounded or not, that carries current. The service grounding conductor (neutral) is considered to be a current carrying conductor.

Disconnecting Means – A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply. Circuit breakers shall be considered a means of disconnect.

Equipment-Grounding Conductor – The conductor used to connect the non-current-carrying metal parts of equipment , raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment or at the source of a separately derived system.

Ground – A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

Grounded - Connected to earth or to some conducting body that serves in place of the earth.

Grounding Electrode – A device that establishes an electrical connection to earth.

Grounding Electrode Conductor – The conductor used to connect the grounding electrode to the equipment-grounding conductor, to the grounded conductor, or to both, at the service, at each building or structure where supplied by a feeder or branch circuit, or at the source of a separately derived system.

Interactive System – An electric power production system that is operating in parallel with and capable of delivering energy to an electric primary source supply system.

Main Bonding Jumper – The connection between the grounded circuit conductor and the equipment-grounding conductor at the service.

Overcurrent protection Device – Any device that limits or interrupts current in a fault or overload condition. Fuses or circuit breakers shall be considered overcurrent protection.

Phasing – A form of marking conductors to the specified use, voltage, or phase.

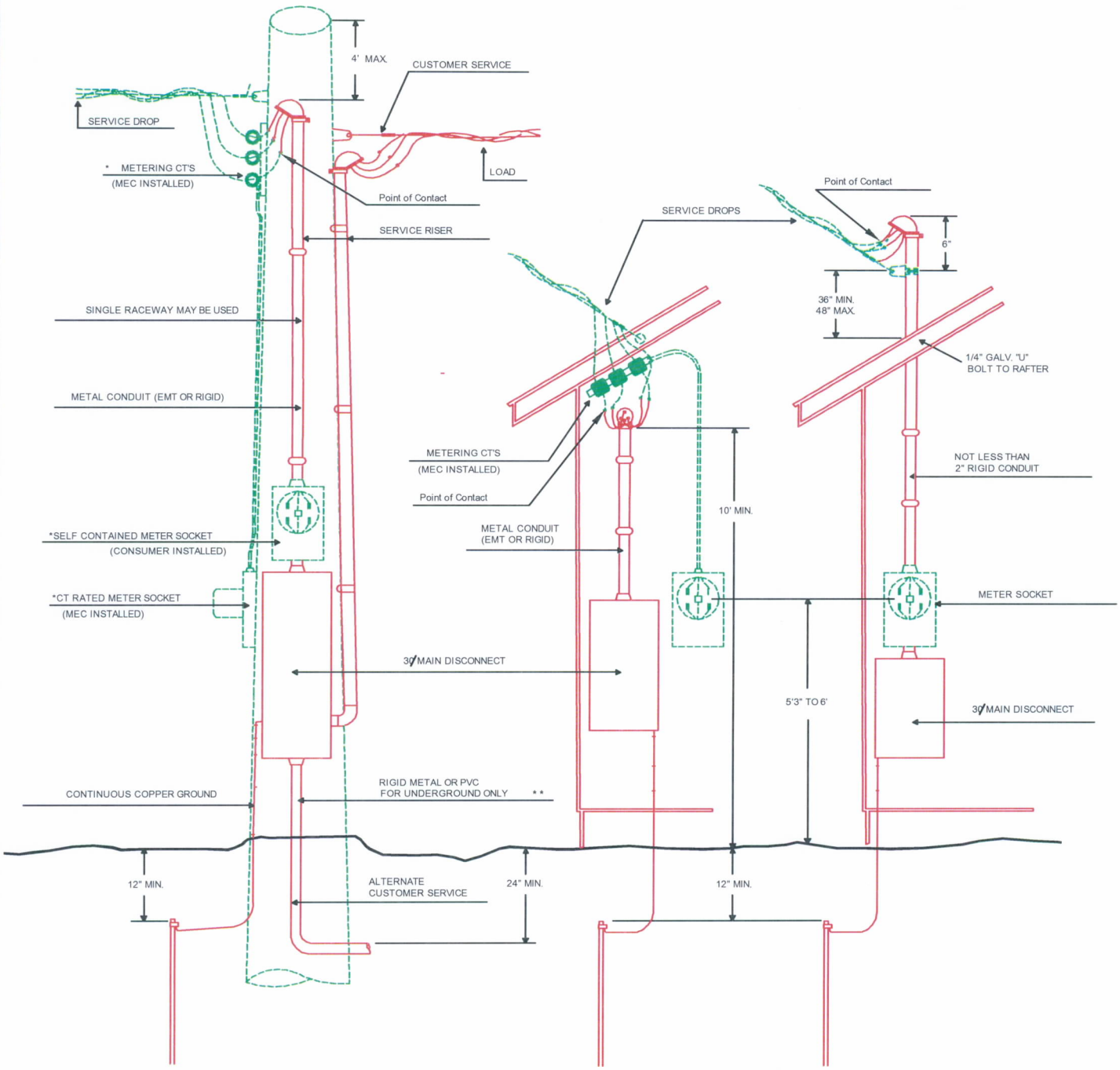
Readily Accessible – The ability for Medina personnel to have unobstructed access to.

Service-Entrance Conductors, Overhead System – The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

Ungrounded Conductor – Any conductor that is not properly bonded to a ground lug, system ground, or equipment ground.

# TYPICAL THREE-PHASE SERVICE ENTRANCE
# MEDINA ELECTRIC COOPERATIVE, INC.

## FIGURE 2




METER POLE INSTALLATION

MEC FURNISHED MATERIAL

BUILDING INSTALLATION

CONSUMER FURNISHED MATERIAL

NOTE: ALL DASHED MATERIAL IS MEC FURNISHED

*METERING CT'S ARE REQUIRED ON 100HP MOTORS OR LARGER AND ON METER LOOPS RATED ABOVE 200 AMPS, ALL CONNECTIONS SMALLER REQUIRE A SELF CONTAINED METER SOCKET

** IN AREAS SUBJECT TO PHYSICAL DAMAGE USE SCHEDULE 80 PVC PER NEC-352.10(F) and 352.12(C)

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