STATION PROTECTION AND SIGNALING GROUNDS SELECTION AND INSTALLATION

CONTENTS

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.

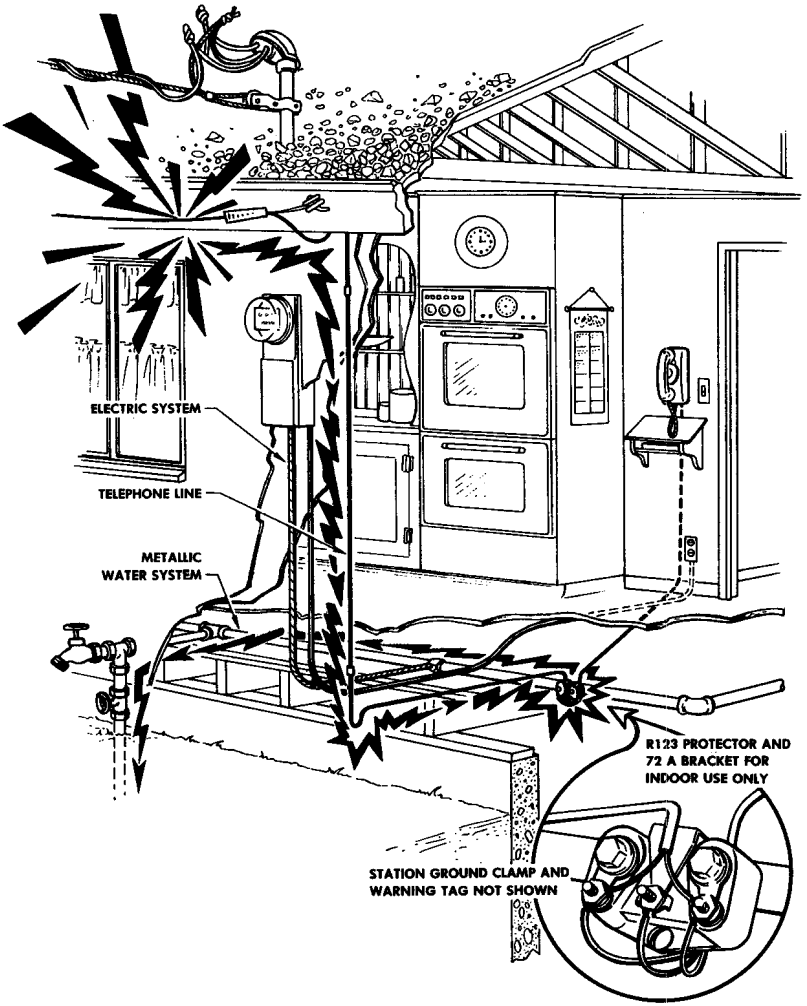

FIGURE 1. Preferred Effective Ground

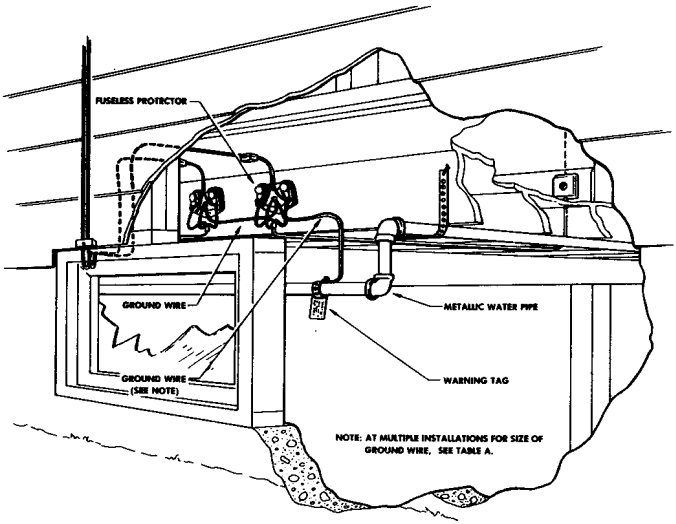

FIGURE 2. Ground Wire Run—Fuseless Protector

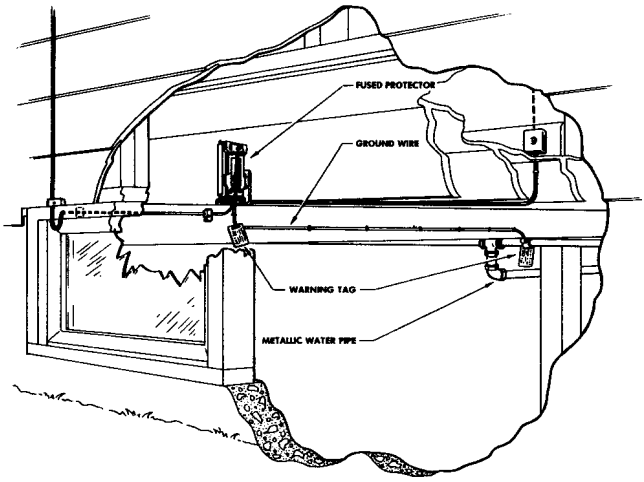

FIGURE 3. Ground Wire Run—Fused Protector

(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 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.

TABLE A. Ground Wire Capacity

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

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

4.04 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.

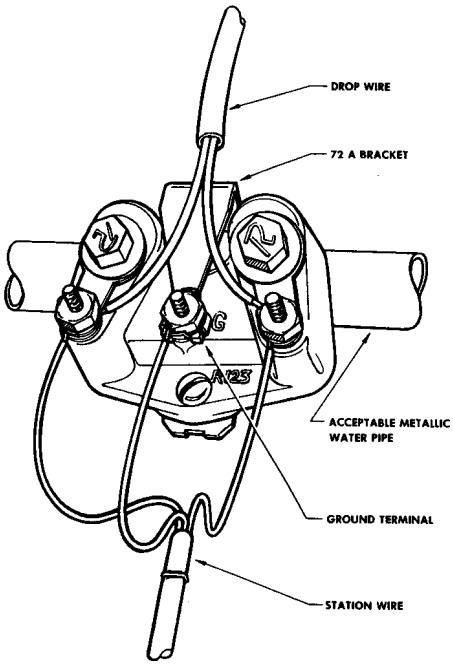

FIGURE 4. Protector Mounting—72A Bracket (For Indoor Use Only) See Paragraph 1.08 Note

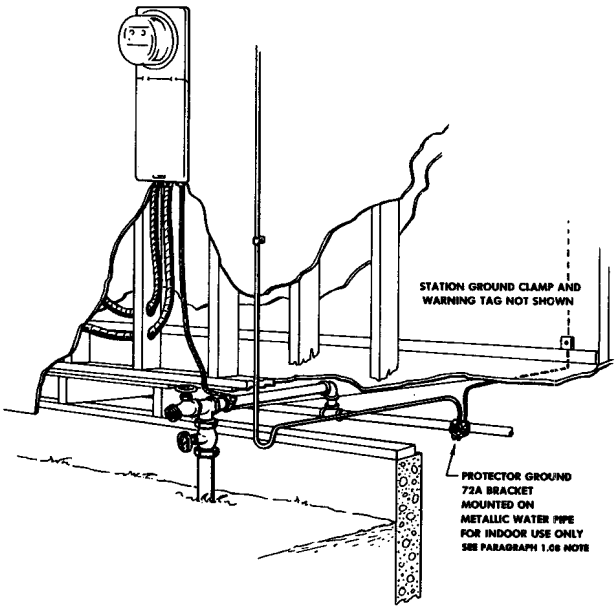

FIGURE 5. Protector Ground—72A Bracket

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.

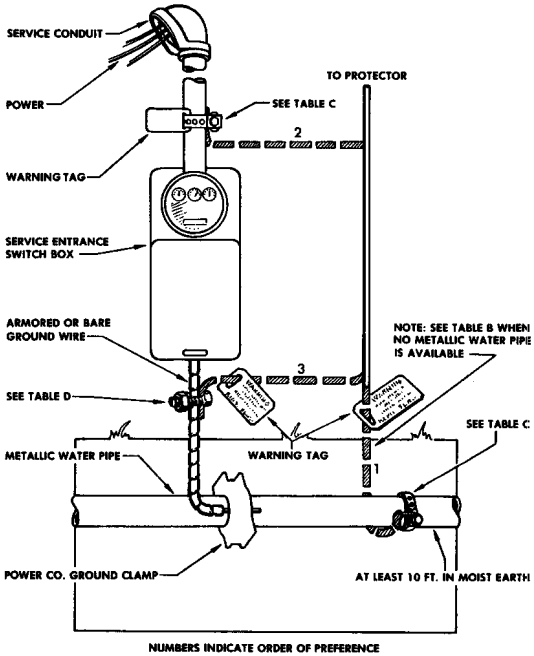

FIGURE 6. Power Grounded to Acceptable Water System

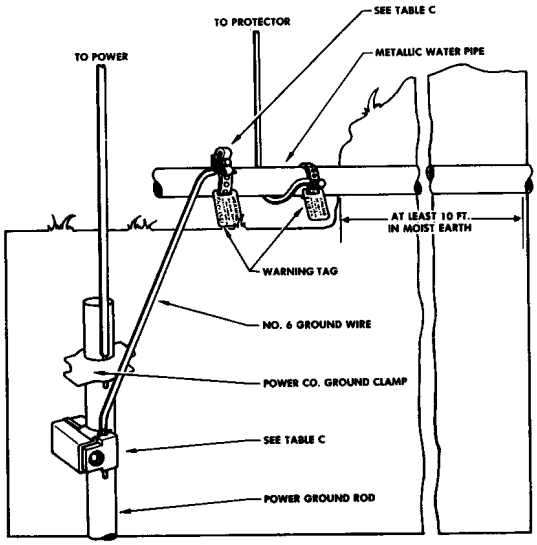

FIGURE 7. Grounding to Metallic Water System—Power on Ground Rod at Premises

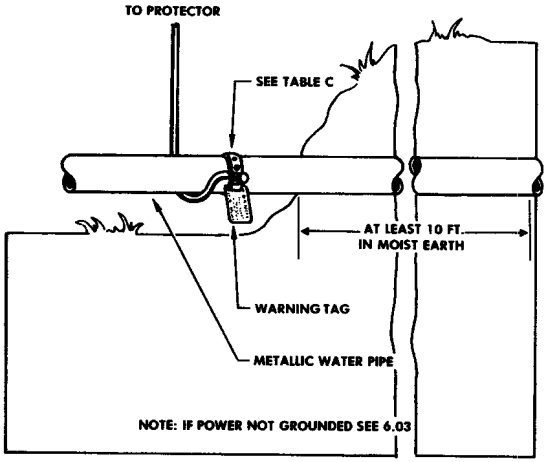

FIGURE 8. Grounding to Metallic Water System—Power (If Any) Not Grounded at Premises

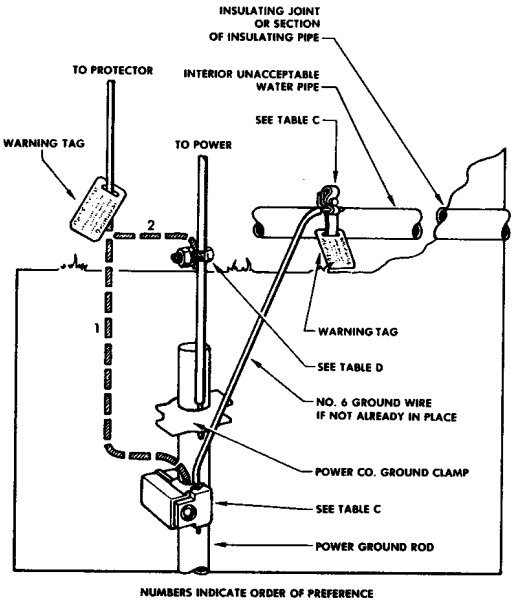

FIGURE 9. MGN Power Grounded to Ground Rod—Unacceptable Interior Water System

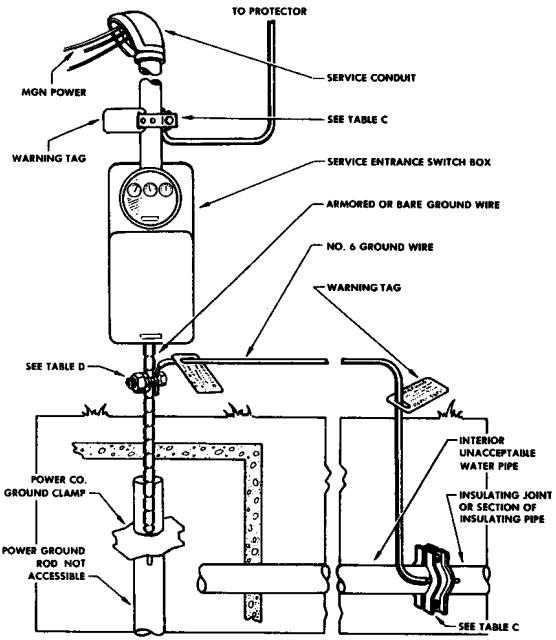

FIGURE 10. MGN Power Grounded to Inaccessible Ground Rod—Unacceptable Interior Water System

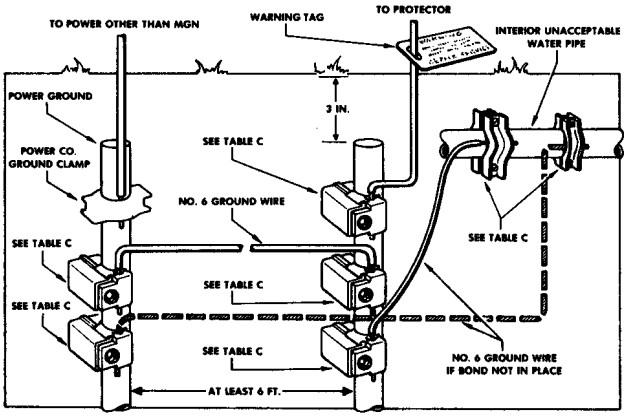

FIGURE 11. Power Other than MGN Grounded to Ground Rod—Unacceptable Interior Water Pipe

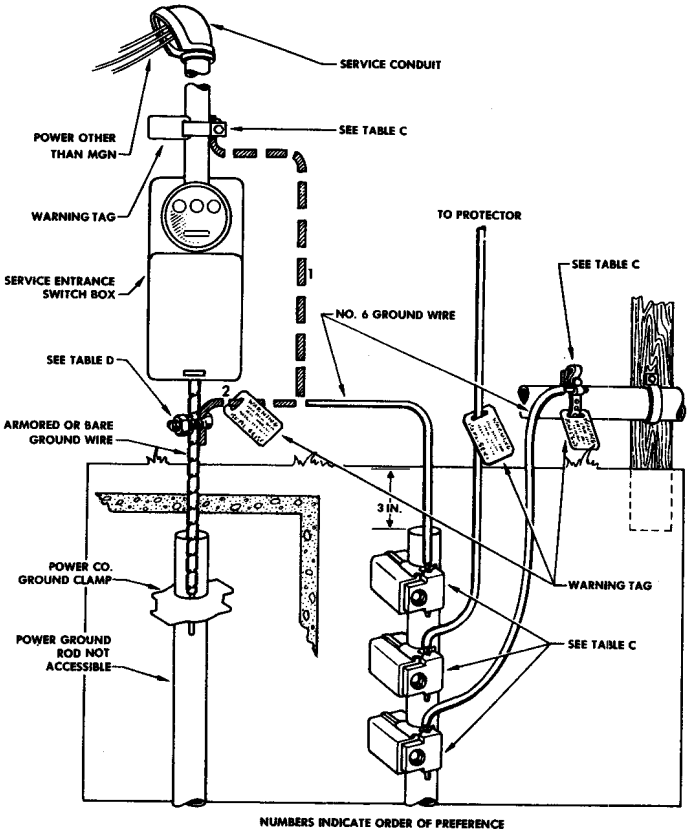

FIGURE 12. Power Other than MGN Grounded to Inaccessible Ground Rod—Unacceptable Interior Water Pipe

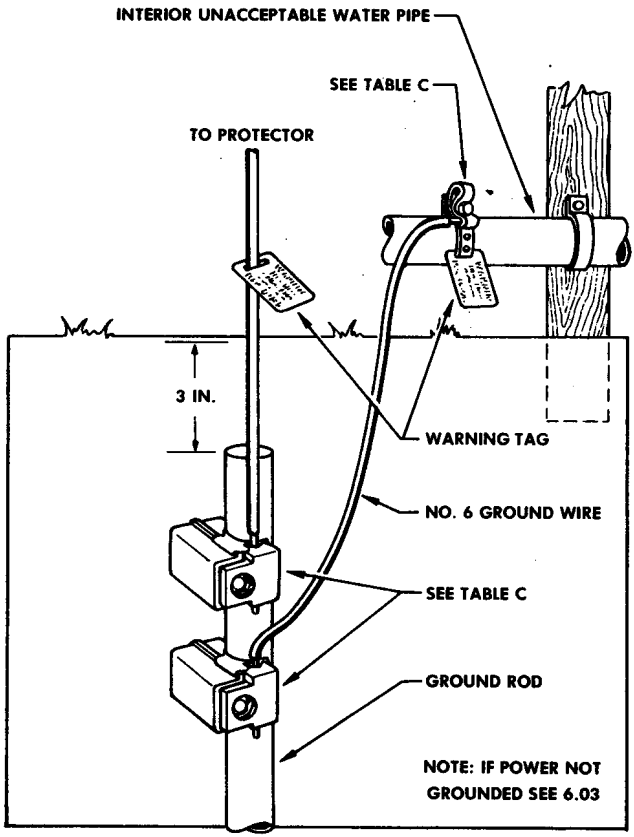

FIGURE 13. Power Not Grounded on Premises—Unacceptable Water Pipe

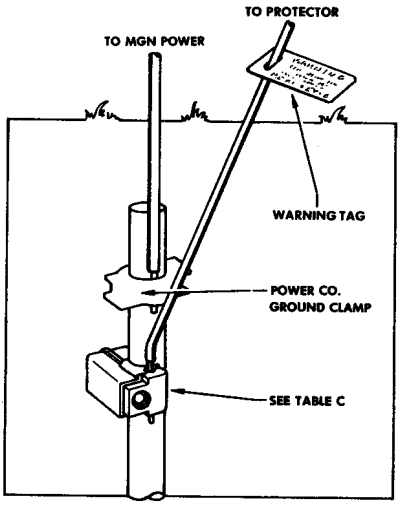

FIGURE 14. MGN Power Grounded to Ground Rod—No Water Pipe—Connection to Pipe Not Possible

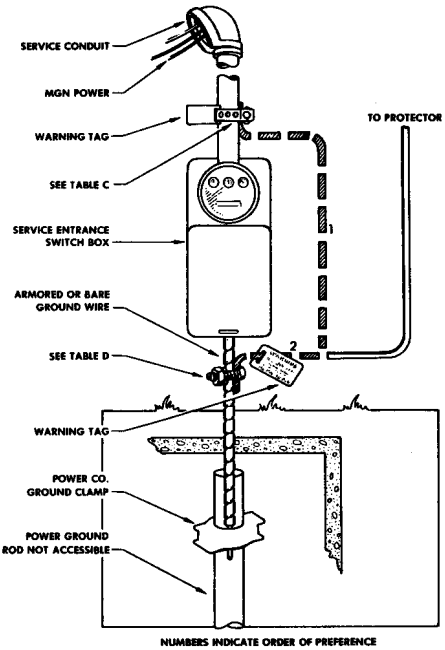

FIGURE 15. MGN Power Grounded to Inaccessible Ground Rod—No Water Pipe—Connection to Pipe Not Possible

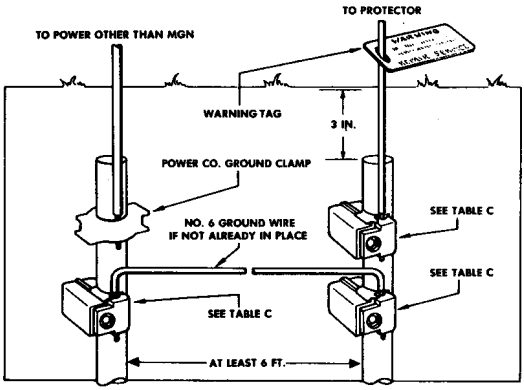

FIGURE 16. Power Other than MGN Grounded to Ground Rod—No Water Pipe

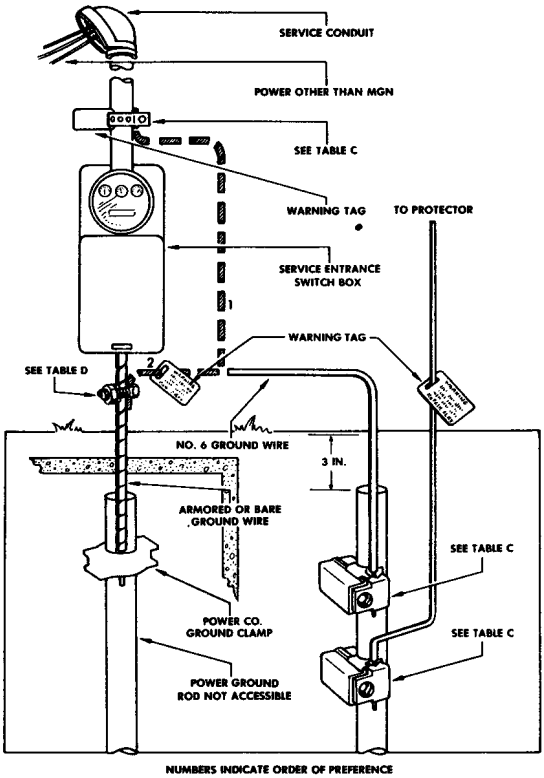

FIGURE 17. Power Other than MGN Grounded to Inaccessible Ground Rod—No Water Pipe

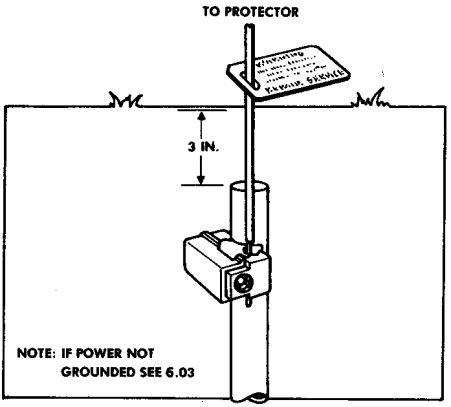

FIGURE 18. Grounding to Telephone Ground Rod—Water Pipe, Power Ground, or Metallic Structure Not Available

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.

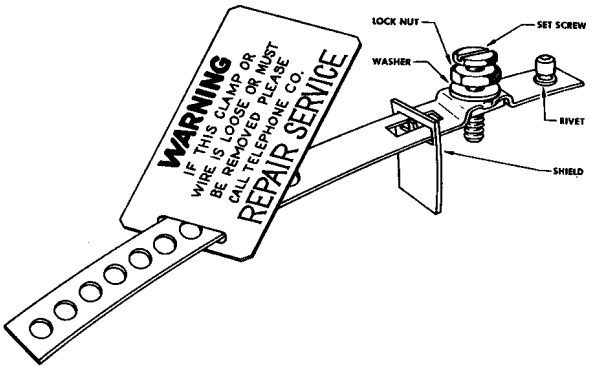

FIGURE 19. Station Ground Clamp

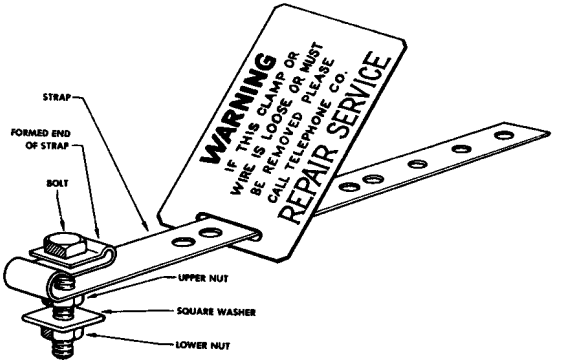

FIGURE 20. L Ground Clamp

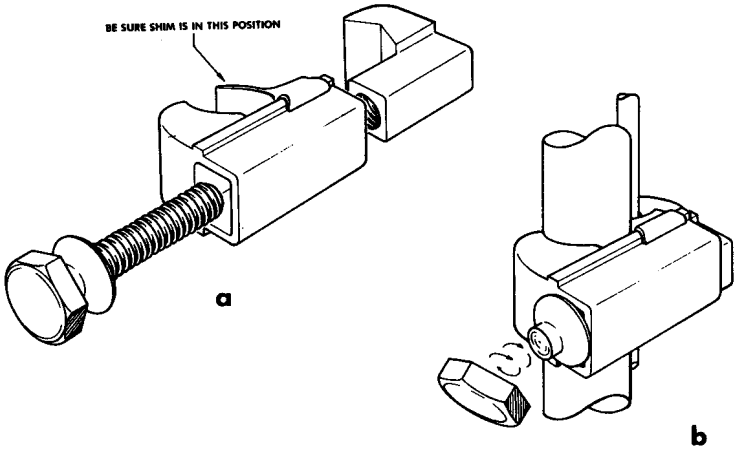

FIGURE 21. GC166S0 Clamp

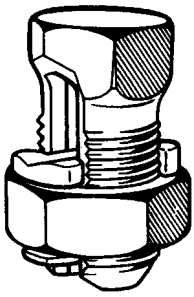

FIGURE 22. Split Bolt Connector

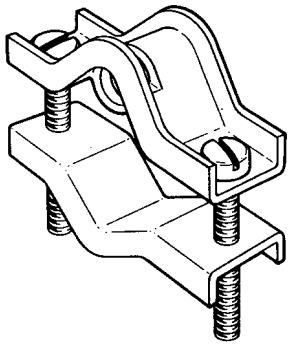

FIGURE 23. 3844 Clamp

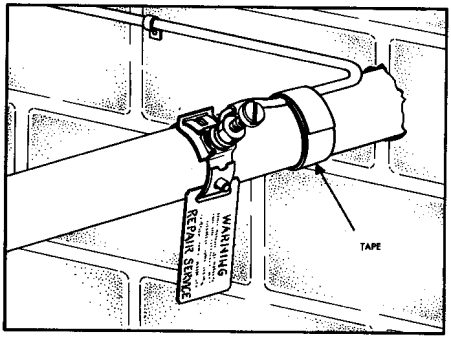

FIGURE 24. Typical Ground Clamp Installation

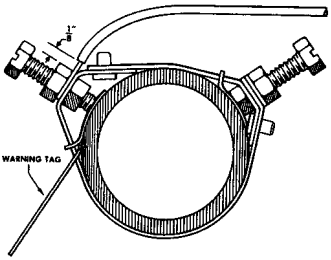

FIGURE 25. Installation on Large Pipes

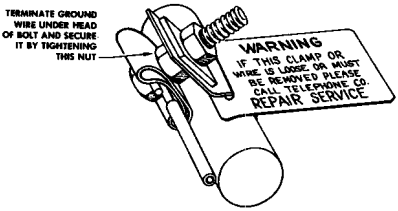

FIGURE 27. Attaching No. 14 or No. 10 ground Wire to L Ground Clamp

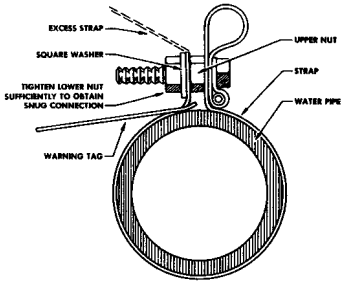

FIGURE 26. Attaching L Ground Clamp to 3-Inch and Smaller Pipe

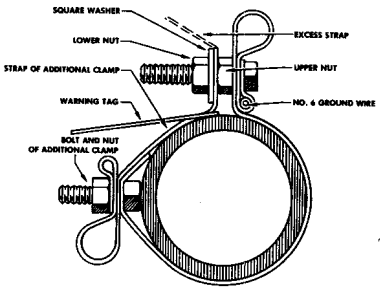

FIGURE 28. Attaching L Ground Clamp to Pipes Larger than 3 Inches

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.

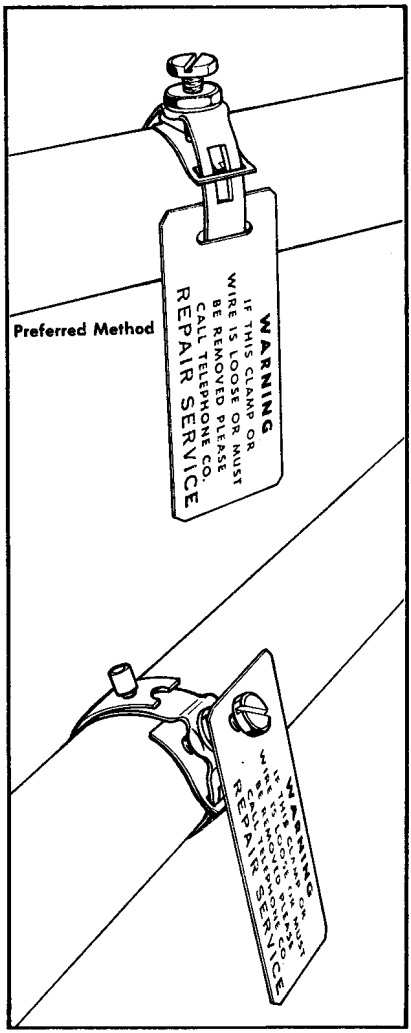

FIGURE 30. Warning Tag Attached to Station Ground Clamp

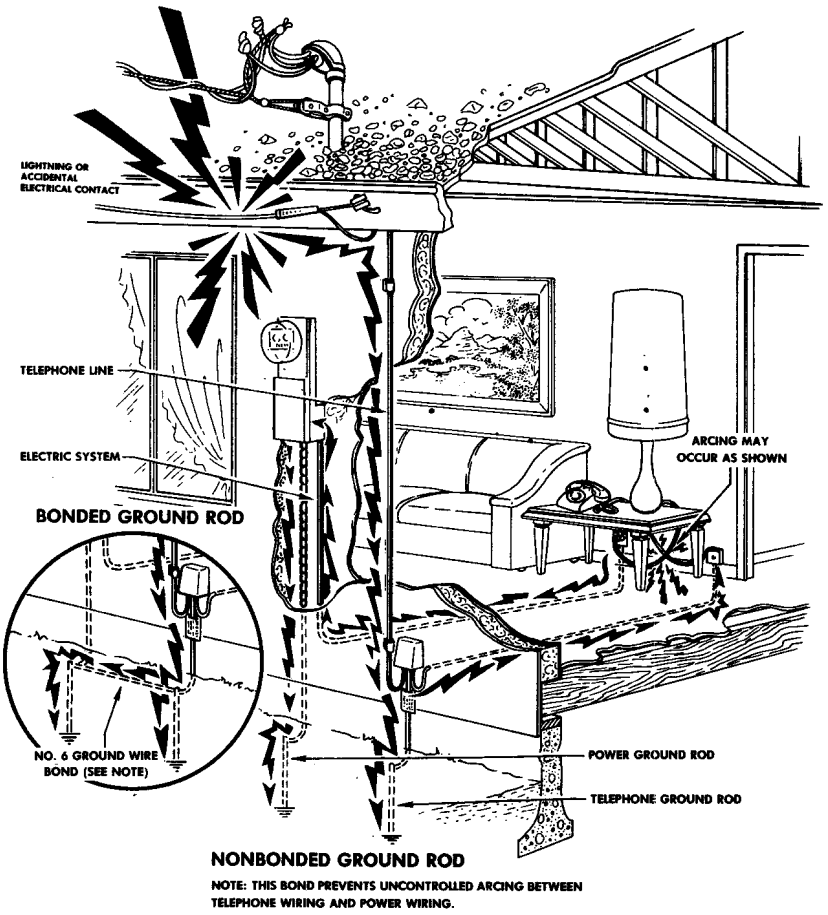

FIGURE 31. Effects of Bonding

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.

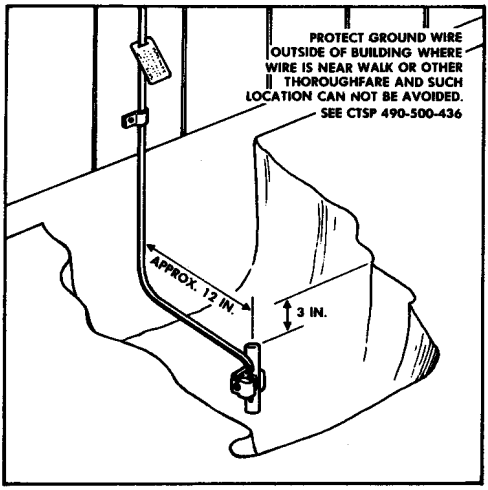

FIGURE 32. Ground Installation Near Wall

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.

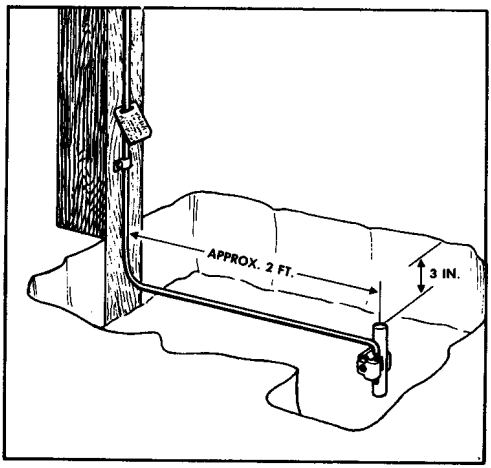

FIGURE 33. Ground Rod Installation Near Pole

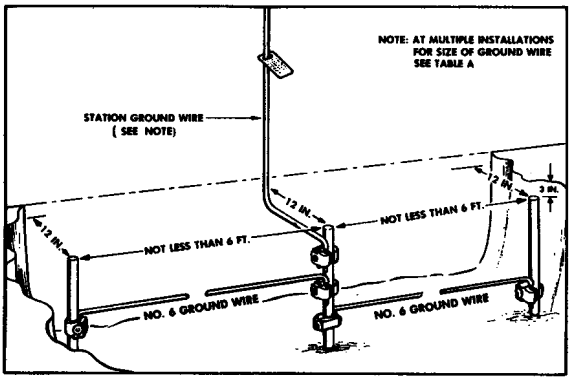

FIGURE 34. Three Ground Rods