

PART IV
PROTECTION AND GROUNDING

PRACTICE NUMBER	TITLE
475-500-400	Addendum —Station Protectors Fuseless, Fused and Gas Tube
475-500-400	Station Protectors Fuseless, Fused and Gas Tube
475-500-402	Addendum —Station Protection Selection and Application
475-500-402	Station Protection Selection and Application
475-500-405	Addendum —Station Protectors Installation and Inspection
475-500-405	Station Protectors Installation and Inspection
475-500-410	Addendum —Station Protection and Signaling Grounds Selection and Installation
475-500-410	Station Protection and Signaling Grounds Selection and Installation
475-500-425	Addendum —Station Protection and Wiring Mobile Homes
475-500-425	Station Protection and Wiring Mobile Homes

STATION PROTECTORS FUSELESS, FUSED AND GAS TUBE

1. GENERAL

1.01 This addendum is issued to inform field forces that the Reliable 350/351 type fuseless gas tube protector and 1304 GF gas tube arrester will no longer be used.

1.02 It is the decision of the Standards Committee to discontinue use of all two-element gas tube protectors. Three-element gas tube protectors will be used. The T.I.I. 300 type protector is currently the only three-element gas tube protector approved for use in the Continental Telephone System.

1.03 Make the changes as shown in paragraph 2 of this addendum.

1.04 File this addendum directly in front of CTSP 475-500-400, Issue 2, 1973.

2. CHANGES

2.01 With red pencil or pen, cross out all references to the Reliable 350/351 gas tube protector as they appear in CTSP 475-500-400, Issue 2, 1973.

- a. Paragraph 2.01, o.
- b. Table A, reference to arrester for 350/351 (last reference in Table A).
- c. All of paragraph 6.03, a. and b.
- d. Figure 12.

INSTALLATION FUSED AND FUSELESS STATION PROTECTORS

1. GENERAL

- 1.01 This practice contains instructions for selecting a location and installing fused and fuseless station protectors.
- 1.02 Fused protectors (Figure 1) consist of a molded body; binding posts for drop, station and ground wires; two fuse holders; two nominal 0.004 inch discharge blocks (color code white); and two plain carbon blocks. They are approved by the Underwriters Laboratories.
- 1.03 The fuses are 7 ampere power rated (blow at 10.5 ampere), non-repairable, and are UL approved (Figure 2).
- 1.04 Fuseless protectors (see Figure 3) are Underwriters Laboratories approved and consist of a molded plastic base, two binding posts for terminating line and station wires, a binding post for the ground wire, and two protector units. Covers are neoprene or plastic.
- 1.05 The protector units to be used with fuseless station protectors are identified by a white mark on the metal cap. No protector unit marked with a color other than white is to be used for station protection.

NOTE: Protected terminals are equipped with the above protector units when used for station protection.

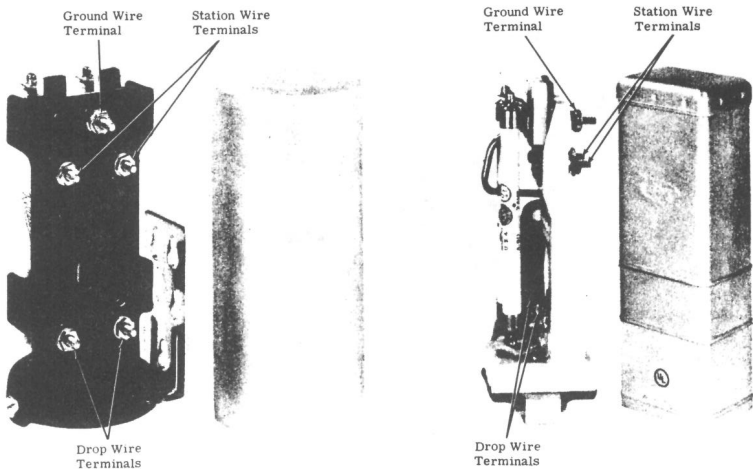


Figure 1 Fused Protectors

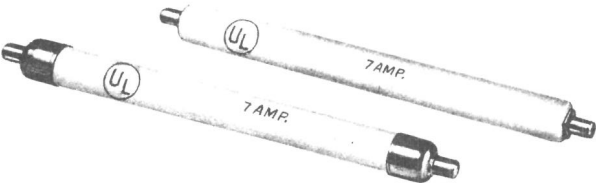


Figure 2 Fuses for Fused Protectors

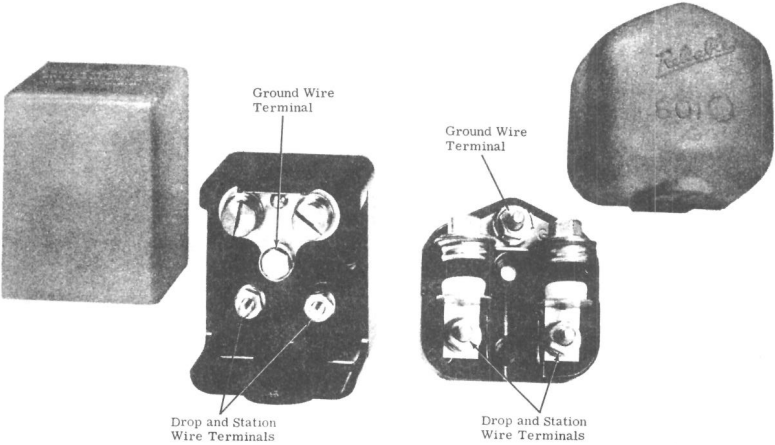


Figure 3 Fuseless Protectors

2. SELECTION OF PROTECTOR LOCATION

- 2.01 The selection of a location (indoor or outdoor) for fused or fuseless protectors depends on the location of entrance points for drop wires, location of an approved ground, telephone location, and the mounting surface available. Ground wire runs should not exceed 50 feet of No. 14 AWG or 75 feet of No. 6 AWG wire; indoor drop wire runs should not exceed 5 feet from point of entrance to the protector.
- 2.02 In addition to wire length restrictions, the protector location should be in accordance with the following:
- a. Locate where the protector will be accessible for inspection and maintenance and where it will not expose an inspector to contact with power wires, moving machinery, etc.
 - b. Avoid flammable materials and areas where the atmosphere may be combustible.
 - c. Locate six inches or more away from window curtains.
 - d. Avoid excessively damp locations.
 - e. Avoid locations where the protector would be subject to tampering and where material might be piled against it.
 - f. Locate at least one foot from electric light or power lines, meters, accessories; water and gas meters except as described in g.
 - g. Telephone protectors, apparatus, and wiring may be located in a common cabinet with power apparatus and wiring if the telephone and power compartments are separated by a rigid mechanical divider.
 - h. Avoid locations where the appearance of the protector would be objectionable to the customer.
- 2.03 Outside protector location is restricted to building attachment. Station protectors should never be pole mounted. For exceptions see paragraph 2.04.
- 2.04 Telephones installed in boats, for plug-in dockside service, or on docks may have their protectors located at the nearest land or any nearer location where a proper ground is available. If power service is being furnished, install the protector and telephone ground at the power service ground location—where requirements for station grounding can be met.
- 2.05 The number of protectors that can be connected to various size copper insulated ground wires is as follows:

Wire	Number of Protectors
No. 14 AWG	1
No. 6 AWG	any number

3. INSTALLATION

- 3.01 At the time of installation or replacement, all protectors and associated wiring should be inspected and any component or wire that appears to be defective should be replaced.

3.02 Protectors mounted side by side shall be placed on not less than five-inch centers. Maintain enough vertical separation or stagger the protectors horizontally so that covers can be removed. If the protector location is a stucco or masonry surface and two or more protectors are required, mount the protectors on a locally fabricated backboard. Where protection for multiple services is required, it is recommended that a protected building terminal (see Figure 4) be installed in place of station protectors.

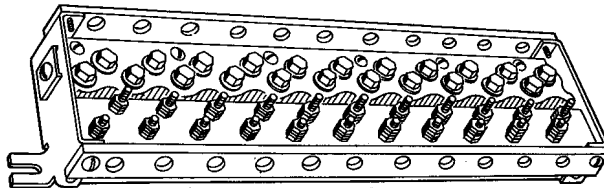


Figure 4 Protected Building Terminal

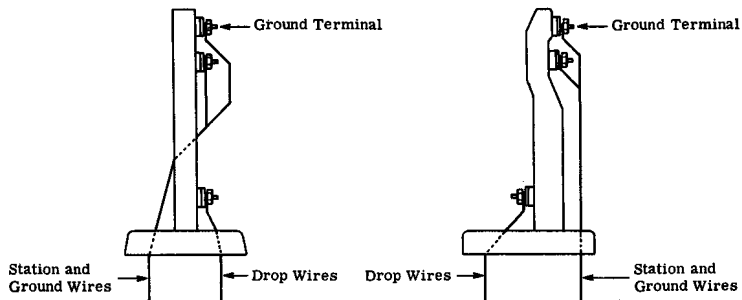


Figure 5 Wiring for Fused Protectors

NOTE: Do not cross station wires and drop wires. Where station and drop wires do not approach protector from the directions shown in these illustrations, rotate the protector 180° on its base.

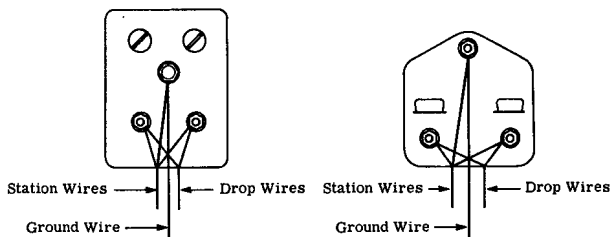


Figure 6 Wiring for Fuseless Protectors

3.03 For mounting, attach the protector to the mounting surface with the proper fastening device. A fused protector must be mounted so that drop and station wires do not cross at the point of entry to the protector (see Figures 5 and 6). Note the direction from which drop and station wires approach the protector location, and mount the protector accordingly. When the protector is mounted on a vertical surface it must be in a vertical position (base at the bottom).

3.04 Wire termination instructions are as follows (see Figures 5 and 6):

- a. Make the last drop wire attachment within four inches of the protector.
- b. Thread the ground, drop, and station wires through the entrance in the base of the protector.

NOTE: For the fuseless protector with a neoprene cover, the wire entrance is in the bottom of the cover. Approximately six inches of slack must be allowed in the wires and the wires threaded through the cover before termination.

- c. Terminate the drop wires on the "L" binding posts.
- d. Terminate the station wires on the "I" binding posts.

NOTE: Steps (3) and (4) apply to fused protectors. On fuseless protectors the drop and station wires are terminated on common binding posts.

- e. Terminate the ground wire on the "G" binding post.
- f. Extend the ground wire to an appropriate ground.
- g. If a fused protector has been installed, check the fuses by attaching the leads of a hand test telephone to the station terminals of the protector. When the operator answers (manual exchange line) or dial tone is heard, tap each fuse with a screwdriver blade. If the fuse contains a loose fuse wire, you will hear line cutout in the receiver and the fuse must be replaced.

STATION PROTECTION SELECTION AND APPLICATION

1. GENERAL

1.01 This addendum is being reissued to correct and add information to CTSP 475-500-402, Issue 2, 1973, Station Protection Selection and Application.

1.02 With red pencil or ink, make the corrections and additions on CTSP 475-500-402 as indicated in paragraphs 2.01, 2.02 and 2.03 of this addendum.

1.03 File this addendum directly in front of CTSP 475-500-402, Issue 2, 1973, and remove and destroy all copies of addendum 475-500-402, Issue 1, 1974 from your files.

2. CORRECTIONS AND ADDITIONS

2.01 Correct paragraph 2.01, a., to read:

a. Red Bridle Wire, CTS #90-07-003-8.

2.02 Change paragraph 2.01, c., to read:

c. 201 Grounding Lug, CTS #68-11-018-9.

2.03 Add paragraph 3.04:

3.04 Do not use grounding mediums (such as ground rods) with fuseless protectors, other than those described in paragraph 3.01, b.

STATION PROTECTION SELECTION AND APPLICATION

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1. GENERAL

1.01 This practice is reissued to update information on when fuseless (carbon or gas) and fused protectors can be used to satisfy the requirements of the National Electrical Code. All copies of CTSP 475-500-402, Issue 1, should be removed from the file and destroyed.

1.02 Fuseless station protectors are preferred over fused station protectors and should be used, provided the requirements listed in paragraph 3 are met. These requirements are for protecting customer stations, including coin telephones at indoor or outdoor locations, and general requirements for protecting PBX circuits.

NOTE: Gas tube protectors or protector units should be installed only at locations specified on detailed plans or other written instructions. They should not be used to replace conventional carbon block protectors in all cases.

1.03 Station protectors ensure safety to customers and telephone company personnel and prevent damage to station equipment from abnormally high voltage and current.

1.04 Isolated sections of aerial cable are considered open wire, unless the cable is effectively grounded to a multigrounded power neutral (MGN) or to an extensive water (metallic pipe) system.

1.05 Cable, wire, strand, etc., that are subject to disturbances by lightning or possible contact or induction from electric circuits in excess of 300 volts are called **exposed** cable, wire, or circuits.

1.06 Cable, wire, strand, etc., that are not subject to disturbances by lightning or electric circuits in excess of 300 volts are called **unexposed** cable, wire, or circuits.

1.07 In nonlightning prone areas, the exposure status of cable or wire is based only on power exposure. The protection specified in the station protection practices is primarily for protection against the effects of power contacts. In lightning areas, protection is required regardless of power exposure except when the plant is effectively shielded by buildings or other structures.

1.08 Ground rods encountered on reinstalls and reconnects shall not be used if a better grounding electrode is available.

1.09 Noninsulated building attachments should be used with fuseless protectors or with fused protectors that have been converted to fuseless operation. Insulated building attachments must be used on flammable surfaces when fused protectors are connected to open or exposed line wire.

2. MATERIAL

2.01 This paragraph lists the material covered in this practice. For convenience, CTS catalog numbers are listed if available.

- a. 20 Gauge Bridle Wire, CTS #90-07-001-0.
- b. UR Cable Conductor Connectors, CTS #66-14-032-3.
- c. 201 Grounding Lug.
- d. Sneak Current Fuse 60D, CTS #70-75-033-5.

3. FUSELESS STATION PROTECTION AND REQUIREMENTS (AERIAL CABLE)

3.01 Fuseless protectors should be used at all stations provided **one** of the three fusible link requirements listed in paragraph a. is met, and **one** of the grounding requirements in paragraph b. is met.

a. Fusible Link Requirement:

- (1) The station is served by 24 gauge (or smaller) cable.

(2) The station is served by cable that has a fusible link, such as a 24 gauge terminal stub, a minimum of 8 inches in length.

(3) Single pair drop wire is served by open or multiple wire and has a fusible link of 24 or 26 gauge copper black wire, or 20 gauge copper steel red bridle wire with 30% conductivity.

NOTE: The bridling between drop wire and open wire (rural wire) must consist of at least 30 inches of 20 gauge copper steel red bridle wire with 30% conductivity.

b. Proper ground medium requirements in order of preference. If a preferred ground is available, it should be used. See CTSP 475-500-410.

(1) A metallic cold water pipe bonded to an MGN system.

(2) A metallic cold water pipe bonded to the power ground.

(3) A metallic cold water pipe (at least 10 feet of this pipe must be buried in moist soil).

(4) Metallic service entrance conduit (except aluminum) bonded to the service entrance box of an MGN system.

(5) Service ground of an MGN power system.

(6) Another effective ground is a recent development known as a **concrete encased electrode**. It consists of not less than 50 feet of 3/8 inch reinforcing steel bar or 20 feet of No. 4 bare copper wire, embedded below grade in a concrete foundation or footing. The bar or conductor is stubbed up into an accessible location for grounding connections. In the absence of an acceptable water pipe or an MGN system, it should be considered as a first choice ground.

NOTE: If one of these grounds is not available, a fused type protector must be used.

3.02 A fuseless protector must not be used with multiple drop wire when the stations are served by open or multiple wire.

NOTE: A fuseless protector can be used with multiple drop wire when the stations are served by a grounded metal sheath or shielded cable.

3.03 Drop wire from an unexposed cable terminal into an exposed area exposes both the customer station and the distribution cable. Fuseless protectors are required at both ends of the drop. When the drop is to be joined to a cable pair, a fusible link is required.

4. FUSED STATION PROTECTION AND REQUIREMENTS

4.01 When the ground requirements or bridling requirements described in paragraph 3 cannot be met, a fused type protector must be used.

5. STATION PROTECTION AND REQUIREMENTS (BURIED AND UNDERGROUND)

5.01 Fuseless station protectors may be used with buried distribution cable connected to exposed cable when 24 or 26 gauge cable is located so that it will serve as a fusible link.

5.02 Fuseless station protectors may not be used when the buried distribution cable is 19 or 22 gauge and no fuse cable has been placed. Fuseless protectors may be used **only** if 24 or 26 gauge copper cable conductors, a minimum of 8 inches in length, are placed at the junction point to serve as a fusible link between the service wire and the buried cable.

NOTE: Use UR cable conductor connectors to join the fine gauge (24 or 26 gauge) conductors, used as a fusible link, to the service wire and buried distribution cable. Use 24 gauge wire as a fusible link for 19 gauge cable conductors. Use 24 or 26 gauge wire as a fusible link for 22 gauge conductors.

5.03 When the requirement specified in paragraphs 5.01 and 5.02 cannot be met, fused type protectors must be used.

5.04 For any length of buried wire, bond the aluminum shield or armored wire to the ground terminal of the protector and cable terminal by means of a 201 grounding lug. See CTSP 475-500-405, paragraph 6.

5.05 Service drops joined to exposed underground cable pairs require the same type of protectors as drop wire joined to exposed aerial cable pairs.

6. PBX STATION PROTECTION (CENTRAL OFFICE TRUNKS, TIE TRUNKS, OFF PREMISES EXTENSIONS, RINGING FEEDERS, AND BATTERY FEEDER CIRCUITS)

6.01 When PBX systems are served by exposed cables, the following protection is required:

a. The sheath or shield of the cable must be grounded.

b. A fuse cable must be spliced between the entrance cable and the terminating facilities if the conductors are larger than 24 gauge.

c. The terminating facilities shall be equipped with heat coils and carbon blocks or sneak current fuses and a station protector.

6.02 When drop or multiple drop wire is extended from exposed cables, fuseless protectors should be used. When drop wire is to be joined to a cable pair, a fusible link is required as instructed in paragraphs 3 and 5.02.

6.03 Fuseless protectors may be used with open or multiple wire when the requirements specified in paragraphs 3.01, a., (3) and 3.01, (b) are observed. Otherwise, fused protectors must be used.

6.04 Battery feeder circuits extended from exposed cables require the following protection:

- a. As specified in paragraph 6.01.
- b. Where a single battery feeder is extended from a grounded metal shielded cable with a fusible link, as specified in paragraph 3.01, a., a protected terminal or a fuseless type protector meeting the requirements specified in paragraph 3.01, b., is all the protection required.
- c. Where two or more cable pairs are used in a multiple and these pairs are extended by a single drop wire, the arrangement may be considered as a single pair and protection provided as described in paragraph 6.05, b.
- d. When two or more cable pairs are used in multiple and these pairs are extended by two or more drop wires, fused type protectors must be used.
- e. When multiple drop wire is extended from a cable terminal (with a fusible link) on a protected distribution terminal, no other protection is required for a single pair battery feeder circuit.
- f. When two or more battery feeder pairs are extended from protected terminals (with a fusible link), no other protection is required.

6.05 Battery feeder circuits extended from open or multiple wire, require the following protection:

- a. When the wire has a fusible link as specified in paragraph 3.01, a., (3) and the protector can be grounded as specified in paragraph 3.01, b., a fuseless protector may be used with a single battery feeder pair. Otherwise, a fused protector must be used.
- b. A fused protector must be used with two or more pairs.

6.06 Exposed PBX lines (central office trunks, tie trunks, off premises extensions, and ringing feeder circuits) extended from metal sheath cables must be protected with sneak current fuses. Sneak current fuses are not required when pairs are extended from a protector frame equipped with heat coils and carbon blocks.

6.07 Exposed PBX lines (central office trunks, tie trunks, off premises extensions, and ringing feeder circuits) extended from open or multiple wire must be protected with sneak current fuses. Protection can be provided as follows:

- a. Fuseless protectors equipped with sneak current fuses may be used with a single drop when the grounding requirements specified in paragraph 3.01, b., can be met. Otherwise, a fused protector equipped with sneak current fuses must be used.
- b. When two or more drops are terminated at the same location, fused protectors equipped with sneak current fuses must be provided for each drop.

7. STATIONS REQUIRING SPECIAL PROTECTIVE MEASURES

7.01 Special protective measures are usually required for stations located in the following areas:

- a. At power substations or generating stations.
- b. In atmospheres containing explosive gas, vapor, or dust.
- c. Where privately owned circuits are in conflict or joint use with power circuits not suitable for general joint use.
- d. Where facilities are leased for the operation of FOREIGN signaling circuits which might impress excessive voltage or current on the system's facilities.

7.02 Outdoor stations served by exposed conductors usually require only fuseless or fused protectors.

7.03 There are some stations where protectors and special grounding arrangements are necessary, such as:

- a. **Coin Telephones:** If the drop or line wire is exposed between the cable terminal and telephone, protectors are required as specified in paragraph 3.03.
- b. **Stations on Wooden Poles:** If possible, install the stations on a pole that has a vertical ground wire connected to a multigrounded neutral. When a multigrounded neutral is not available and the station is served from a metal shielded cable, the protector is grounded to a ground rod. If the station is served from open or multiple wire, ground the protector to a ground rod in accordance with local procedures.

CAUTION: Do not install a station on a pole that has a power vertical ground wire for lightning protection unless the ground wire is connected to a multigrounded neutral.

c. Stations on Metal Poles:

CAUTION: Do not install stations on metal poles that support power circuits (open wire or in conduit) of 300 volts or more unless the pole is grounded to a multigrounded neutral or a metallic cold water pipe.

- (1) Fuseless protectors are required on metal poles supporting power circuits of 300 volts or more.
- (2) When the conductors are exposed and the power circuits on the metal pole are 300 volts or less and the pole is bonded to a

multigrounded neutral or low impedance ground, such as a metallic cold water pipe, a fuseless protector is required.

- (3) When the conductors are exposed and the power circuits on an ungrounded metal pole are 300 volts or less, a fused protector is required.
- (4) When the conductors are unexposed and the power circuits on the metal pole are 300 volts or less, no protection is required.

STATION PROTECTORS
INSTALLATION AND INSPECTION

1. GENERAL

- 1.01 This addendum is to provide additional information when the common clamping method is used and also to specify the type of buried service wire referred to.
- 1.02 With red pencil or ink, make the changes as shown in paragraph 2 of this addendum. In the margin of subject paragraph and below the subject figures, write the words "See Addendum".
- 1.03 File this practice directly in front of CTSP 475-500-405.

2. CHANGES

- 2.01 Change paragraph 4.02 to read:

4.02 Where possible, use a common clamp for wiring at the protector. The common clamp method is used to retain station and ground wires or buried drop and ground wires. Drop and station wires may use the common clamp method, provided requirements in CTSP 475-300-407, Table C are met.

- 2.02 Change paragraph 6.02 to read:

6.02 The 201 grounding lug will be used to bond aluminum shielded buried service wire only. Armored buried service wire will be bonded with a grounding harness. See CTSP 490-800-300.

- 2.03 Change paragraph 6.03 to read:

6.03 To install the 201 grounding lug, proceed as follows: Install the protector on the wall. Mark the location of the 201 grounding lug on the service wire. Cut around the outer jacket with a knife.

- 2.04 Change Figures 22, 24, 25 and 26 as shown in Figures 1 and 2 of this addendum.

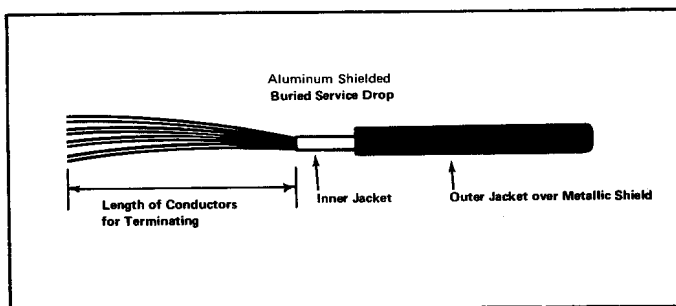


FIGURE 22.

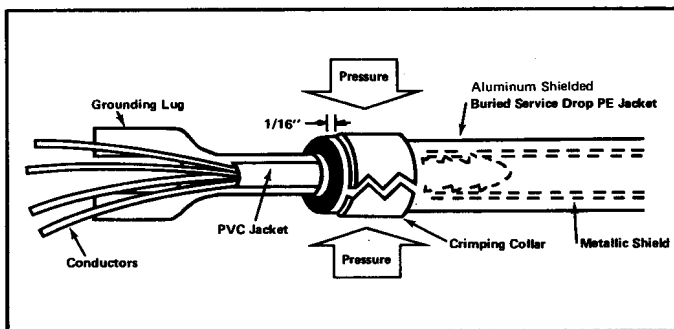


FIGURE 24.

FIGURE 1.

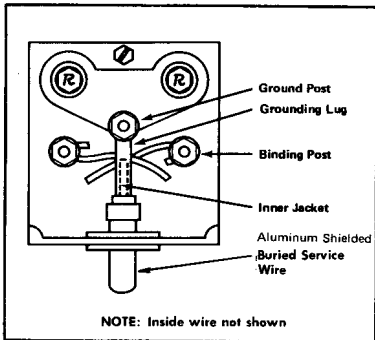


FIGURE 25.

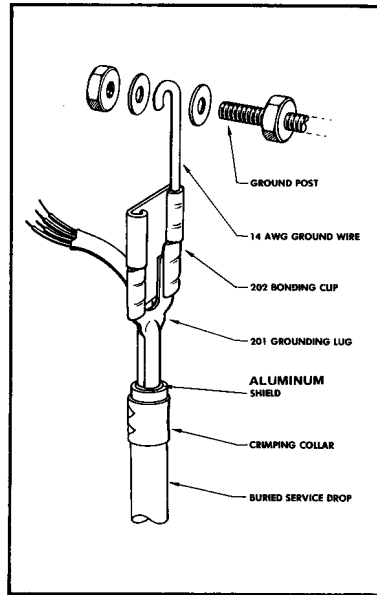


FIGURE 26.

FIGURE 2.

STATION PROTECTORS INSTALLATION AND INSPECTION

CONTENTS	PARAGRAPH	
GENERAL	1	specified by local instructions.
TEST EQUIPMENT AND MATERIAL	2	1.08 No other protection is required at locations where circuits terminate on main frame type protectors equipped with heat coils and carbon blocks.
LOCATION OF PROTECTORS	3	2. TEST EQUIPMENT AND MATERIAL
INSTALLING PROTECTORS—GENERAL	4	2.01 This paragraph lists the test equipment and material covered in this practice. For convenience, CTS catalog numbers are listed if available.
INSTALLING PROTECTORS—FUSELESS	5	a. Test Equipment:
BURIED INSTALLATIONS	6	(1) B. Voltage Tester, CTS #74-94-310-3.
INSTALLING PBX PROTECTORS	7	b. Material:
1. GENERAL		(1) 72A Bracket, CTS #70-75-104-8.
1.01 This practice provides information for installing station protectors used at stations served by grounded metal shielded cable and open or multiple line wire. See CTSP 475-500-402 and 475-500-403 for information on protector selection and application and ground selection.		(2) 123 Type Protector, CTS #70-75-052-0.
1.02 Station protectors minimize danger to people and damage to station equipment from abnormally high voltage or currents.		(3) Ground Wire Warning Tag, CTS #51-77-016-4.
1.03 Insulated building attachments must be used on flammable surfaces when fused type of protectors are used.		(4) 350 Type Fuseless Protector, CTS #70-75-056-4.
1.04 Building attachments may be of the noninsulated type when fuseless protectors or converted fused protectors are used.		(5) 300 Type Gas Tube Protector, CTS #70-75-079-3.
1.05 If possible, use a 72A bracket and station ground clamp attached directly to a water pipe when installing a fuseless 123 type protector indoors. Where accessibility to the protector for maintenance presents a problem, do not install any protector indoors.		(6) 590 Type Fused Protector, CTS #70-75-054-8.
1.06 Fused protectors must be used when it is necessary to run more than one drop or cross-connect wire to furnish battery for a telephone system. A maximum of three drop or cross-connect wires furnishing battery for a system may be terminated on one fused protector and should be bridged on the line side of the protector.		(7) Busbar Adapter, CTS #70-75-001-7.
1.07 Sneak current fuses are not required with protectors associated with residence systems, wiring plans, or key equipment. However, they shall be provided on special services and leased lines when		(8) 2100H Type Fused Protector, CTS #70-75-053-0.
		(9) 502A1 Type Fuseless Multiple Protector, CTS #70-75-062-9.
		(10) 492 Protector Modules, CTS #70-75-041-6.
		(11) 400 Type Fuseless Gas Tube Multiple Protector, CTS #70-75-077-7.
		(12) 405 Gas Tube Two-Pair Mounting Block, CTS #70-75-106-4.
		(13) U Type Fused Multiple Protector, CTS #70-75-090-4.
		(14) 201 Grounding Lug, CTS #68-11-018-9.
		(15) 202 Bonding Clip, CTS #68-11-018-9.
		(16) 1094A Type Sneak Current Protector, CTS #70-75-059-9.
		3. LOCATION OF PROTECTORS
		3.01 Before installing protectors, the following should be taken into consideration:

a. Fuseless Protector: The line conductors remain grounded for the duration of a power contact and the voltage on the wire cannot rise sufficiently to create a hazard. To ensure this safety feature, the length of ground wire from the protector should be as short as possible (50 feet maximum for 14 and 10 AWG; 75 feet maximum for 6 AWG) to provide a low resistance path to ground. A ground wire run from the foundation of a building to an exterior ground should be buried at least 12 inches deep. Increase the depth to 18 inches where earth is likely to be disturbed. Buried ground wire runs should not exceed approximately 3 feet for No. 14 and No. 10 wire and 15 feet for No. 6 wire.

b. Fused Protector: To reduce the extent of exposure that might exist when fuses open as a result of power contact, the line conductors on the line side of the protector should be as short as possible.

c. Accessibility: Avoid placing protectors where a ladder is necessary for installation or maintenance or where they would be inaccessible. See paragraph 1.05.

d. Location of Telephone and Power Ground: The telephone ground shall be located to simplify common grounding.

e. Appearance: Avoid locations on the front of buildings or in living quarters.

f. When mounted indoors or underneath buildings, select a dry and well ventilated location.

g. Where snow and moisture might create a problem, locate the protector between 3 and 5 feet above grade if exterior mounted.

h. The location of station protectors, station wire, and ground wires should always comply with the practices covering electrical and mechanical protection and separations.

i. Unless absolutely necessary, attachments should not be made to aluminum siding and other such siding. If it is necessary to make an attachment to such materials, the property owner should be notified and permission obtained.

j. In general, station protectors should be located as near as possible to the entrance hole for the station and ground wires.

k. When locating protectors in alleys and on business buildings, etc., where there is commercial or private traffic, it is necessary to select a safe location. This may involve raising or

lowering the protector; also, it may be desirable to locate the protector inside the building.

3.02 When it is necessary to multiple fuseless or fused protectors for interior installation, there should be 1 inch separation when mounted horizontally, and 2 inches separation when mounted vertically. On external installations, there should be 1 inch separation horizontally and sufficient separation vertically to allow removal of the cover.

4. INSTALLING PROTECTORS—GENERAL

CAUTION: Before connecting the protector ground wire, test the power company ground rod, wire, cabinet, meter box, etc., using a B voltage tester.

4.01 Whenever possible, use a 72A bracket and 123 type protector to provide a direct connection to the grounding medium. The 123 type protector and the 72A bracket should be used indoors only. See paragraph 1.05.

4.02 Where possible, use a common clamp for wiring at the protector. The common clamp method is used to retain station and ground wires or buried drop and ground wires. Drop and station wires should NEVER be in the same clamp. Generally, aerial drop wire will not be affected by this practice.

NOTE: Never place an aerial drop or buried service wire on a building (when station protection is required) unless the station protector can be installed and grounded before the installer leaves the premises.

4.03 The first clamp to be placed on buried service wire should be 4 inches above ground level; the last clamp should be 2 to 4 inches below the protector.

4.04 The intermediate clamps should not exceed 18 inches maximum distance from the first, last, or any other intermediate clamp.

4.05 Terminate line and inside wires on the protector so that the ring conductors (single tracer or red wires) are connected to the right side of the protector.

4.06 All screws and fasteners should be of sufficient length to mount the protector securely.

4.07 Table A lists the ground wire size required for single or multiple installation of protectors.

4.08 The initial protector ground wire installed should be of sufficient gauge to provide protection for any future protectors installed. See Table A.

TABLE A. Ground Wire Capacity

Size	Protectors		
	Fused	Fuseless	
No. 14	1 to 3	Or	1
No. 10	4 to 8		2 to 6
No. 6	any number		any number

NOTE: The ground wire between protectors shall be the same size as the ground wire between the protector and the grounding electrode.

4.09 In all cases, a ground wire warning tag shall be placed conspicuously on the ground wire beneath the protector and at all other ground and bond wire terminations. The tag shall be secured on the ground wire as close as possible to the protector and clamps.

5. INSTALLING PROTECTORS—FUSELESS

5.01 Preferably, the 123 type protector should be installed directly on an acceptable metallic cold water pipe by means of a 72A bracket (see Figure 1) and a station ground wire clamp. The 123 type

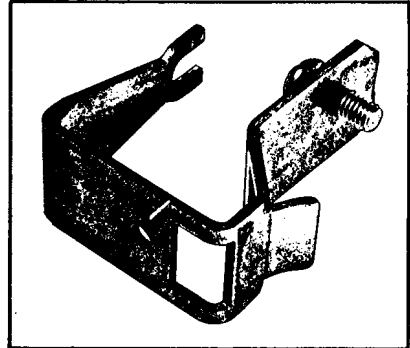


FIGURE 1. 72A Bracket

protector is for indoor installation only. See paragraph 1.05.

5.02 To install the 72A bracket on the 123 type protector, proceed as follows:

- a. Place a station ground wire clamp through the slots in the 72A bracket. See Figures 2 and 3.

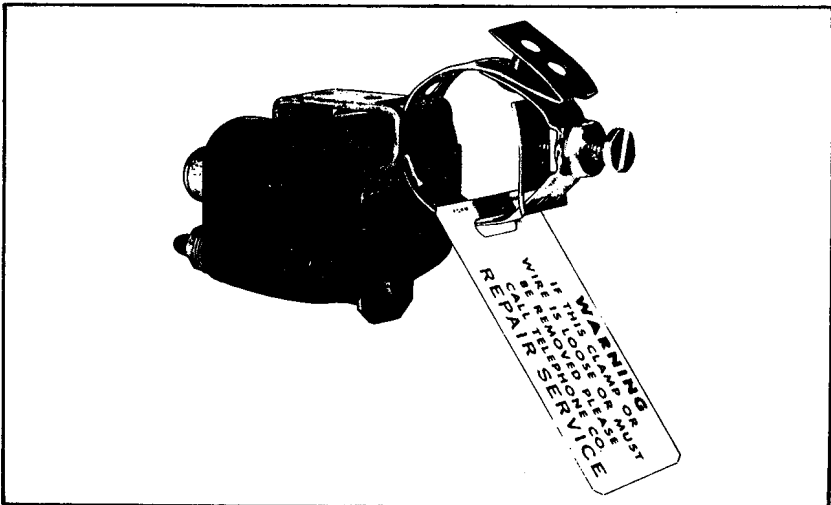


FIGURE 2. Station Ground Wire Clamp Through Slots in 72A Bracket Attached to 123 Type Protector



FIGURE 3. Front View of 123 Type Protector, 72A Bracket and Ground Clamp with Water Pipe Removed

b. Attach the ground wire clamp to an acceptable cold water pipe in the usual manner. Remove the screw from the 72A bracket and slide the protector into place, making sure the notched portion of the bracket is under the pronged washer of the protector ground terminal.

c. Place the mounting screw furnished with the 72A bracket in the bottom mounting hole of the 123 type protector and into the threaded hole of the bracket. Tighten the mounting screw, ground terminal nut, and protector ground terminal nut. See Figure 4.

NOTE: A protector installed in this manner is grounded through the 72A bracket; therefore, a station ground wire is not necessary.

5.03 Figures 5 through 16 show typical installations of single and multiple protectors. Also shown are typical installations of two single protectors at the same location.

a. Figure 5 shows a typical installation when the 123 type protector cannot be installed on a metallic cold water pipe (for indoor use only). See paragraph 1.05.

b. Figures 6, 7, and 8 show typical installations of

single fuseless and gas tube protectors.

c. Figure 9 shows a typical multiple installation of fuseless protectors.

d. Figure 10 shows a typical installation of a single fused protector.

e. Figure 11 shows a typical multiple installation of fused protectors.

f. Figure 12 shows a typical installation of a multiple type fuseless protector.

g. Figure 13 shows a typical installation of the multiple type gas tube protector.

h. Figures 14, 15, and 16 show a typical installation of the multiple type fused protector.

5.04 All the measurements shown in Figures 17 through 21 should be followed when locating and wiring station protectors.

6. BURIED INSTALLATION

6.01 The armor of underground wire or the aluminum tape of service wire should always be grounded at the buried closure and at the customer's location. The grounding is required to minimize shock

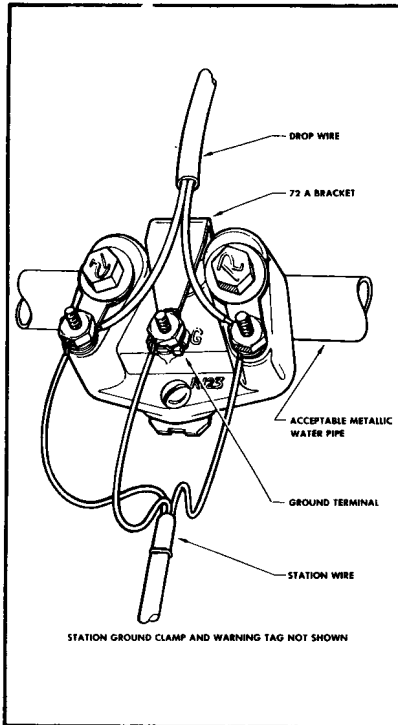


FIGURE 4. 123 Type Protector Installed on a Metallic Water Pipe (for Indoor Use Only)

or fire hazards from sustained power contact at the customer's location.

6.02 The 201 grounding lug will be used to bond the aluminum shield of service wire or the armor of underground wire to the protector.

6.03 Install the protector on the wall. Mark the location of the 201 grounding lug on the service wire. Cut around the outer jacket with a knife.

CAUTION: Do not cut into metallic shield. Bend the service wire at the cut in several directions until the outer jacket and shield break away cleanly. Slide the jacket and shield material off the end, exposing the inner PUC jacket.

6.04 Remove all but approximately 3/8 inch of the inner jacket by cutting around with a knife; then pull off the jacket. See Figure 22.

CAUTION: Do not cut into the conductor insulation.

6.05 Straighten the service drop at the prepared end. Slip the crimping collar (see Figure 23) over the wires and inner jacket and up onto the outer jacket.

6.06 With pliers or fingers, place the grounding lug (see Figure 23) against the inner jacket and push it under the metallic shield until the tapered end is inserted up to the step at the end of the sawtoothed edges. If the lug binds, tap it in lightly.

6.07 Move the crimping collar to within 1/16 inch of the cut end of the outer jacket. Rotate it until the opening in the collar is on the opposite side of the service drop from the grounding lug. Crimp the collar. Ordinary pliers may be used for this operation, with pressure applied as shown in Figure 24 (the crimp will be oval and the teeth of the grounding lug will not close). Apply enough pressure to close the collar, ensuring penetration of the lug teeth into the metallic shield.

6.08 Terminate the grounding lug directly on the ground post of a station protector. See Figure 25.

6.09 Use the lug, 202 bonding clip and wire combination where the ground post will not accept the spade tip of the grounding lug, such as when multiple protectors 400, 502A1, and U-type are used. Place the 202 bonding clip over the lug, securing the clip with two crimps on each of the two edges, using wire cutters. Slip an end of a 14 AWG ground wire into one of the open edges of the bonding clip and make two crimps. Use the other end of the 14 AWG ground wire for terminating on the ground post of the protector. See Figure 26. The same method can be used for terminating the buried service drop in a pedestal or terminal.

7. INSTALLING PROTECTORS—PBX

7.01 No other protection is required at location where PBX circuits terminate on main frame type protectors equipped with heat coils and carbon blocks.

7.02 Where main frame type protectors are not used, sneak current fuses are required. The 1094A type protector equipped with sneak current fuses (60D) will be used with either fuseless or fused protectors. Insert the 1094A type protector between the fuseless or fused protector and the station wire (for indoor mounting only). See Figure 27.

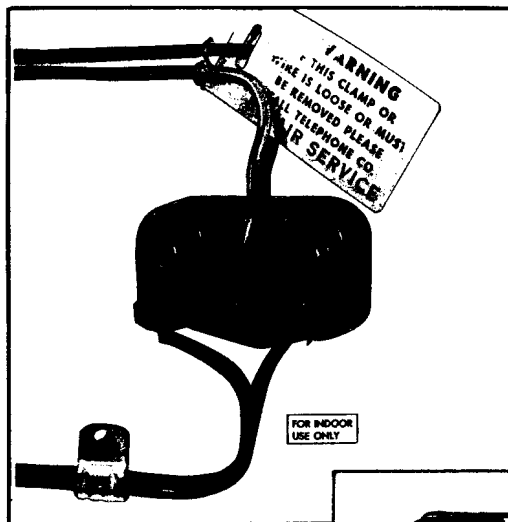
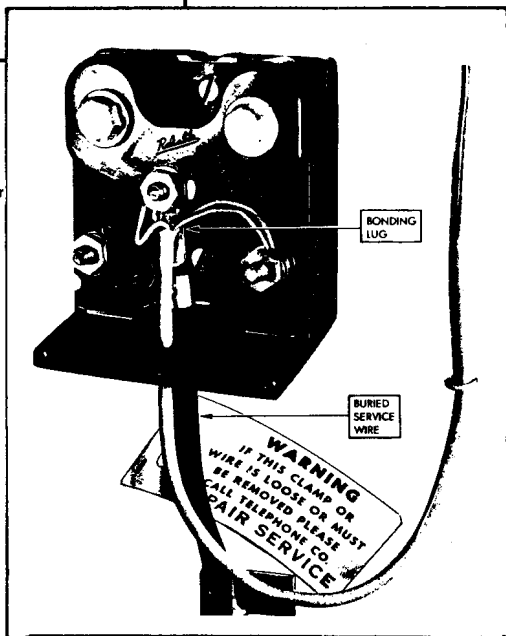


FIGURE 5. 123 Type Protector Mounted on Wall (For Indoor Use Only)

FIGURE 6. 350 Type Fuseless Protector With Buried Service Wire



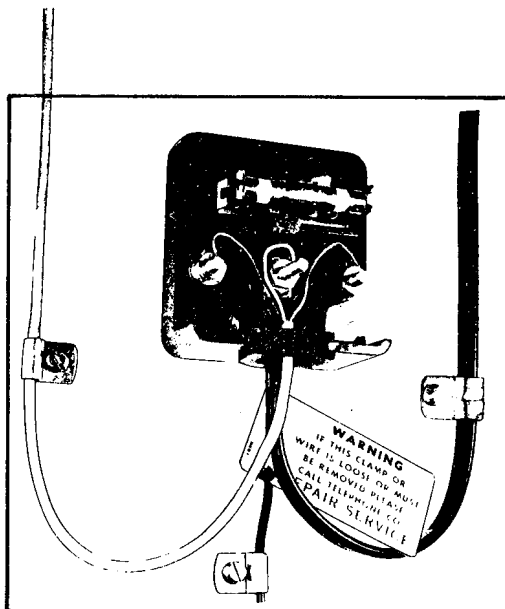
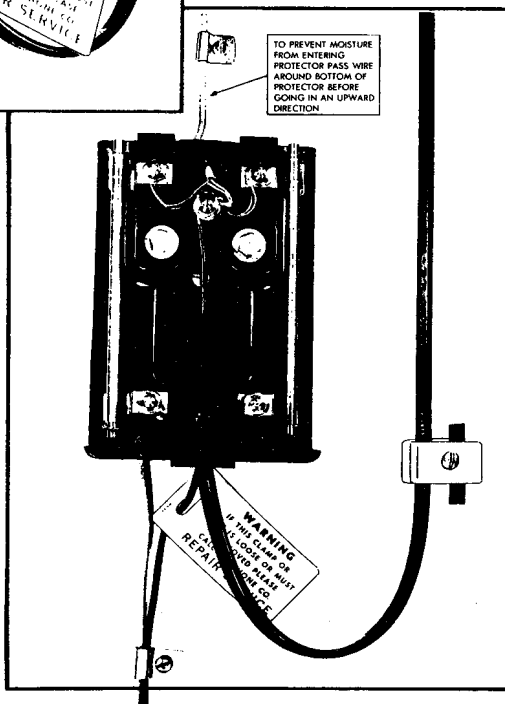


FIGURE 7. 300 Type Gas Tube Protector
(Cover Removed)

FIGURE 8. 590X Protector—Converted
590 Type Fused Protector
to Fuseless Operation With
Two Inside Wires Using
Busbar Adapters



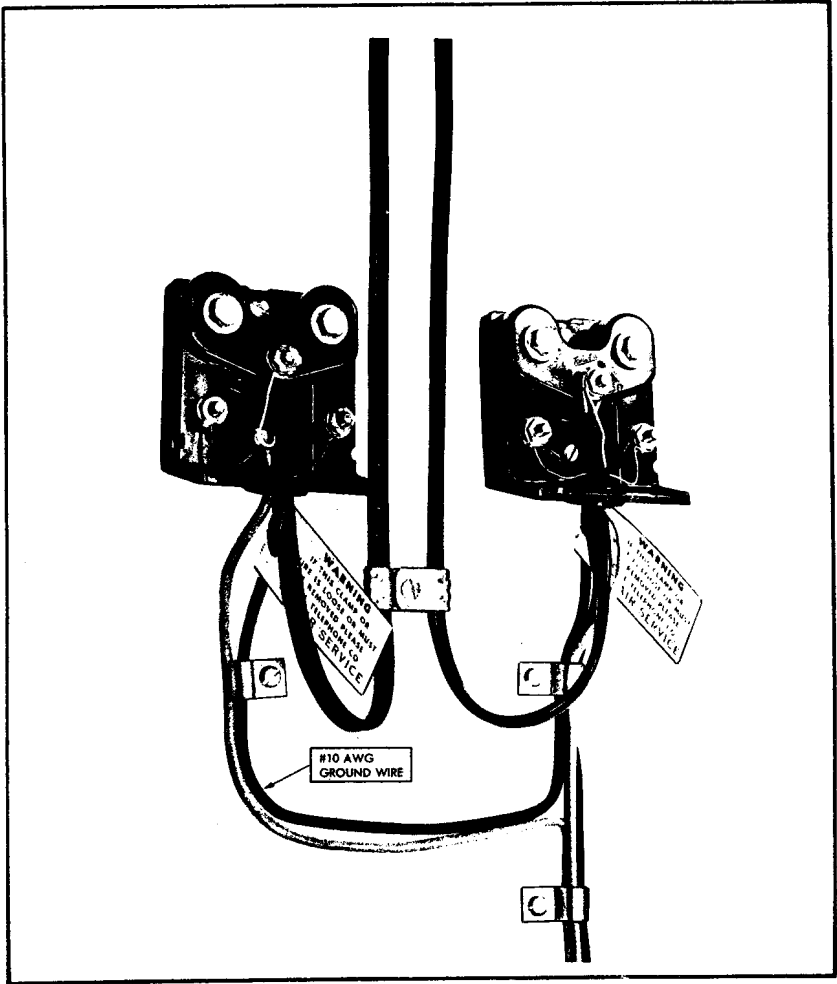


FIGURE 9. Typical Multiple Installation of Fuseless Protectors

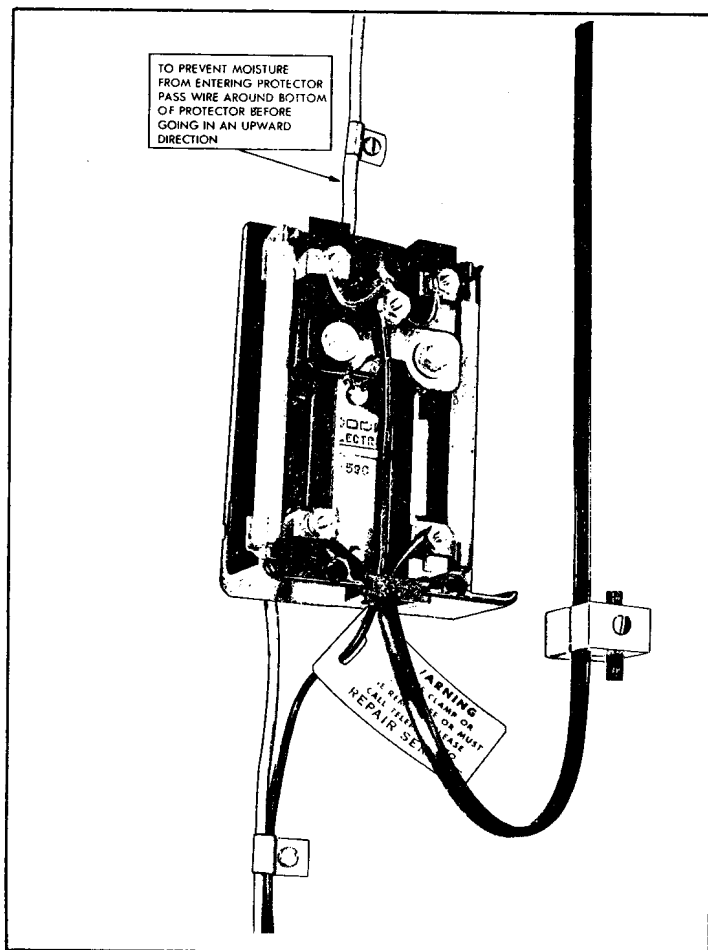
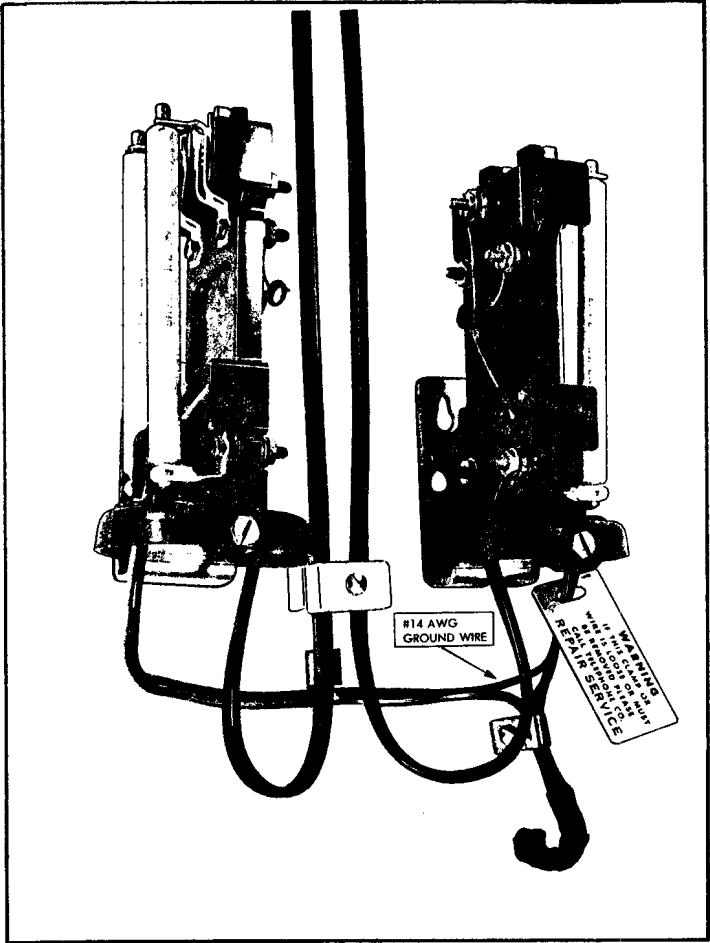


FIGURE 10. 590 Type Fused Protector with Two Inside Wires



**FIGURE 11. Typical Multiple Installation of 2100H Type Fused Protectors
(Covers Removed)**

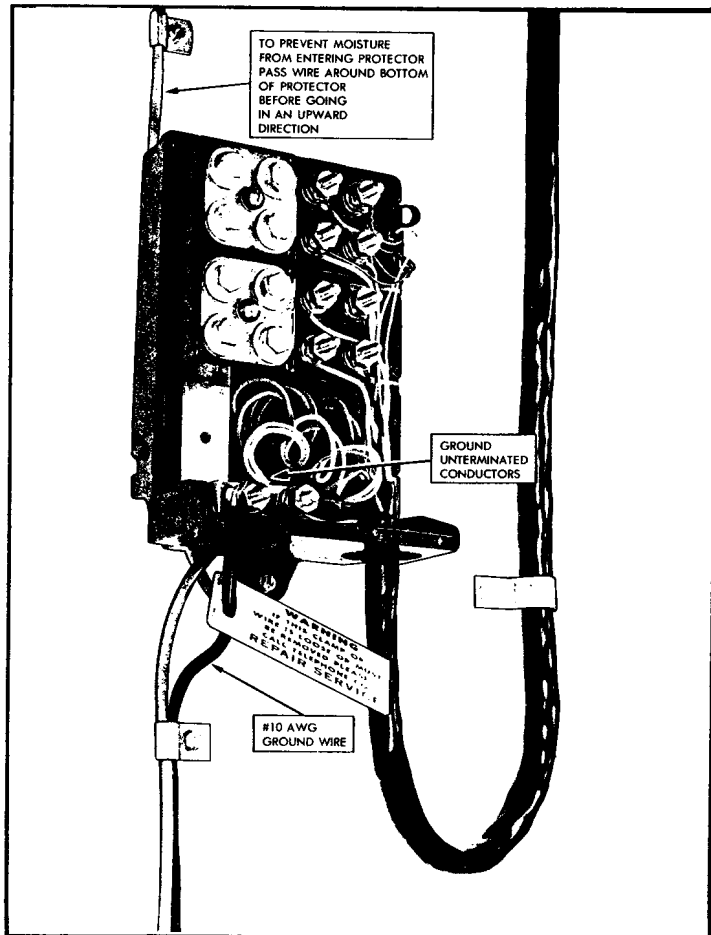


FIGURE 12. Typical Installation of Fuseless Multiple Protector 502A1 Type with Two 492 Protector Modules

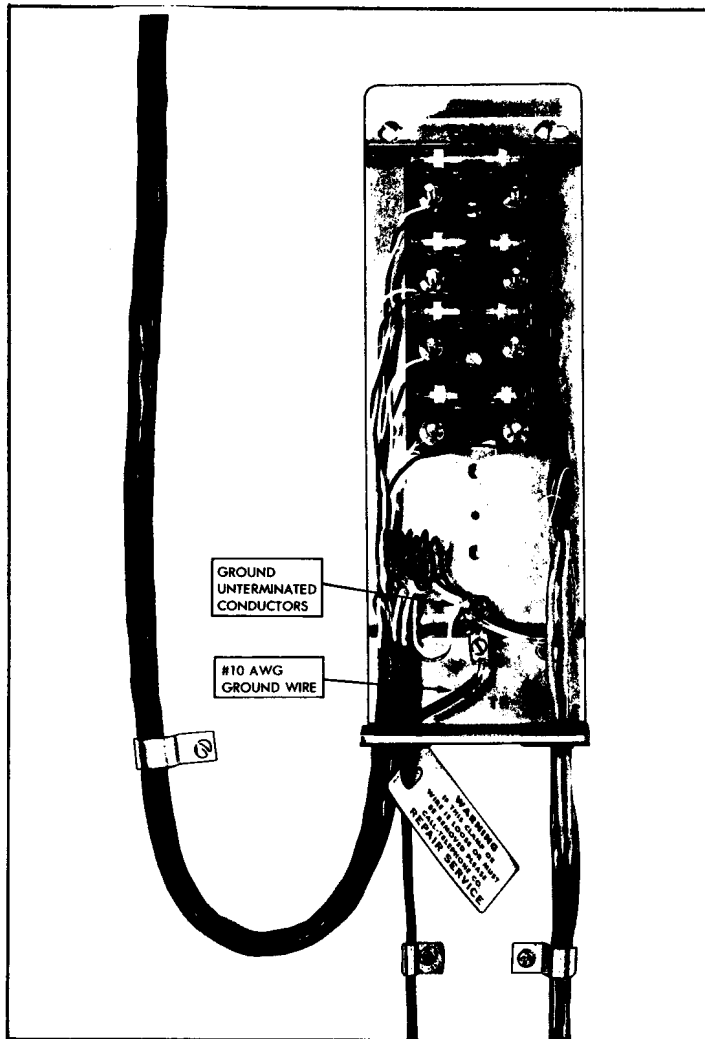


FIGURE 13. Typical Installation of Fuseless Gas Tube Multiple Protector Type 400 with Two 405 Two-Pair Mounting Blocks (Cover Removed)

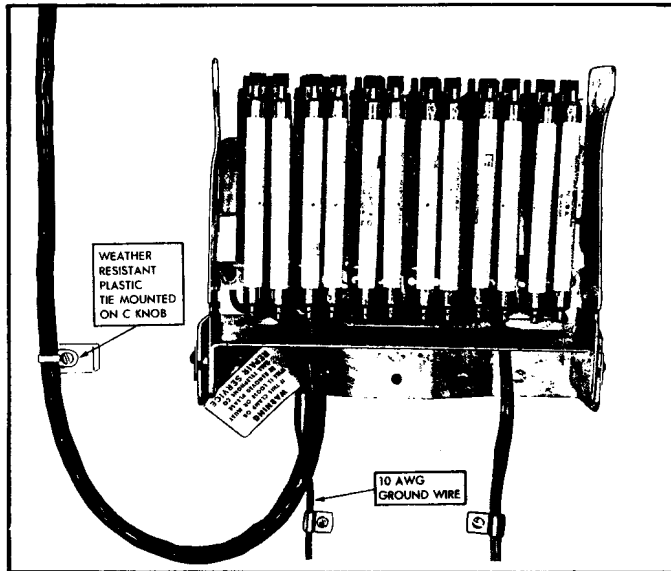


FIGURE 14. Typical Installation of U-Type Multiple Fuse Protector (Cover Removed)

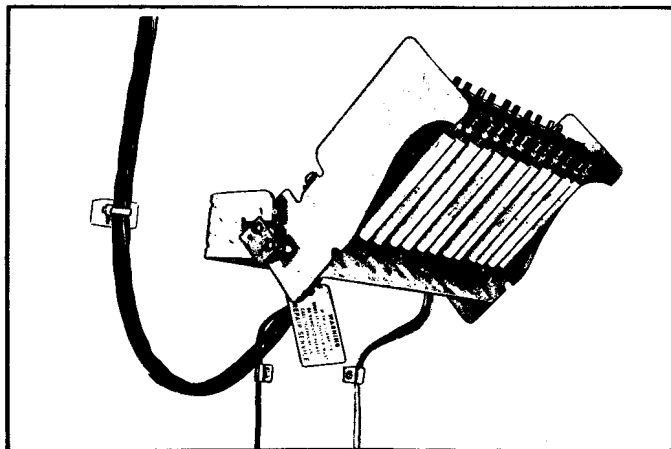


FIGURE 15. U-Type Protector Tipped Forward to Facilitate Attaching Inside Wires

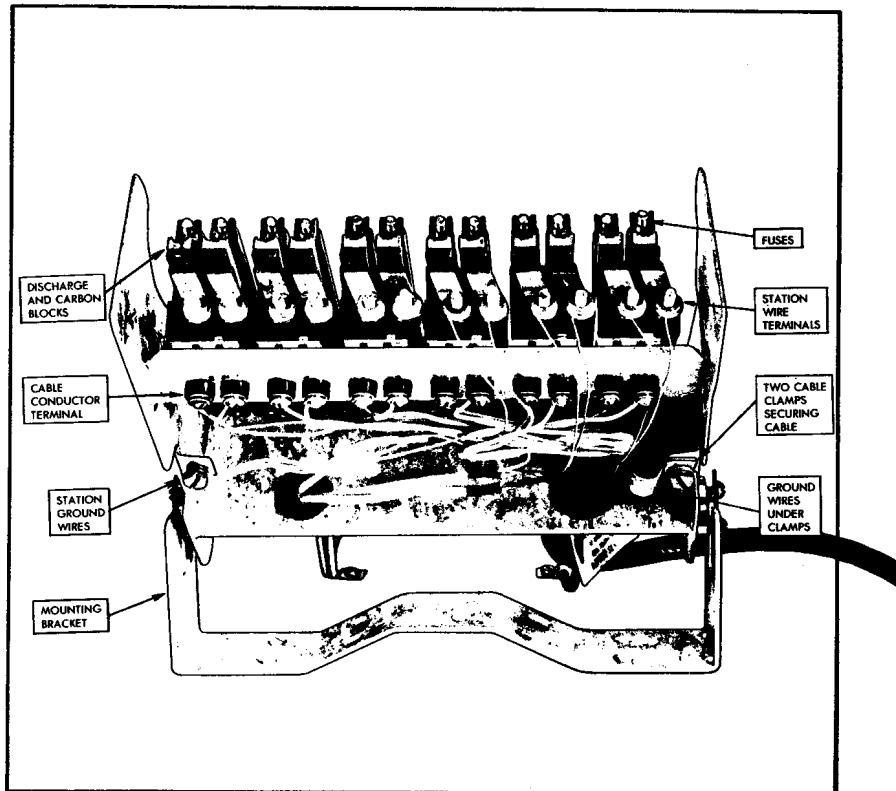


FIGURE 16. U-Type Protector as Viewed from Above with Protector Tipped Forward

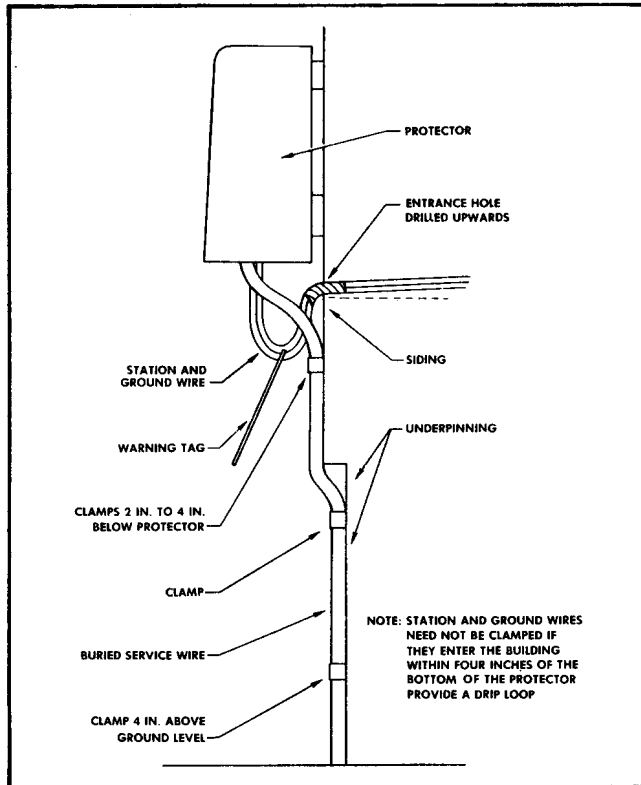


FIGURE 17.

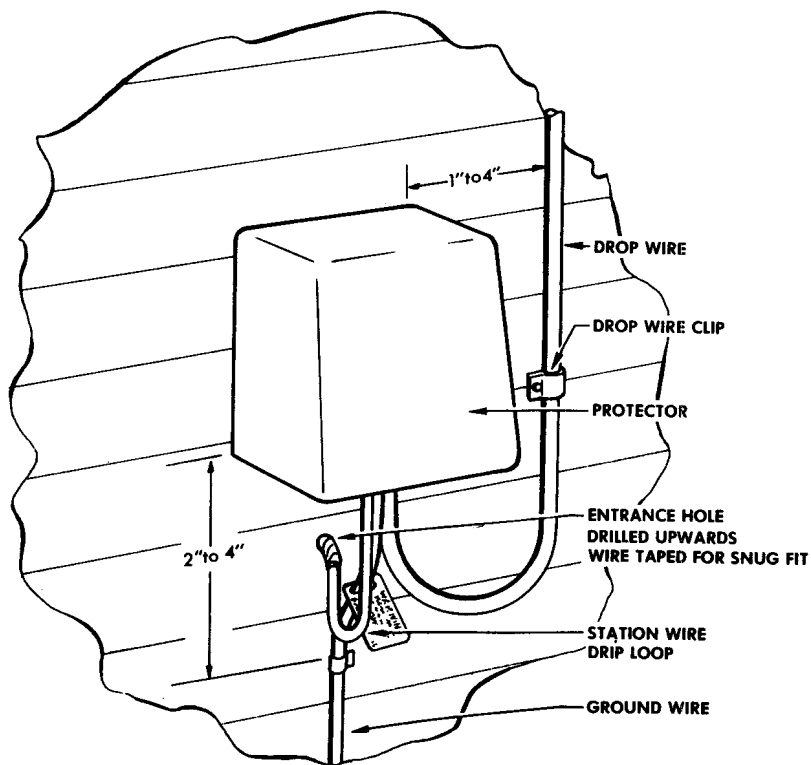


FIGURE 18.

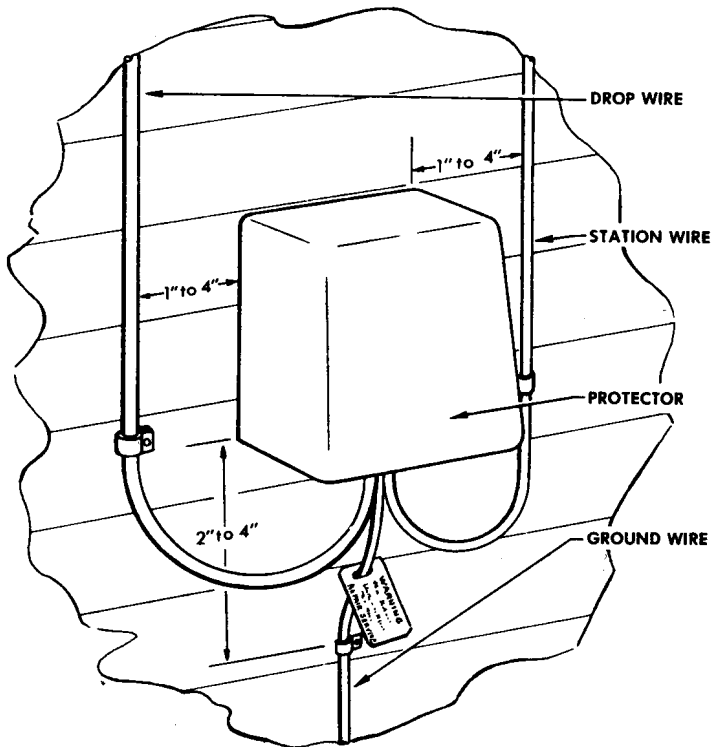


FIGURE 19.

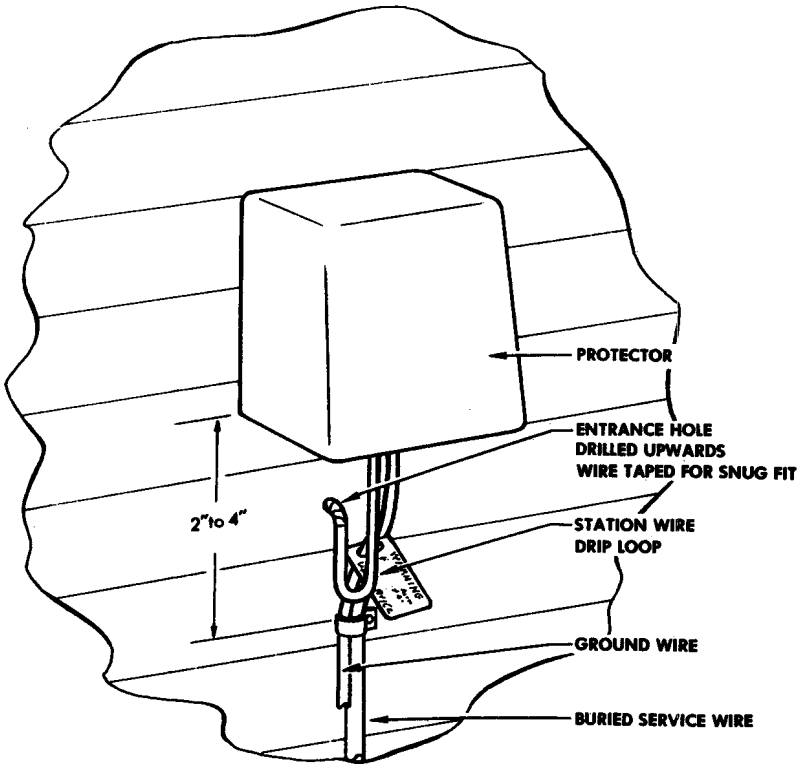


FIGURE 20.

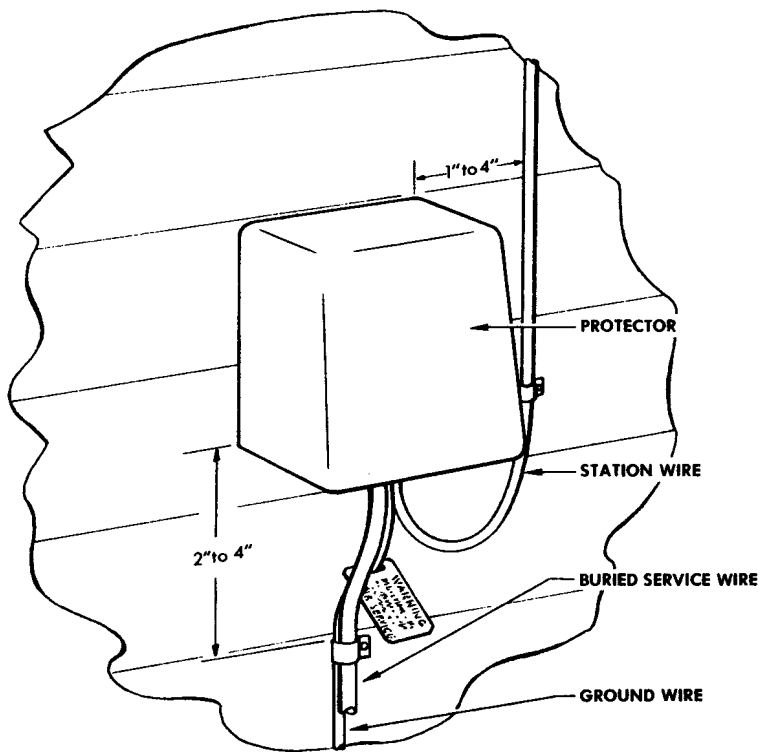


FIGURE 21.

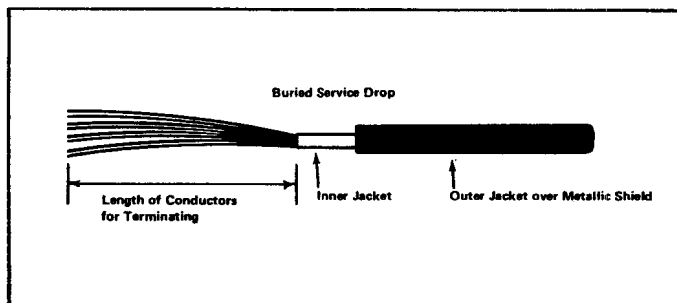


FIGURE 22.

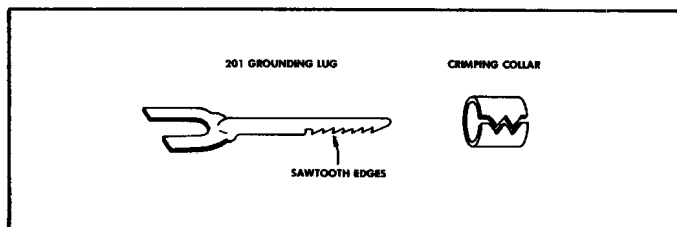


FIGURE 23.

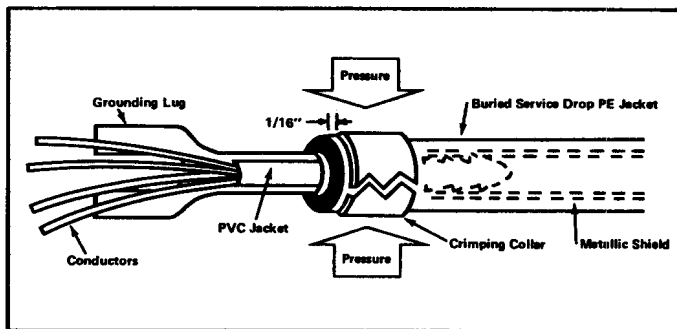


FIGURE 24.

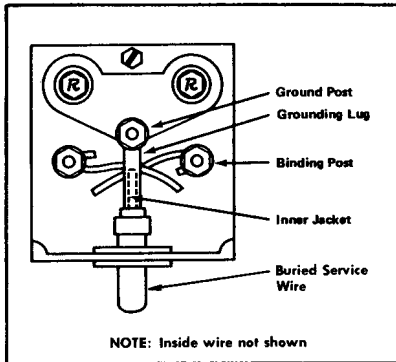


FIGURE 25.

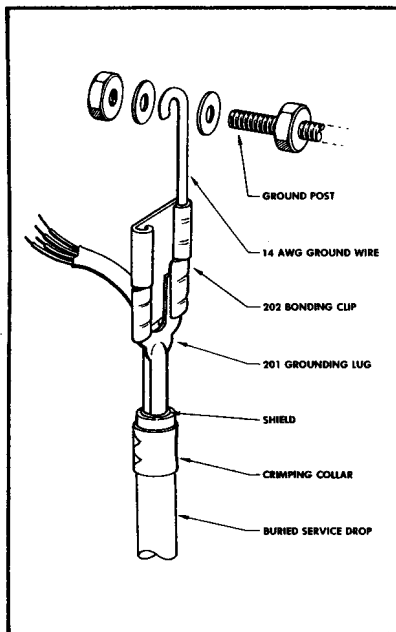


FIGURE 26.

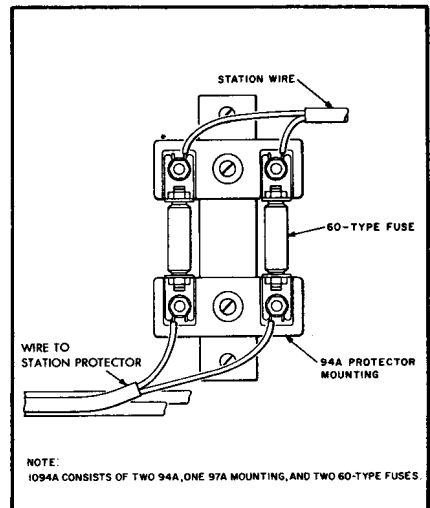


FIGURE 27. 1094A Type Protector with Type 60 Fuses

STATION PROTECTION AND SIGNALING GROUNDS
SELECTION AND INSTALLATION

1. GENERAL

- 1.01 This addendum is to correct and add information on ground clamps and wiring.
- 1.02 With red pencil or ink make the changes as shown in paragraph 2 of this addendum. In the margin of subject paragraphs and tables write the words "See Addendum".
- 1.03 File this addendum directly in front of CTSP 475-500-410.

2. CHANGES AND ADDITIONS

- 2.01 Change paragraph 2.01 b. (6) to read: (6) GC 166SO Ground Clamp, CTS #68-11-061-8.
- 2.02 Add paragraph 3.08 which shall read: 3.08 Run the ground wire in as straight a line as possible with no sharp bends or kinks.
- 2.03 Change Table D as follows:

TABLE D. Wire Connectors

WIRE CONNECTOR	POWER CO. GROUND WIRE (MAX. SIZE)	TEL. CO. GROUND WIRE (MIN. SIZE)
No. 6 split bolt	8 solid	14 AWG
No. 4 split bolt	6 solid	14 AWG*
No. 4 split bolt	4 solid	14 AWG*
GC166SO	Larger than 4 solid	14 AWG
* #14 AWG must be doubled to fit into connector.		

STATION PROTECTION AND SIGNALING GROUNDS SELECTION AND INSTALLATION

CONTENTS	PARAGRAPH
GENERAL	1
TEST EQUIPMENT AND MATERIAL	2
SAFETY PRECAUTIONS	3
SELECTION OF PROTECTOR GROUND	4
INSTALLATION OF STATION GROUND CLAMPS	5
BONDING OF POWER AND TELEPHONE GROUNDS	6
SELECTION OF SIGNALING GROUND	7
LOCATING AND INSTALLING GROUND RODS	8

1. GENERAL

1.01 This practice covers the selection of protector and signaling grounds and the installation of ground connecting equipment. See CTSP 475-500-402 for information on protector selection and application.

1.02 This practice replaces in their entirety CTSP 475-500-401, CTSP 475-500-403, and CTSP 475-500-404, all copies of which should be removed from the file and destroyed.

1.03 Power contacts, power induction, or lightning disturbances may cause abnormal voltages to develop between telephone plant and power services or metallic structures (such as water pipes) in a building. To equalize or limit possible voltage differences between telephone facilities and metallic structures, the station protector ground shall be bonded to the power service ground and the water system. The interconnection of the various metallic systems is known as **common bonding or grounding**.

NOTE: The telephone protector ground and the electrical service ground shall be interconnected. The method of interconnecting these facilities is described in paragraph 6.

1.04 When maintenance or repair work is performed on previously installed stations, the grounding system should be inspected. All systems must meet the current grounding and bonding requirements.

1.05 When available, a public metallic water pipe

provides the preferred grounding medium. A private metallic water system with at least 10 feet of buried metallic pipe is an acceptable grounding medium and is preferred to a ground rod. Connect the ground wire to the metallic cold water pipe at a point where normal maintenance of water meters, pumps, or the installation of insulating sections for reducing vibrations will not interrupt the circuit to ground or common bonding to power ground. Figure 1 is an illustration of a preferred effective ground.

1.06 If the interior metallic cold water pipe is insulated from the buried water system by an insulating joint, or if the water system is nonmetallic, the interior metallic water piping is not an acceptable ground and an alternate method (see paragraph 4) must be used. The selected alternate ground shall always be bonded to the interior metallic cold water piping system.

1.07 The MGN (multiground neutral) type power system is an acceptable ground, but it is not in general use in all areas. The power company may have adopted the MGN as the standard on new or rearranged construction and still have a portion of plant operating without a multiground neutral. In all cases, it must be determined through supervisory channels whether the power system is MGN.

1.08 To provide a direct connection to the grounding medium, use a 72A bracket and a 123 type protector whenever possible. See CTSP 475-500-405. If a ground wire is necessary, the run should be short, straight, and continuous. See Figure 2.

NOTE: The 72A bracket and 123 type protector are to be used indoors only. Where accessibility to the protector for maintenance presents a problem, do not install any protector indoors.

1.09 If a fused protector must be used, the length of drop wire indoors should be as short as possible, no longer than five feet. See Figure 3.

2. TEST EQUIPMENT AND MATERIAL

2.01 This paragraph lists the test equipment and material covered in this practice. For convenience, CTS catalog numbers are listed if available.

a. Test Equipment:

(1) B Voltage Tester, CTS #74-94-310-3.

b. Material:

(1) 72A Bracket, CTS #70-75-104-8.

Distribution C D E F

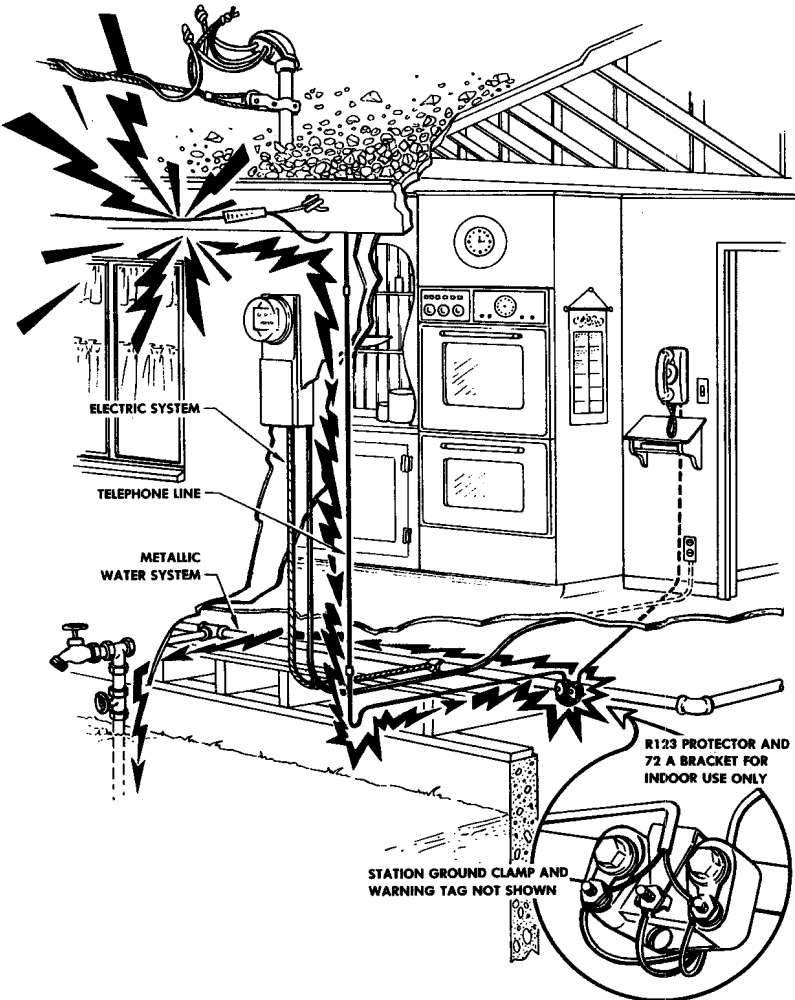


FIGURE 1. Preferred Effective Ground

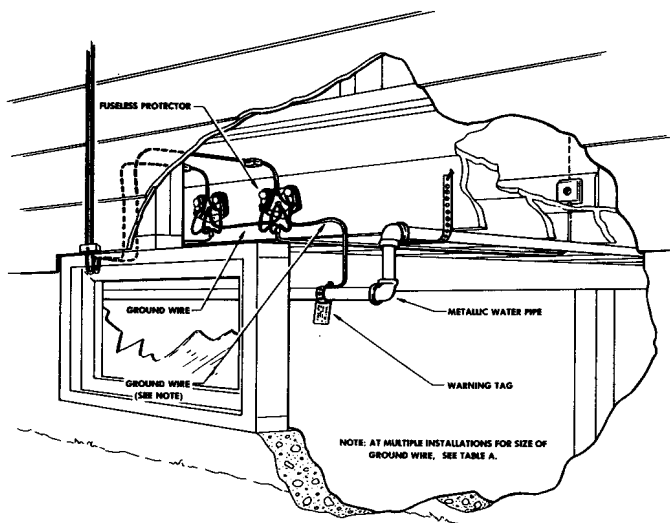


FIGURE 2. Ground Wire Run—Fuseless Protector

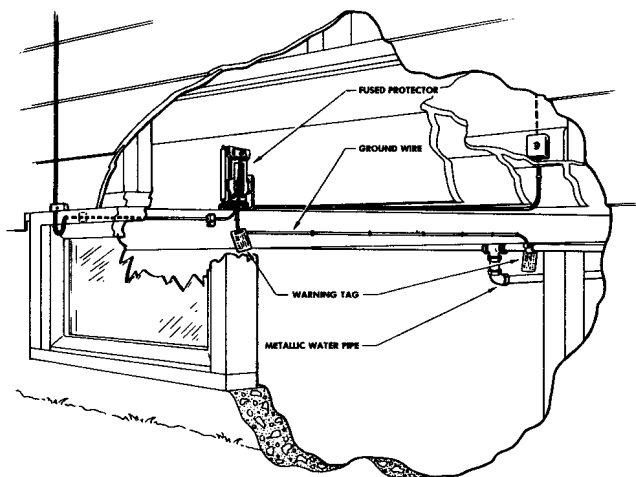


FIGURE 3. Ground Wire Run—Fused Protector

- (2) 123 Type Fuseless Protector, CTS #70-75-052-0.
- (3) Ground Wire Warning Tag, CTS #51-77-016-4.
- (4) 3844 Ground Clamp, CTS #60-17-040-9.
- (5) Station Ground Clamp, CTS #68-11-014-6.
- (6) GC16650 Ground Clamp, CTS #68-11-061-8.
- (7) L Ground Clamp, CTS #60-17-041-7.
- (8) No. 4 Split Bolt Connector, CTS #60-17-057-3.
- (9) No. 6 Split Bolt Connector, CTS #60-17-058-3.

3. SAFETY PRECAUTIONS

- 3.01** Before connecting the protector ground wire, test the power company ground rod, ground wire, cabinet, meter box, etc., with a B voltage tester. Make the voltage test as prescribed for vertical power ground wires or metallic conduit. If the grounding mediums are energized, do not proceed with the work. Report the condition to the proper supervision so that the power company or customer-owned power system may be informed of the situation.
- 3.02** To prevent damage to copper pipe or tubing, place ground clamps on fittings only.
- 3.03** Do not spiral the ground wire around the pipe.
- 3.04** Do not attach ground wires to the interior of any service entrance box, fuse box, meter box, etc.
- 3.05** Do not attach ground wire to power service aluminum ground wire, aluminum conduit, aluminum service boxes, etc., due to corrosive action.
- 3.06** Do not attach ground wire to gas pipes.
- 3.07** The ground wire warning tag shall be used as prescribed in paragraphs 5.07, 5.08, and 5.09.

4. SELECTION OF PROTECTOR GROUND

- 4.01** The gauge of station ground wire used depends on the type and number of protectors. See Table A.
- 4.02** The selection of the protector ground should be made in accordance with Table B and as shown in Figures 4 through 18. The only exceptions permitted without the approval of the supervisor or as stated in authorized instructions are those covered in paragraphs 4.06 and 4.07.
- 4.03** The wire directly connected to the metallic cold water pipe or other grounding medium is the

TABLE A. Ground Wire Capacity

Size	Protectors		
	Fused		Fuseless
No. 14	1 to 3		1
No. 10	4 to 8	Or	2 to 6
No. 6	any number		any number

NOTE: The ground wire between protectors shall be the same size as the ground wire between the protector and the grounding electrode.

grounding conductor of the power system. If this wire is encased in metallic armor or metallic conduit, the armor or conduit may be considered as the grounding conductor.

4.04 The portion of conduit from the power drop entrance to the service equipment enclosure is the metallic entrance of the power service. The conduit or armoring on the branch circuits in the building must not be used as protector ground.

4.05 Figure 4 shows the 123 type protector attached to a metallic cold water pipe by means of a station ground clamp and a 72A bracket. This arrangement should be the first choice of grounding to an acceptable metallic cold water pipe.

NOTE: The 72A bracket and 123 type protector are to be used indoors only. See paragraph 1.08 note.

4.06 Stations located at power company stations, in an explosive atmosphere, or connected to foreign communication circuits usually require special protection. See the appropriate Continental Telephone System practices.

4.07 At radio or television stations, connect the protector or signaling ground wire to the radio or television station ground.

4.08 Tanks or pipes (public or private) that contain or have contained flammable gases or liquids are prohibited as protector or signaling grounds. Steam and hot water space heating pipes are also prohibited.

4.09 Another effective ground is a recent development known as a **concrete encased electrode**. It consists of not less than 50 continuous feet of 3/8 inch reinforcing steel bar or 20 continuous feet of No. 4 bare copper wire, embedded below grade in a concrete foundation or footing. The bar or conductor is stubbed up into an accessible location for grounding connections. In the absence of an acceptable water pipe or an MGN system, it should be considered as a first choice ground.

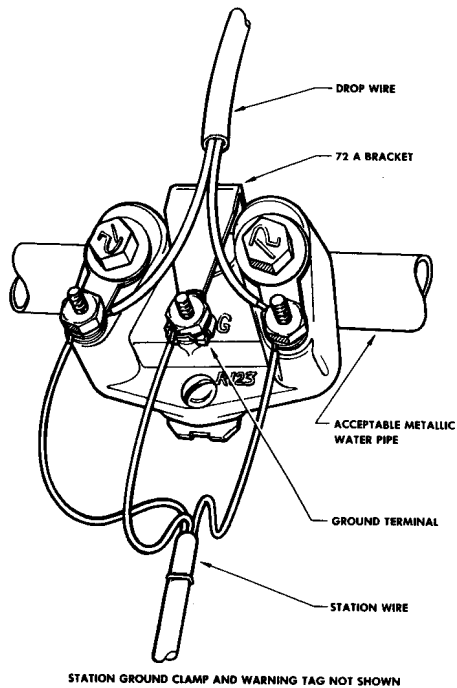


FIGURE 4. Protector Mounting—72A Bracket
(For Indoor Use Only) See Paragraph 1.08 Note

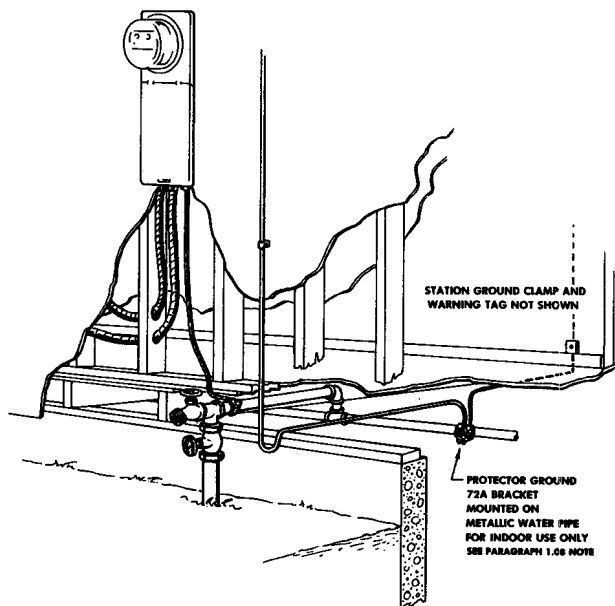


FIGURE 5. Protector Ground—72A Bracket

TABLE B—PROTECTOR GROUNDING			
A1—MGN System on acceptable metallic water pipe or concrete encased electrode. A2—MGN System on ground rod B1—Non-MGN System on acceptable metallic water pipe or concrete encased electrode. B2—Non-MGN System on ground rod C —Power not grounded at premises D —No power			
WATER PIPE	POWER CONDITION	WHAT TO DO FOR PROPER PROTECTOR GROUNDING	FIG.
Acceptable metallic water pipe (at least 10 feet in moist soil)	A1 or B1	Ground protector preferably to metallic water pipe or second choice to power service conduit or third choice power service ground wire. See 4.03.	4, 5, or 6
	A2 or B2	Ground protector to metallic water pipe. Bond power to water pipe with No. 6 ground wire.	7
	C or D	Ground protector to metallic water pipe (if C, refer to 6.03).	8
Metallic interior water piping not acceptable because of plastic entrance, insulating joints, etc.	A2	Ground protector to MGN ground rod. Bond with No. 6 ground wire to metallic water pipe. If ground rod not accessible ground to power service conduit or ground wire.	9 or 10
	B2	Ground protector to best available ground or telephone ground rod. Bond to power ground rod and interior metallic water pipe with No. 6 ground wire. If power ground rod is not accessible bond to power service conduit or ground wire.	11 or 12
	C or D	Ground protector to best available ground or ground rod. Bond to interior metallic water pipe using No. 6 ground wire (if C, refer to 6.03).	13
No metallic water pipe or not possible to connect to metallic water pipe	A1 or B1	Ground protector to power service conduit or power service ground wire or concrete encased electrode.	6
	A2	Ground protector to MGN power ground rod, or, if ground rod is not accessible, ground protector to power service conduit or ground wire.	14 or 15
	B2	Ground protector to telephone ground rod and bond with No. 6 ground wire to power ground rod.	16 or 17
	C or D	Ground protector to best available ground (if C, refer to 6.03).	18
NOTE: Verify existing power and telephone bonding and grounding. If they meet these requirements no further action is required.			

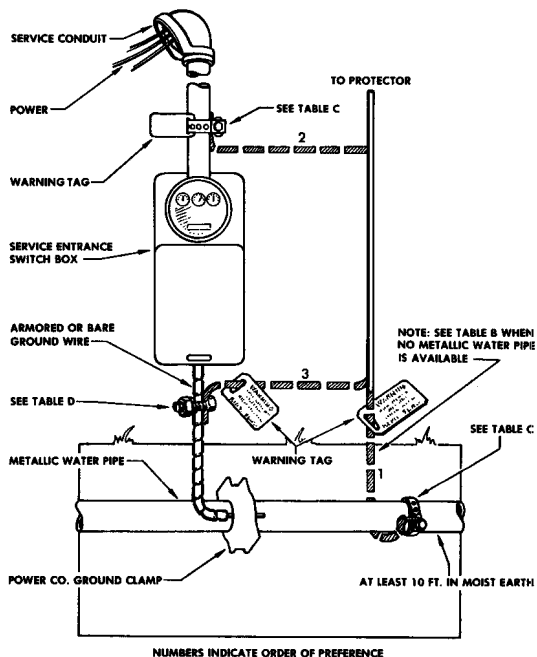


FIGURE 6. Power Grounded to Acceptable Water System

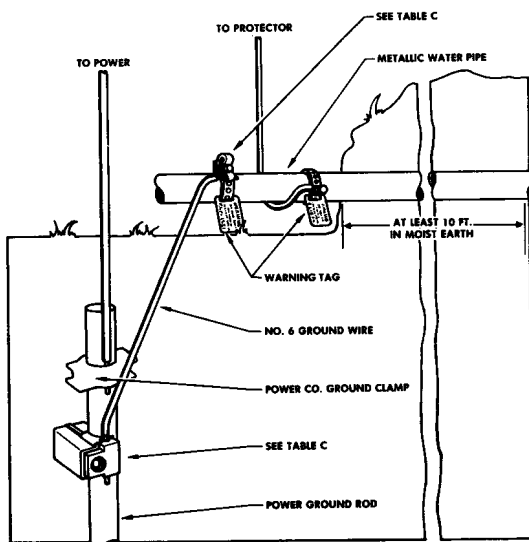


FIGURE 7. Grounding to Metallic Water System—Power on Ground Rod at Premises

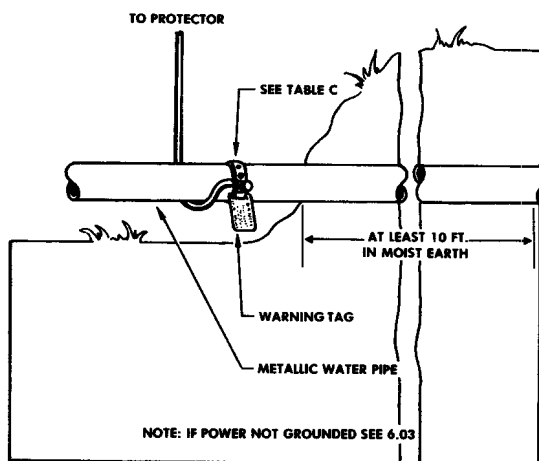


FIGURE 8. Grounding to Metallic Water System—Power (If Any) Not Grounded at Premises

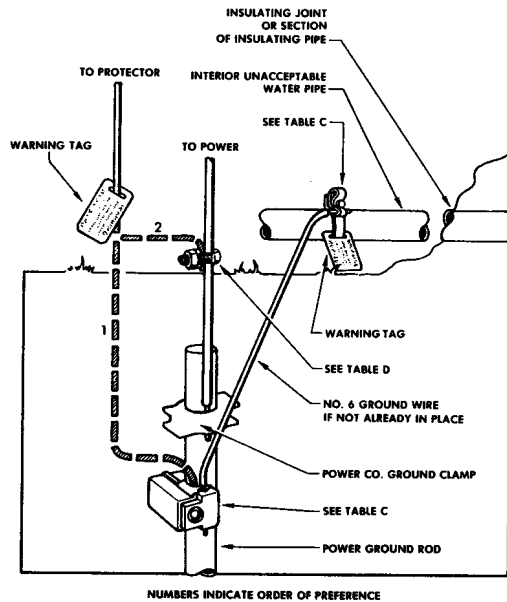
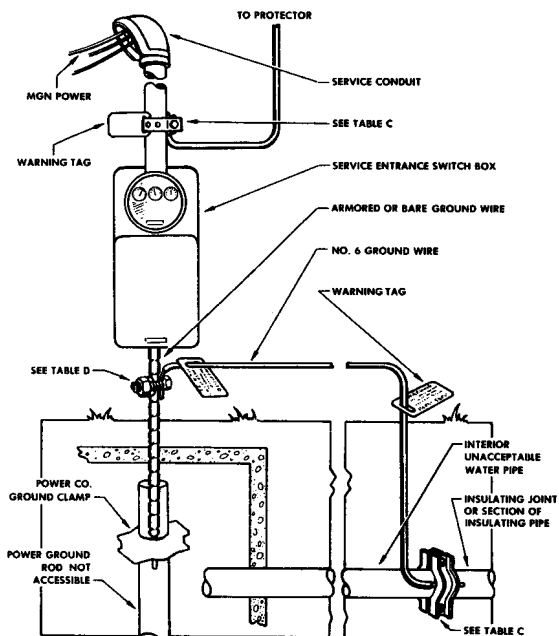


FIGURE 9. MGN Power Grounded to Ground Rod—Unacceptable Interior Water System



**FIGURE 10. MGN Power Grounded to Inaccessible
Ground Rod—Unacceptable Interior
Water System**

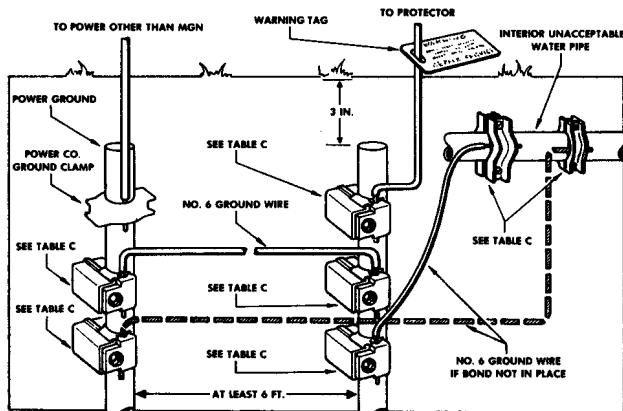


FIGURE 11. Power Other than MGN Grounded to Ground Rod—Unacceptable Interior Water Pipe

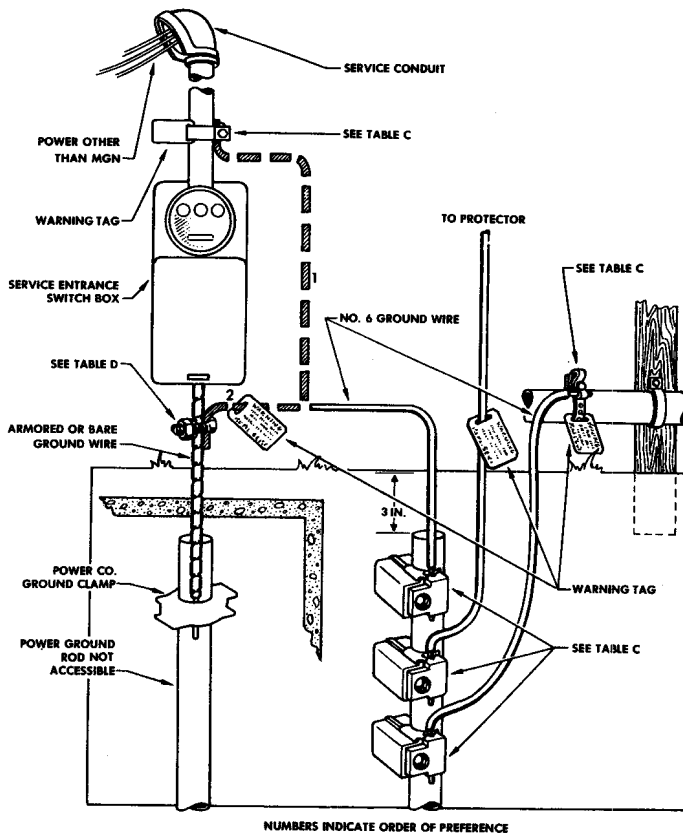


FIGURE 12. Power Other than MGN Grounded to Inaccessible Ground Rod—Unacceptable Interior Water Pipe

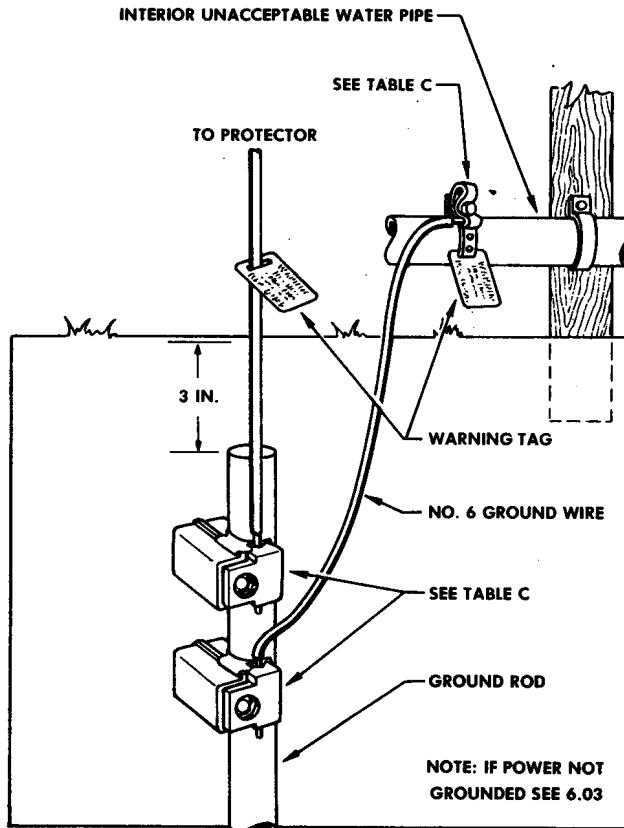


FIGURE 13. Power Not Grounded on
Premises—Unacceptable Water Pipe

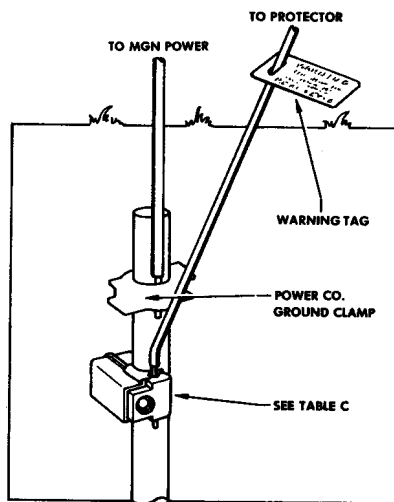
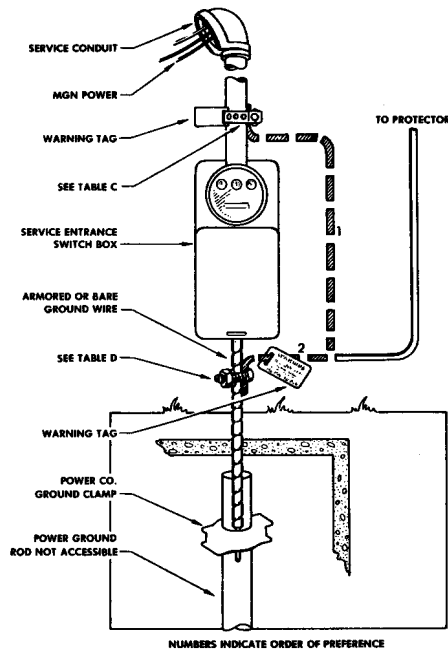


FIGURE 14. MGN Power Grounded to Ground Red—No Water Pipe—Connection to Pipe Not Possible



**FIGURE 15. MGN Power Grounded to Inaccessible
Ground Rod—No Water
Pipe—Connection to Pipe Not Possible**

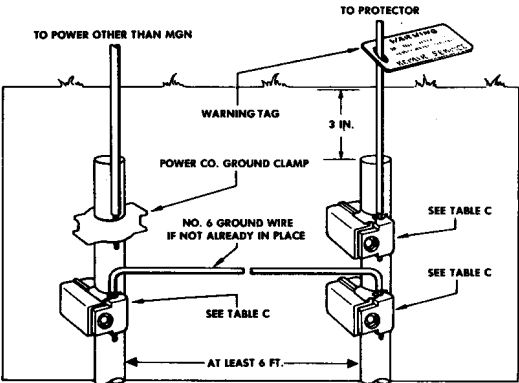


FIGURE 16. Power Other than MGN Grounded to Ground Rod—No Water Pipe

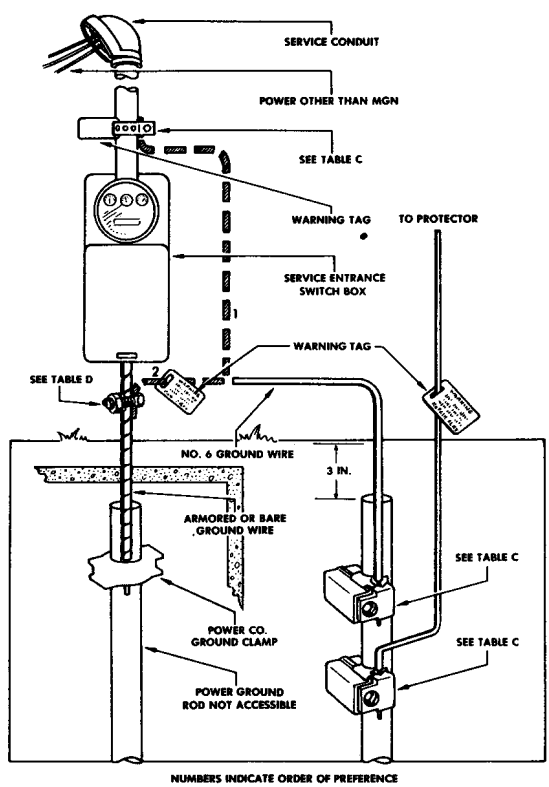


FIGURE 17. Power Other than MGN Grounded to Inaccessible Ground Rod—No Water Pipe

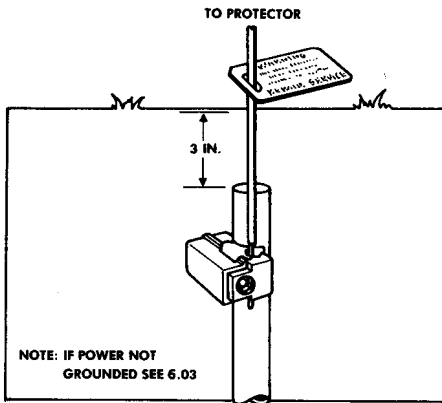


FIGURE 18. Grounding to Telephone Ground Rod—Water Pipe, Power Ground, or Metallic Structure Not Available

5. INSTALLATION OF STATION GROUND CLAMPS

5.01 The hardware used to terminate station ground wire is listed in Tables C and D.

5.02 The station ground clamp, L ground clamp, GC166S0 clamp, 3844 clamp and split bolt connector are shown in Figures 19 through 23.

5.03 The ground clamp should be located at an accessible point where it will not be subject to excessive movement or vibration and where it will least likely be damaged by plumbers or other workmen. If the pipe is insecure or subject to

vibrations, tape the ground wire to the pipe in close proximity to the ground clamp. See Figure 24.

5.04 Figures 24 through 28 show correct installations of the station ground clamp and the L ground clamp.

5.05 Where insulating joints are found (usually at meters, pumps, valves, etc.), the ground clamp should be installed at a point where the insulating joint will not break continuity to ground. Where pumps, meters, etc., may be removed for seasonal overhaul, the ground clamp should be installed at a point where the continuity to ground will not be broken.

TABLE C. Ground Clamps

GROUND CLAMPS	CONDUCTOR SIZE	SERVICE PIPE INTERIOR OR ABOVEGROUND SIZE (IN.)	SERVICE PIPE OR GROUND ROD (BURIED) SIZE (IN.)
72A bracket with station ground clamp size 6-3/4		3/8 through 1-1/4	
72A bracket with two station ground clamps		1-7/8 through 3	
3844 ground clamp	No. 6		1/2 through 1 water pipe only
Station ground clamp	No. 14 or 10	3/8 through 1-1/4	3/8 through 1-1/4
Two station ground clamps (Figure 25)	No. 14 or 10	1-7/8 through 3	
Fargo GC166S0	No. 6, 10 or 14		3/8 through 5/8 Ground Rod Only
L ground clamp	Small opening of formed end No. 6 wire. Place No. 10 or No.14 wire under bolt head (Figures 26,27,28)	3/8 through 3	

TABLE D. Wire Connectors

WIRE CONNECTOR	POWER CO. GROUND WIRE (MAX. SIZE)	TEL. CO. GROUND WIRE (MIN. SIZE)
No. 4 split bolt	8 solid	14 AWG
No. 6 split bolt	6 solid	14 AWG*
No. 4 split bolt	4 solid	14 AWG*
GC166S0	Larger than 4 solid	14 AWG

*#14 AWG must be doubled to fit into connector.

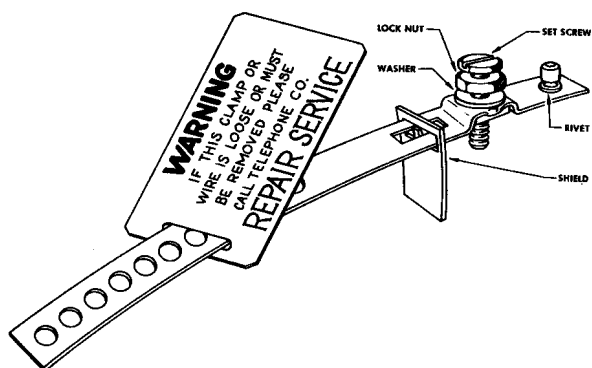


FIGURE 19. Station Ground Clamp

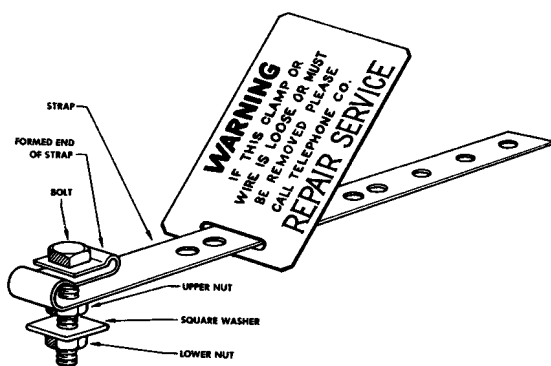


FIGURE 20. L Ground Clamp

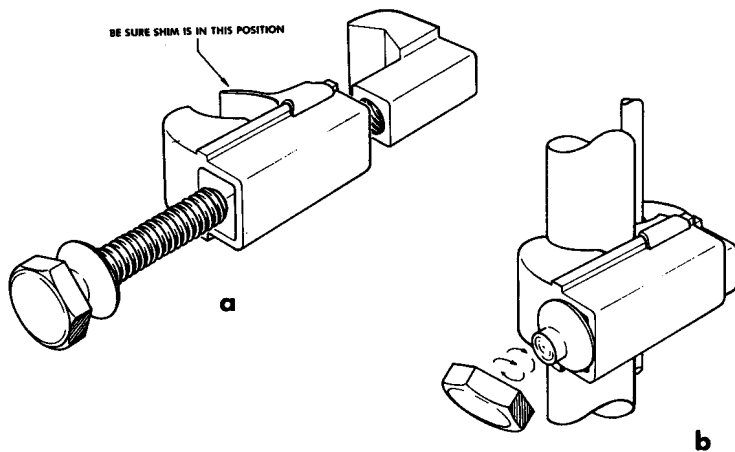


FIGURE 21. GC16650 Clamp

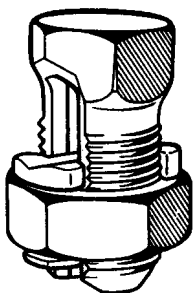


FIGURE 22. Split Bolt Connector

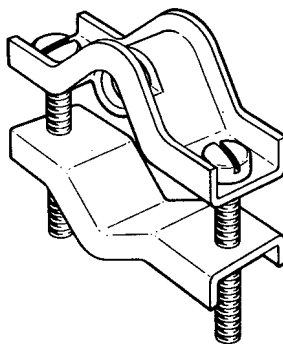


FIGURE 23. 3844 Clamp

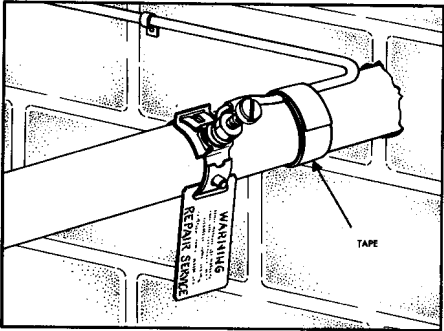


FIGURE 24. Typical Ground Clamp Installation

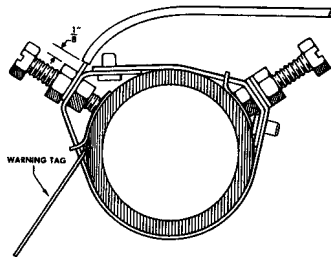


FIGURE 25. Installation on Large Pipes

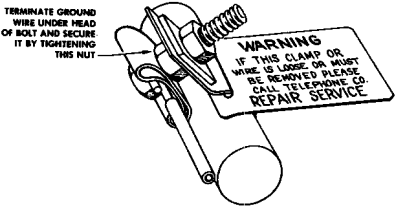


FIGURE 27. Attaching No. 14 or No. 10 ground Wire to L Ground Clamp

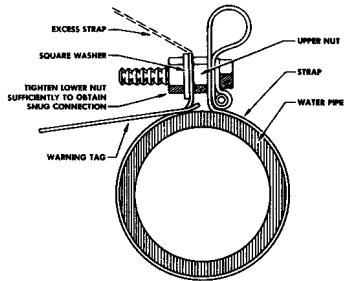


FIGURE 26. Attaching L Ground Clamp to 3-Inch and Smaller Pipe

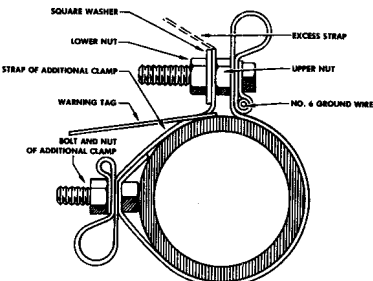


FIGURE 28. Attaching L Ground Clamp to Pipes Larger than 3 Inches

5.06 Make certain that the surface of the metallic pipe to which the ground clamp is being fastened is free of paint, rust, etc.

5.07 The ground wire warning tag shall be placed at all ground wire terminations including the clamp, protector, and bonding terminations.

5.08 The warning tag (see Figure 29) shall be placed at all ground wire terminations to warn people not to disturb the clamp or wire and to notify the telephone company if the clamp or wire is disturbed.



FIGURE 29. Warning Tag

5.09 The preferred method of attaching the warning tag is to insert the station ground clamp through the elongated slot before attaching to a pipe. See Figure 30. An alternate means of attaching the warning tag to the station ground clamp is to place the elongated slot over the hexagonal screw. See Figure 30.

NOTE: After the installation is complete, check the ground clamps to be sure that the ground wire warning tag has been placed.

6. BONDING OF POWER AND TELEPHONE GROUNDS

6.01 The selection of protector grounds listed in Table B and shown in Figures 4 through 18 is intended primarily to provide the best available ground for the telephone protector. It is also intended to accomplish bonding between the power and telephone grounds where there is a choice of acceptable grounds. The necessity for bonding is shown in Figure 31.

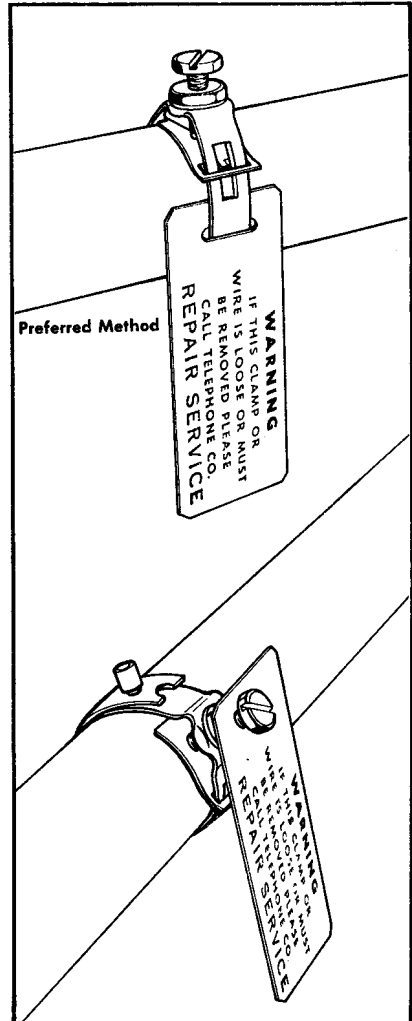


FIGURE 30. Warning Tag Attached to Station Ground Clamp

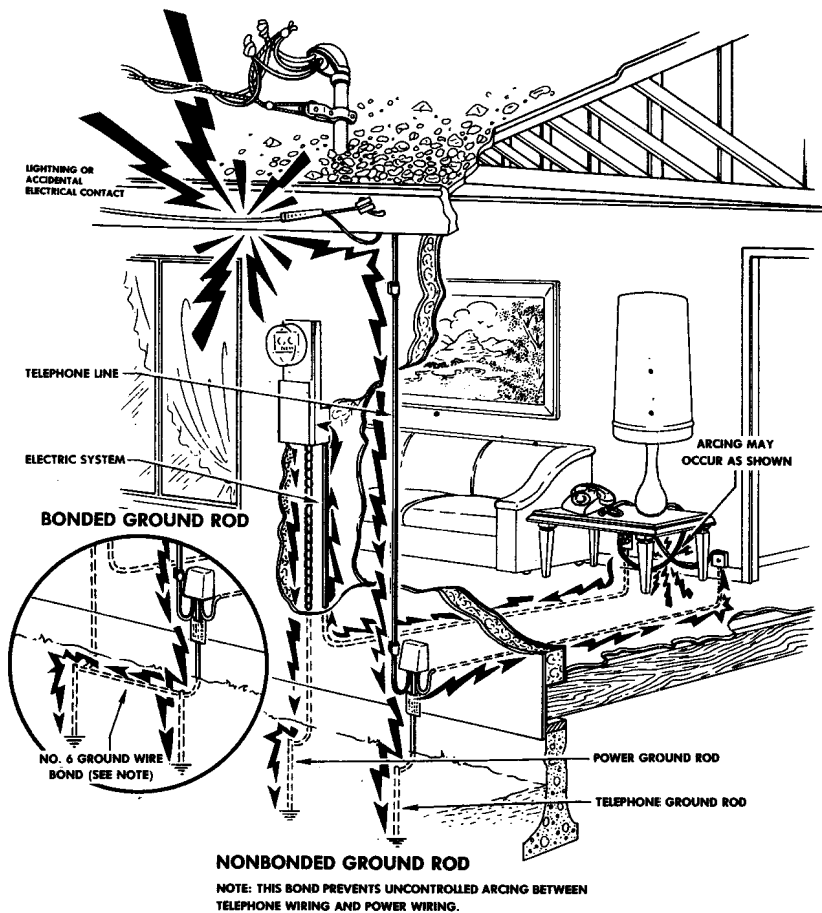


FIGURE 31. Effects of Bonding

6.02 When a situation exists where the power and telephone grounds are not common, the following corrective arrangements should be made:

a. If an acceptable public or private water system is available and the power service is grounded to a ground rod, connect the telephone protector to the metallic water system. In addition; a No. 6 ground wire should be bonded to the interior metallic water pipe and the power ground rod.

b. If the power service and the telephone protector are connected to separate ground rods, bond the two rods together as shown in Figures 11 and 12.

CAUTION: Whenever a bond has been established, it should not be removed. If it becomes necessary to open the bond, as in the case of a rearrangement, a temporary bond should be placed across the location before it is opened.

6.03 The customer's telephone service may be installed where a power ground is not provided. However, the customer should be informed immediately of the need for a power ground and

should be requested to notify the telephone company when the ground has been provided. Follow local procedures for notifying the customer. Where telephone service is already being furnished and there is no power ground, the same procedure should be followed. When installing telephones at contractor shacks, trailers, etc., and an acceptable metallic cold water pipe is not available, the telephone protector must be connected to a telephone ground rod. This ground rod must be bonded to a power ground rod as soon as the power ground rod has been installed and connected.

7. SELECTION OF SIGNALING GROUND

7.01 When a signaling ground is required, the protector ground should be used as a first choice. Ground strips connected to ground sheath cables at terminals are suitable for signaling grounds. When commercial power is connected to telephone equipment, the signaling ground shall be bonded to the protector ground at the protector, or by using the same grounding medium. When commercial power is not connected to telephone equipment, it is desirable to bond protector and signaling grounds; however, it is not required.

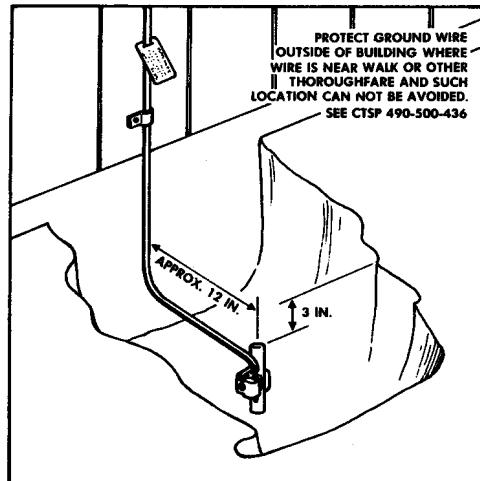


FIGURE 32. Ground Installation Near Wall

8. LOCATING AND INSTALLING GROUND RODS

CAUTION: Avoid personal injury by protecting the eyes and hands when driving ground rods.

8.01 Locate and install ground rods as follows:

- a. Where they are least likely to be damaged or tampered with.
- b. As near as possible to masonry walls in earth-floor basements.
- c. Approximately 12 inches from the outside wall. See Figure 32.
- d. Approximately 2 feet from the base of wooden poles or posts, where conditions permit. See Figure 33.
- e. At least 6 feet from the power service ground rod.
- f. Drive the ground rods until the top of the rod is approximately 3 inches below ground level. See Figures 32 and 33. Increase the depth where damage from digging is possible.
- g. If the vertical or horizontal station ground wire run is located so it can be damaged or tampered with and such a location cannot be avoided, protect the ground wire with P.V.C. plastic house and building riser. See CTSP 490-500-436.

8.02 After the ground rod is installed, select the proper size and type of ground clamp from the list in Table C.

8.03 When two or more protectors requiring ground rods are installed at the same location, proceed as follows:

NOTE: Refer to Table A for the proper size of station ground wire to be used.

- a. If a power ground rod is not available, install a ground rod for each protector. It is not necessary to place more than 3 ground rods. Place station ground wire from each ground rod as shown in Figure 34.
- b. If a power rod is available, one telephone ground rod is sufficient. Bond all protectors together and bond the telephone ground rod to the power ground rod, as shown in Figure 11.

8.04 Multiple type station protectors may be connected to any of the grounds shown in Figures 6 through 18, but they should not be connected to a single telephone ground rod unless the rod is bonded to the power system ground rod. If a power ground rod is not available, a multiple station protector may be connected to an assembly of three telephone ground rods, spaced at least 6 feet apart and bonded together with No. 6 station ground wire. See Figure 34.

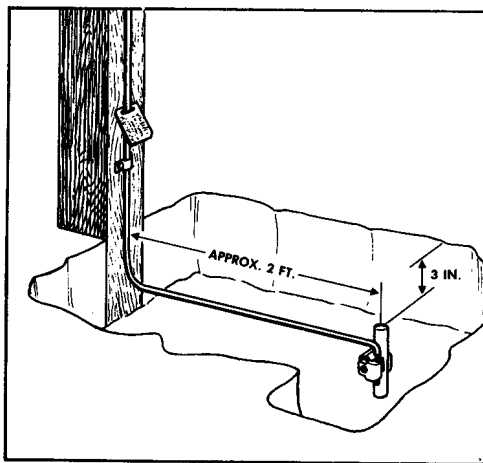


FIGURE 33. Ground Rod Installation Near Pole

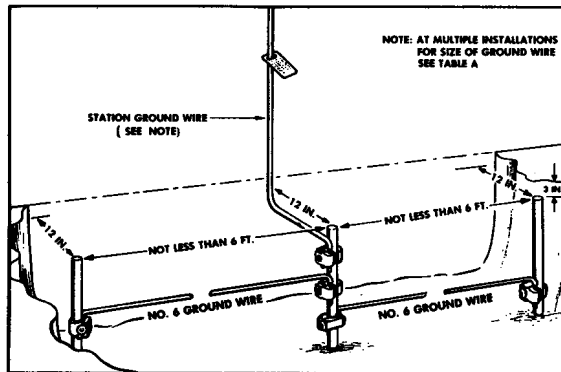


FIGURE 34. Three Ground Rods

STATION PROTECTION AND WIRING
MOBILE HOMES

1. GENERAL
 - 1.01 This addendum is to correct Figures 1, 2, 3 and 4 reference to other figures.
 - 1.02 With red pencil or ink, make the changes shown in paragraph 2 of this addendum. Under the subject figures, write the words "See Addendum".
 - 1.03 File this addendum directly in front of CTSP 475-500-425.
2. CORRECTIONS
 - 2.01 Change the reference in Figures 1, 2, 3 and 4, that presently reads "Buried Service Wire, See Figures 9, 10 and 11" to read, "Buried Service Wire, See Figures 7, 8 and 9". The reference is located at the top of the window of the mobile home in Figures 1, 2, 3 and 4.

STATION PROTECTION AND WIRING MOBILE HOMES

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GENERAL	1
TEST EQUIPMENT AND MATERIAL	2
TESTING FOR HAZARDOUS VOLTAGE	3
INSTALLING SERVICE DROPS	4
GROUNDING MOBILE HOMES	5
BONDING MOBILE HOMES	6
INSTALLING STATION PROTECTORS AND WIRE	7

1. GENERAL

1.01 In many areas of the Continental Telephone System, the electrical hookup to mobile homes is not state regulated. This practice provides information on installation, grounding and bonding procedures for mobile home telephone service.

1.02 For the purpose of this practice, the term **mobile home** includes camp cars, trailer coaches, and travel trailers.

1.03 This practice replaces in its entirety CTSP 475-300-413, Attachments, Trailer Courts and Auto Trailers. All copies of CTSP 475-300-413 should be removed from the file and destroyed.

1.04 Before installation is started, all necessary arrangements should be made with the customer and mobile home park manager or owner. The arrangements may include such facilities as private poles, opening and closing trenches for buried underground wire, and permission to attach wire to mobile homes for proper installation. Where such arrangements have not been made, the installer should refer the Contact Memo to the supervisor.

1.05 Where attachments are made on jointly used poles or posts, standard separations between power and telephone wires shall be provided. All clearance requirements over driveways and/or streets shall be met.

CAUTION: Defects in electrical equipment or wiring in a mobile home could energize the unit and become an electrical hazard to persons in or near it. If it is found that a hazardous condition exists, the installer shall inform the supervisor of the condition and cease all work operations until the condition has been corrected. The occupant or

mobile home park manager should also be informed of the hazardous condition.

1.06 Ground wire warning tags should be placed at (or as close as possible to) all ground and bond wire terminations including the protector.

2. TEST EQUIPMENT AND MATERIAL

2.01 This paragraph lists the test equipment and material covered in this practice. For convenience, CTS catalog numbers are listed when available.

a. Test equipment

- (1) B. Voltage Tester, CTS #74-94-310-3.

b. Material

- (1) Ground Wire Warning Tag, CTS #51-77-016-4.
(2) Rubber Gloves; see Gloves, Rubber, Lineman's.
(3) Beam Clamp, CTS #68-11-058-8.
(4) Round Head Machine Screw, 1/4-20 x 3/8 inch.
(5) Station Ground Clamp, CTS #68-11-014-6.
(6) L Ground Clamp, CTS #60-17-041-7.
(7) Ground Rod Clamp, GC166S0, CTS #68-11-061-8.
(8) 201 Grounding Lug and Crimping Collar, CTS #68-11-018-9.
(9) Flat Washer, Zinc or Cadmium Plated, 3/4 inch.
(10) Mobile Home Connecting Block, CTS #70-10-040-3.

3. TESTING FOR HAZARDOUS VOLTAGE

3.01 Before making bodily contact with any metal portion of the mobile home, test for the presence of hazardous voltage on the mobile home body or chassis.

3.02 Use the B Voltage Tester and follow the instructions in CTSP 490-050-106 for verifying the presence of voltage on ground leads on joint use poles. If it is necessary to cut through paint to ensure good contact between the mobile home and the B Voltage Tester, select an inconspicuous location to avoid marring the appearance of the mobile home. Wear rubber gloves and avoid bodily contact with the mobile home during this operation.

CAUTION: If the B Voltage Tester indicates that

Distribution C D E F

any part of the mobile home is energized, do not proceed until the supervisor is notified and the condition corrected.

4. INSTALLING SERVICE DROPS

4.01 The distribution plant serving a mobile home park may be any of the following types, depending on the number of lines required:

- a. Drop wire, multiple or single.
- b. Distribution wire.
- c. Aerial cable.
- d. Buried cable.

4.02 Service to individual mobile homes may be either an aerial drop wire or a buried wire.

a. For **aerial installations**, the pole should be 4 inches by 4 inches, and extend a minimum of 10 feet above the ground. See Figure 1. The base of the pole (or post) should be set into the ground a minimum of 3 feet, as shown in Figure 1. Do not attach drop wire spans which cross over public thoroughfares to a customer's pole. For instructions on clearances, refer to the CTS 490-060 series of practices.

NOTE: Under no circumstances should two posts, 2 inches by 4 inches, be nailed or wired together in lieu of one post, 4 inches by 4 inches.

b. For **buried installations**, the pole should be 4 inches by 4 inches and extend a minimum of 2 feet above the ground. See Figure 2. The base of the pole (or post) should be set into the ground a minimum of 18 inches, as shown in Figure 2.

NOTE: Under no circumstances should two posts, 2 inches by 4 inches, be nailed or wired together in lieu of one pole, 4 inches by 4 inches.

5. GROUNDING MOBILE HOMES

5.01 See CTSP 475-500-410 for grounding and bonding procedures and preferred ground choice. After installing the protector, connect a No. 14 ground wire from the protector to the grounding medium. See Figures 1 through 4. **It is particularly important to have the power and telephone grounds bonded together. If separate ground rods are used for any reason, bond them together.**

5.02 Place a ground wire warning tag at (or close as possible to) **all** ground wire terminations including the protector.

6. BONDING MOBILE HOMES

CAUTION: The mobile home chassis must be bonded directly to either the power ground or the telephone ground, both of which are bonded together. No additional external bond is necessary where this condition is fulfilled. After making the test for hazardous voltage as instructed in paragraph 3., verify that electrical continuity exists from the mobile home chassis to ground. This bond shall not be removed once installed. If it becomes necessary to temporarily open the bond, a temporary bond should be provided across the location before it is opened.

6.01 Use a suitable size beam clamp to bond the mobile home chassis to the station ground. Attach the clamp to a flange on the structural member of the mobile home chassis (see Figures 1 through 4). Attach the No. 10 ground wire to the beam clamp with a 1/4-20 x 3/8 inch round head machine screw (zinc or cadmium plated) and a suitable size zinc or cadmium plated flat washer. The ground wire should be installed in a manner to provide the best possible mechanical protection.

6.02 Bonding should be completed before any installation work is started on the mobile home.

6.03 Place a ground wire warning tag at (or as close as possible to) **all** bond wire terminations.

7. INSTALLING STATION PROTECTORS AND WIRING

7.01 Mobile home installations vary, depending on the type of facilities provided by the customer.

7.02 The protector should be located on a private post, as near as possible to the mobile home. **Protectors and attachments shall not be mounted on mobile home siding.** See CTSP 475-500-402 for selection of protectors to be used.

7.03 The inside wiring and cabling of mobile homes should be done in the same manner as for permanent structures. In some cases, short lengths of conduit for telephone wiring are provided between the bottom of the mobile home and outlet locations. Where such facilities are not provided, entrance holes should be drilled in the floor, the wire pulled through, taped to protect from the weather, and terminated on a connecting block on the inside wall.

7.04 In all cases, use buried service wire from the service post to the mobile home. Secure the buried service wire, remove the outer jacket; then proceed to wire the mobile home with the buried service wire (outer jacket and shield removed). When the mobile

home is located more than 12 inches from the service post, the buried service wire (along with any other wires) must be placed at least 18 inches in the ground. Be careful not to expose the buried service wire to buried power in the ground. See Figures 5 and 6.

7.05 The metallic shield should be grounded at both ends to keep all conducting material at ground potential. See CTSP 475-500-405, paragraph 6. Attach buried service wire to mobile home chassis using a beam clamp as shown in Figure 7.

7.06 It is not necessary to run all buried service wires directly to the protector. The following method can be used for terminating wires under the mobile home to eliminate the need for running more than one buried service drop to the mobile home from the protector:

- a. Attach a mobile home connecting block to the mobile home steel understructure at a convenient location. See Figure 8.

CAUTION: Be sure the securing bolt of the clamp and the undernut of the ground post are tight; together they serve as the bond wire termination when the chassis must be bonded to ground.

- b. Use the strain relief clamp to hold all wires terminating on the connecting block.

c. Terminate on the mobile home connecting block:

- (1) The No. 10 bond wire on the ground post, if a bond of the chassis to ground is necessary.
- (2) The shield of the buried service drop using the 201 grounding lug and crimping collar on the ground post. See Figures 8 and 9 and CTSP 475-500-405, paragraph 6.
- (3) The buried service wire and all other station wires on the appropriate wire terminals. See Figures 8 and 9.
- (4) Snap cover into place.

7.07 The method used for running inside wire on the underside of the mobile home depends on its construction. In some cases, the wire can be attached to exposed wood. Clamps, rings or staples can be used in such cases. If no wood is found, beam clamps, utility clips and rings, or adhesive inside wire clips should be used to support the wire. **Under no circumstances should any attachment be made to the composition material on the underside of the mobile home.**

NOTE: In areas of high humidity where corrosion is a problem, it may not be desirable to use a mobile home connecting block. In these cases, all of the wires (buried service wires) should terminate at the protector. Be sure to ground both ends of the shield of all buried service wires.

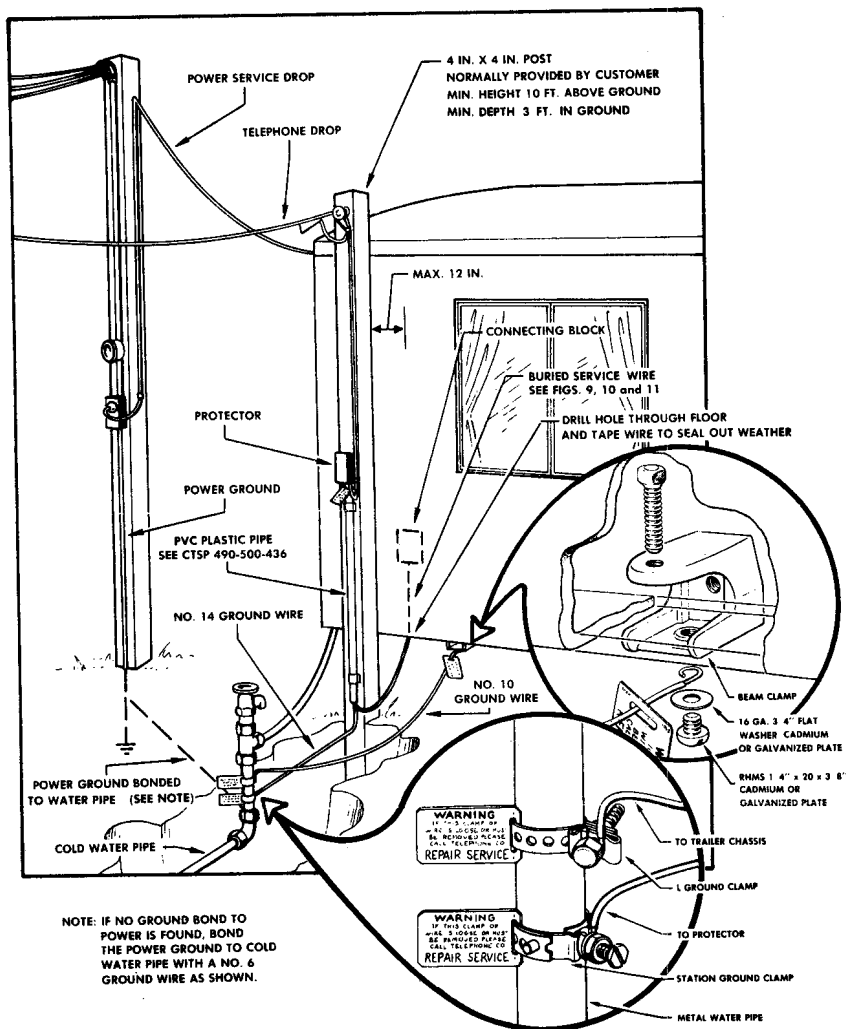


FIGURE 1. Typical Installation—Aerial Distribution Water Pipe Ground

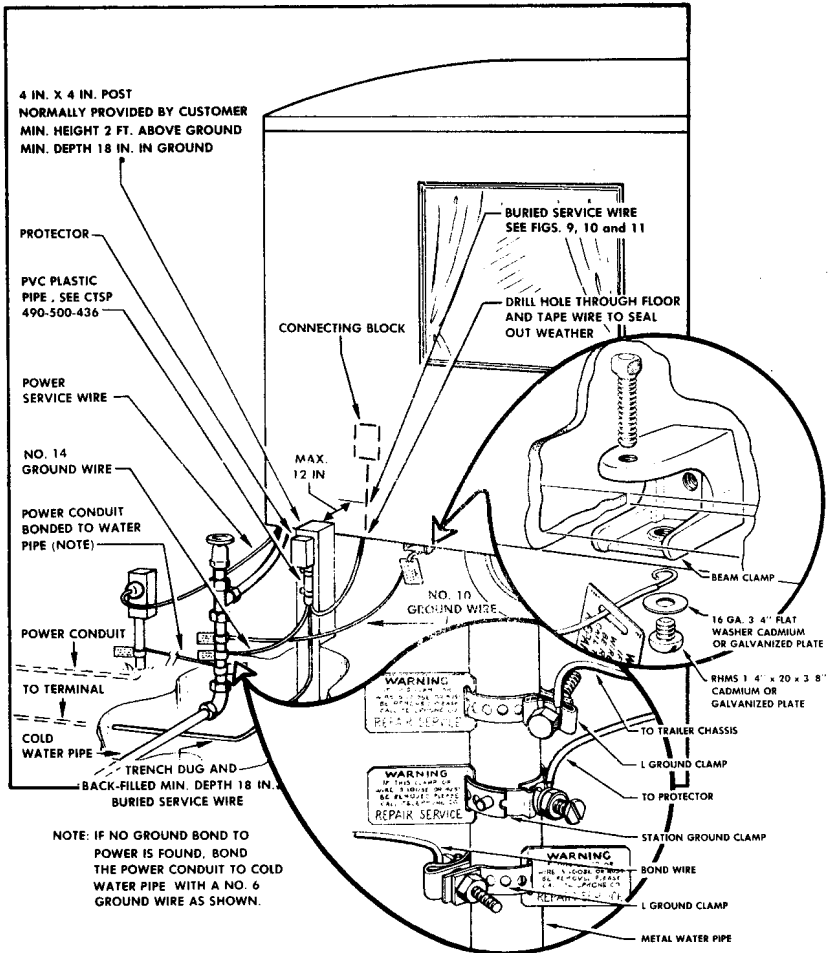


FIGURE 2. Typical Installation - Buried Distribution Water Pipe Ground

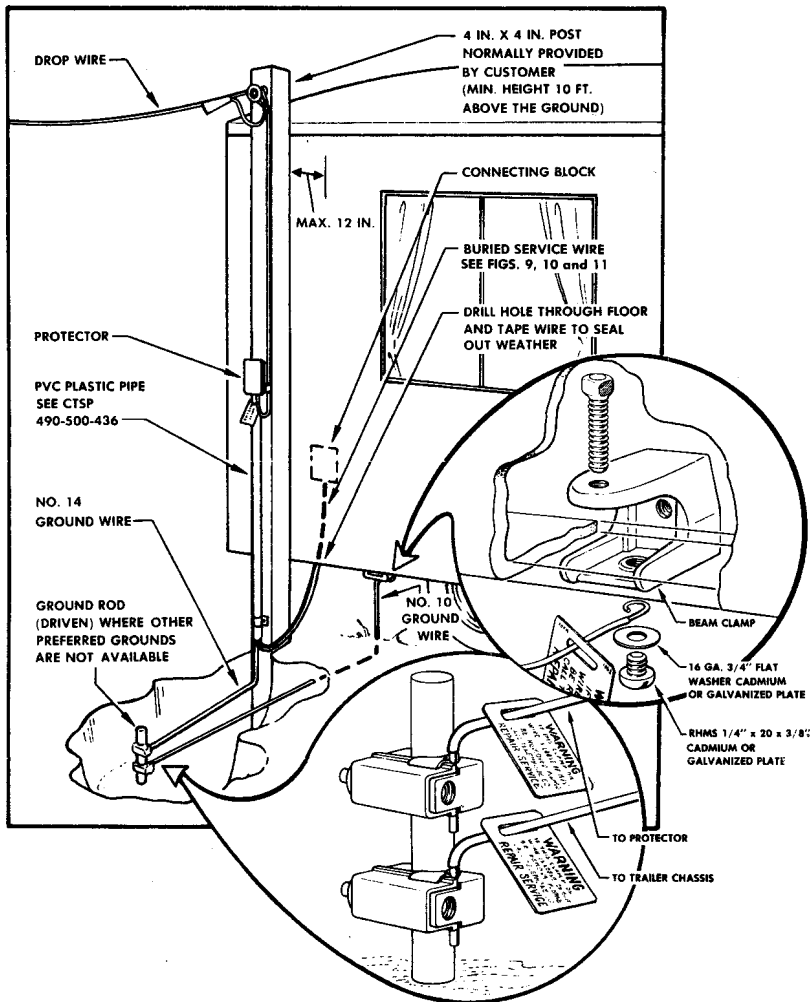


FIGURE 3. Typical Installation—Aerial Distribution, Ground Rod Ground

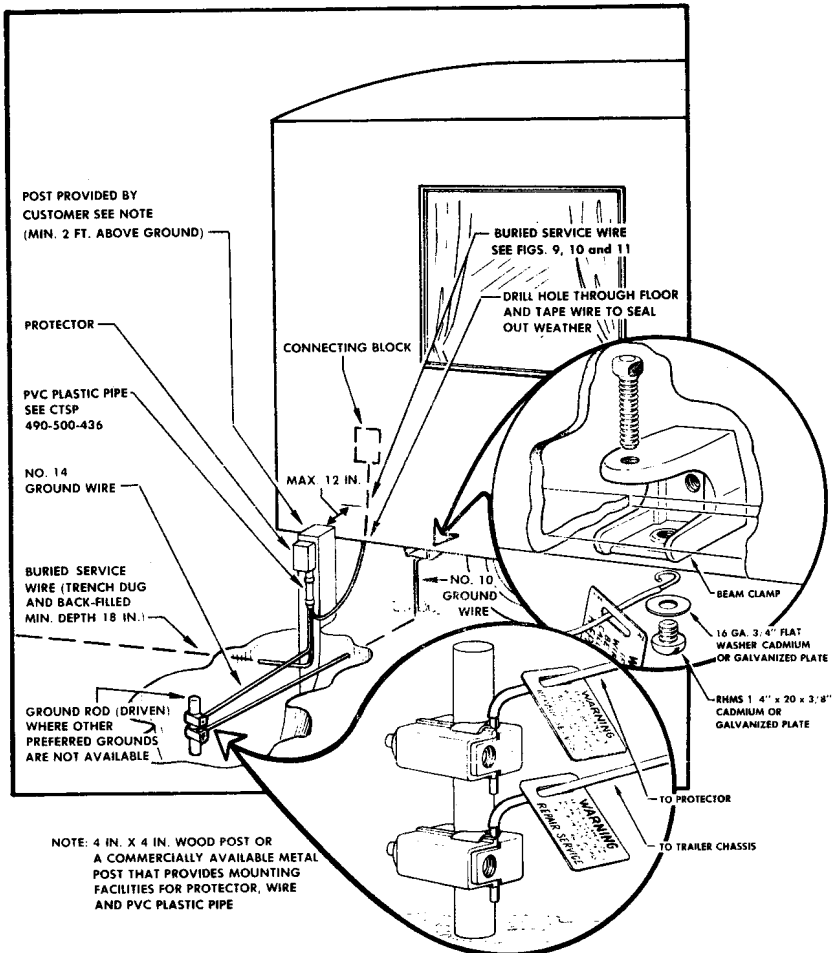
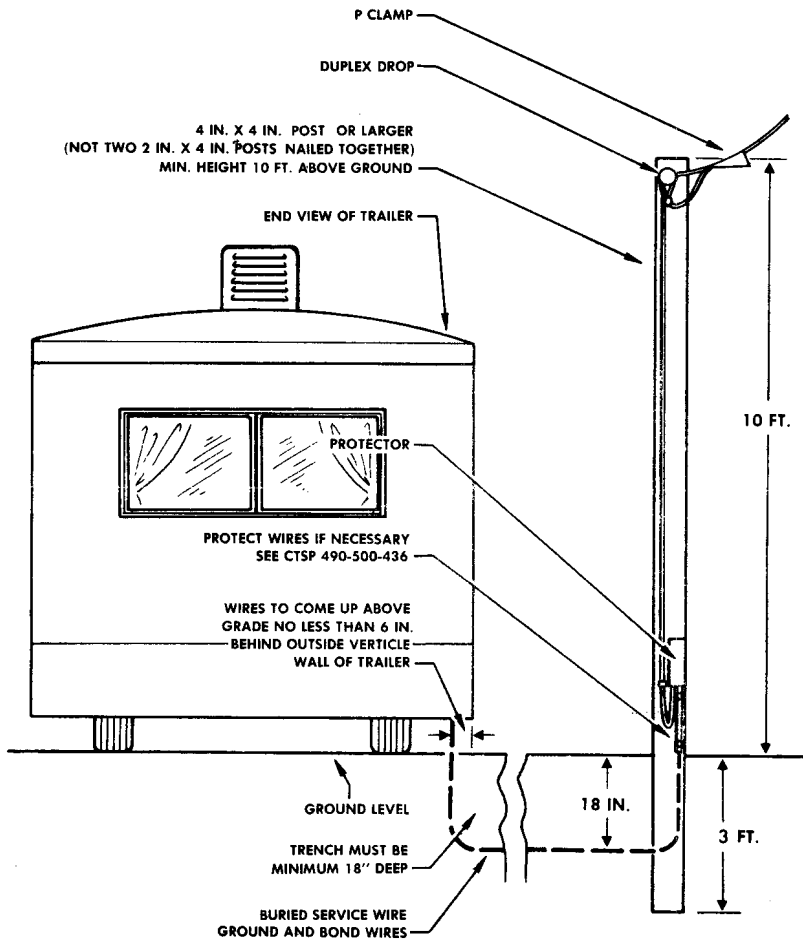


FIGURE 4 Typical Installation--Buried Distribution, Ground Rod Ground



NOTE: POST MAY BE PLACED IN ANY CONVENIENT LOCATION
AROUND TRAILER PROVIDING ABOVE CONDITIONS ARE MET

FIGURE 5. Mobile Home Installation When Service Post Is Not Within 12 Inches of Aerial

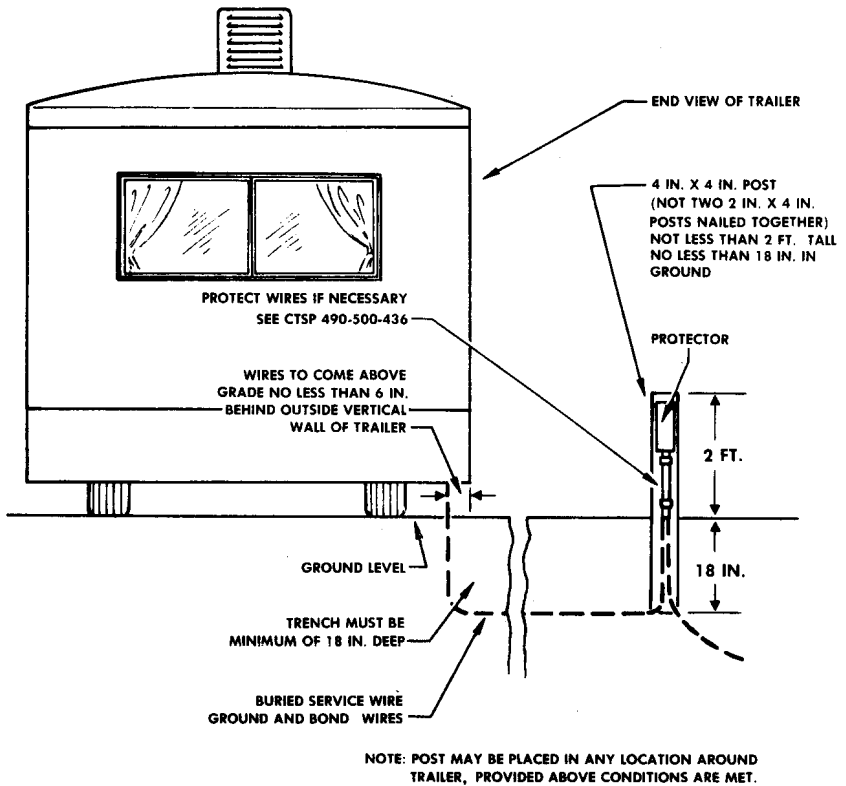


FIGURE 6. Mobile Home Installation When Service Post Is Not Within 12 Inches - Buried

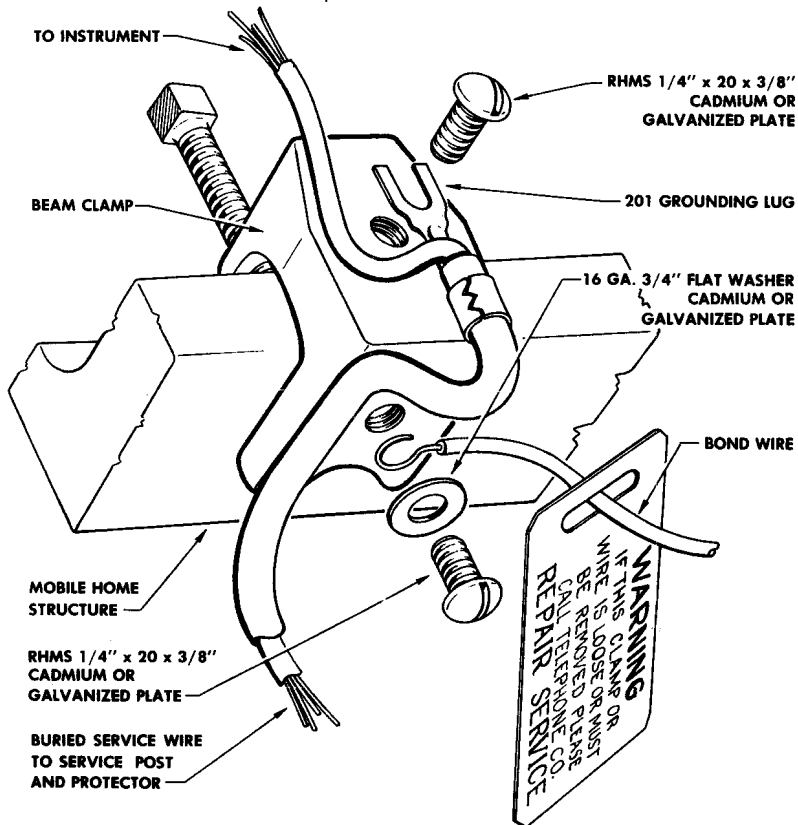


FIGURE 7. Grounding Shield of Buried Service Wire Using Beam Clamp

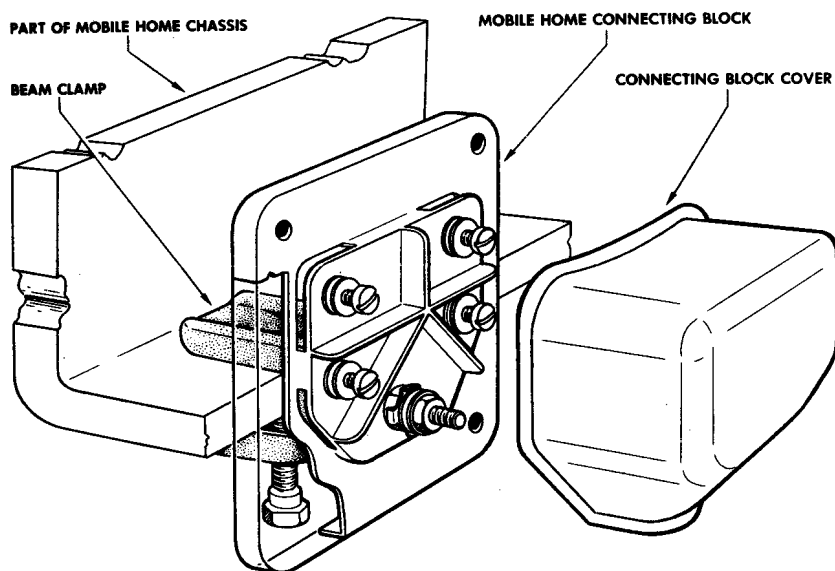


FIGURE 8. Mobile Home Connecting Block

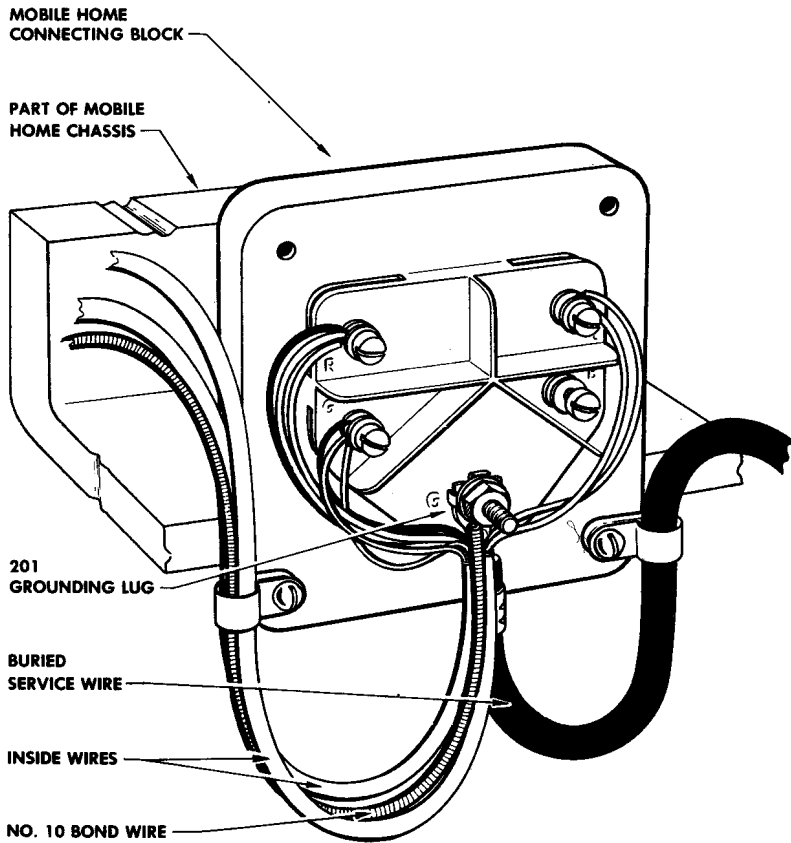


FIGURE 9. Using Mobile Home Connecting Block Under Mobile Home As
A Junction Point For Inside Wires And Bond Wire .