PROTECTOR AND SIGNALING GROUNDS

1. GENERAL

1.01 This section covers the selection of protector and signaling grounds and the installation of ground connecting apparatus. It is reissued to bring the section up to date.

1.02 Arrows normally used to indicate changes have been omitted due to a complete revision of the text.

2. SELECTION OF PROTECTOR GROUND

2.01 The selection of protector grounds shall be made in accordance with the order of preference shown in Table 1. No deviation is permitted from this requirement except by the approval of the supervisor or other authorized instructions.

2.02 Where insulated joints are found (usually at meters, valves, pumps, etc.) the ground wire connection should be made at a point in which the insulating joint will not break continuity to ground. Where pumps, meters, etc., may be removed for seasonal overhaul the ground wire connection should be made at a point at which the continuity to ground will not be broken.

2.03 To provide an effective ground, a metallic pipe or structure must have ten feet or more of its surface buried in moist soil.

2.04 Where it is determined that nonmetallic pipe has been used for service entrance, connect to the next choice ground.

TABLE 1

Choice	Grounding Medium	Limitations
1st	Public Water System Pipe	Connect to cold water pipe in service.
Note: Where a water pipe is not readily available, (within 35 feet) or where unusual circumstances are encountered, the protector may be grounded to the power service conduit, service equipment enclosures (meter boxes, etc.) or grounding conductor of the power service if the grounded conductor of the power service is connected to a water pipe at the building. Limitations and methods of fastening to service equipment enclosures and grounding conductors of power service shall be covered by local instructions.		
2nd (Any one of three listed, **preferably same as power ground**)	Private Water System Pipe (Note directly above also applies)	Connect to cold water pipe in service.
	— or —	
	Grounded Metallic Structures (Buried tanks, pipes and conduits)	Where permitted to use Public Gas System Pipes, connect to street side of meter.
	— or —	
	Ground Rod of Multigrounded Neutral Power System	Identification of multigrounded neutral power systems should be covered by local instructions.
3rd	Tel. Ground Rod	Do not use with 109A, 116A or 117A protectors. See Paragraph 5.05 for bonding tel. ground rod to power rod when required by local instructions.

3. SELECTION OF SIGNALING GROUND

3.01 The grounding mediums listed in Table 1 may also be used for signaling grounds. Follow same order of selection as for protector grounds. Ground strips connected to grounded sheath cables are also suitable signaling grounds.

3.02 The wire used for signaling grounds may be any of the following:

(a) *Single station or B block wire.

(b) *Pair station wire.

(c) *One cable pair.

*Limited to six coin collectors in one group. Use No. 14 ground wire for larger installations.

4. INSTALLATION OF STATION GROUND CLAMPS

4.01 The ground clamp should be located at a point where it will not be subject to excessive movement or vibration and where least likely to be damaged by plumbers or foreign workmen.

4.02 Before installing clamp, make certain that surface of pipe being fastened to is free of paint, rust, etc. Clean brass or copper tubing and also nickel or chromium plated pipes carefully.

4.03 Install ground clamp as follows:

(a) Back off lock nut and set screw.

(b) Form copper shoe to approximate contour of pipe.

(c) Bend the strap on each side of the soldered nut as shown in Fig. 1.

(d) Bend strap around the pipe and place strap on the rivet using the hole that provides the least slack in the strap.

(e) Bend excess portion of strap back and tighten set screw. Tighten firmly, but exercise care to avoid breaking clamp. Remove excess portion of strap. Use caution when fastening ground clamp to brass or copper tubing to avoid damaging pipe.

(f) If pipe is too large for a single clamp, use two clamps bolted together as shown in Fig. 1.

(g) A ground wire caution tag Form E-3013 or local equivalent may be placed at the station ground clamp to avoid tampering with the clamp or wire.

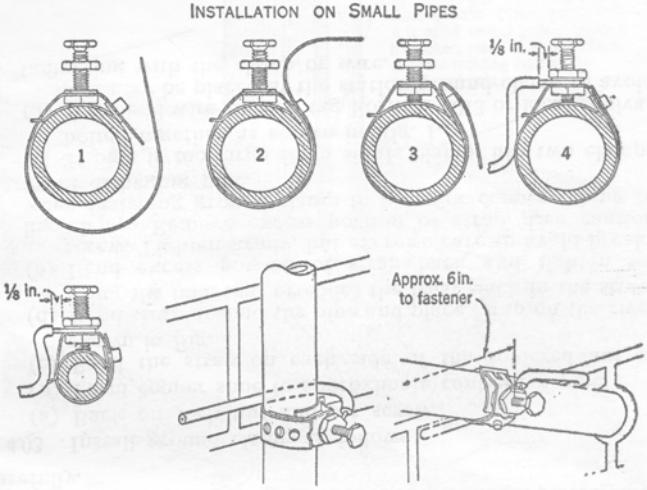


Fig. 1—Typical Ground Clamp Installations

4.04 The capacity of a ground clamp is one protector ground wire or two signaling ground wires. A protector ground and a signaling ground shall not be fastened to the same ground clamp.

4.05 When pipe is insecure or subject to vibration, tape ground wire to pipe in close proximity to ground clamp.

5. INSTALLATION OF GROUND RODS

5.01 Inspect ground rods before and after driving to make certain that tail wire is not broken.

5.02 Locate and install ground rods as indicated in the following:

(a) Where least likely to be damaged or tampered with.
(b) As near as practicable to masonry walls in basements.
(c) Drive to a depth of approximately 3 inches below ground level. Increase depth where digging is likely.
(d) Space telephone ground rods at least 12 inches apart.
(e) At least six feet from power service ground rods.
(f) Approximately two feet from base of wooden poles.

5.03 After ground rod is installed, fasten ground wire to tail of rod with an 064 brass sleeve. Do not tape splice.

5.04 **Only one protector may be connected to a ground rod.** Ground rods should not be used with multiple protectors.

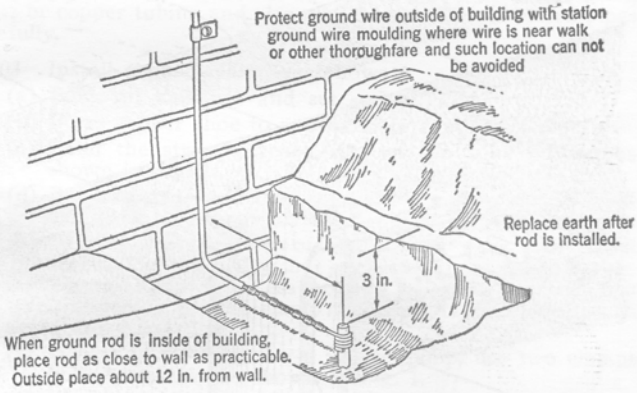


Fig. 2—Ground Rod Near Wall

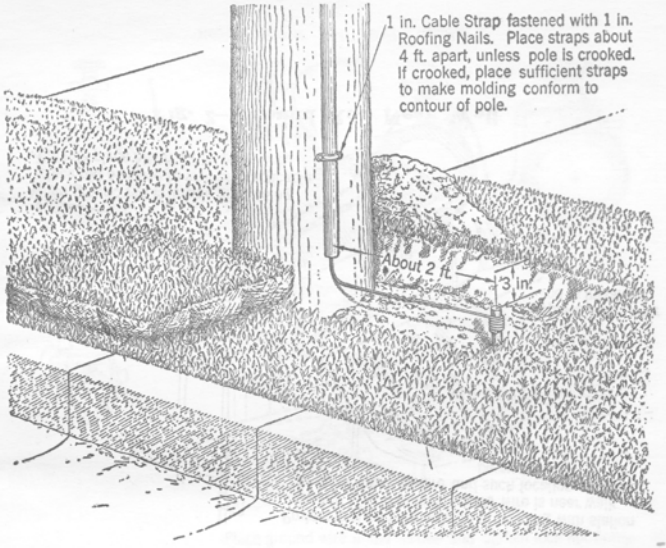


Fig. 3—Ground Rod Near Wooden Pole

5.05 Where local instructions so specify, bond the telephone ground rod to the power ground rod as shown in Fig. 4. The strand ground clamp or approved equivalent may be used at the telephone ground rod and an L ground clamp used at the power ground rod.

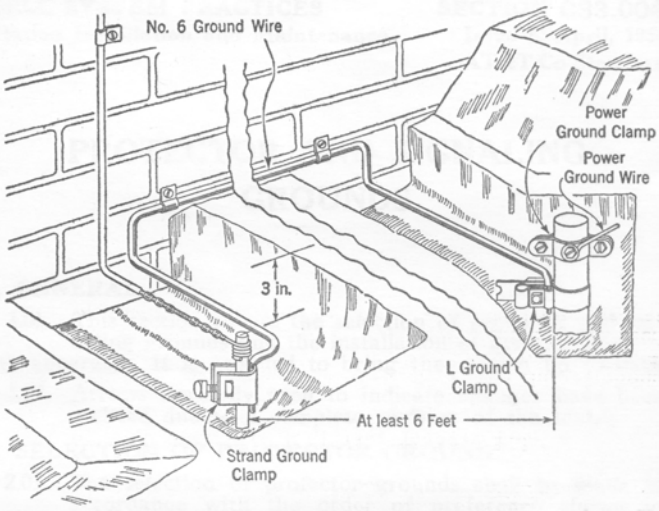


Fig. 4—Bonding Telephone and Power Service Ground Rods

5.06 When using a power ground rod as a grounding medium, fasten ground wire to rod with a station ground clamp.

5.07 Look for and use such conduits provided for ground wires with protector cabinets.

PROTECTOR AND SIGNALING GROUNDS

1. GENERAL

1.01 This addendum supplements Section C33.004, Issue 5 and is issued to replace Part 2 of the section with the following:

2. SELECTION OF PROTECTOR GROUNDS

2.01 The selection of a grounding connection for a station protector is of extreme importance. The object is to obtain the most effective grounding connection practicable, and this may not be the one which is most conveniently available. The best possible protection for telephone apparatus, for telephone users, and for the occupants of a premises is provided where both the power wiring and the telephone wiring on the same premises employ the same good grounding connection.

2.02 **A Cold Water Pipe Giving Metallic Connection With a Public Water System Is Available.** At the usual private premises a cold water pipe of a public water system offers the very best practicable connection to ground, and it is common practice for telephone companies and for power companies to utilize such a cold water pipe as the preferred grounding connection. Frequently the power wiring on a premises is carried in continuous rigid metallic conduit, and where such a conduit system has been bonded effectively to a cold water pipe the conduit installation in fact forms a continuation and extension of the cold water pipe ground connection. Where it can be made certain that the power conduit in fact is an extension of a cold water pipe ground connection the station installer may obtain his protector ground either on a cold water pipe or on a conduit, whichever affords the more direct run less subject to damage. Where it cannot be determined readily that the conduit is bonded effectively to a cold water pipe the station ground connection must be made directly to a cold water pipe.

The absence of a ground wire between the meter or main switch enclosure and a driven rod or pipe usually is evidence that the power service is grounded on a cold water pipe. However, the presence of this driven ground proves nothing because it is used frequently in cases where the power conduit system is grounded on a cold water pipe. Conduit and cold water pipe usually are bonded together with a clamp made specifically for this purpose, or by a piece of No. 6 wire with a ground clamp. Either form of connection usually can be identified readily in an unfinished basement.

If the installation involves an M1-Carrier station the telephone and power wiring must employ a common grounding connection regardless of other considerations, and appropriate arrangements must be made to accomplish such a result involving the use of a cold water pipe connection, if available.

2.03 **Private Water Systems, Buried Metallic Structures, and Power System Ground Rods** are second-choice grounding connections and shall not be used to ground station protectors at any locations where the requirements of 2.02 can be met. These possible grounding connections come under the following general descriptions:

(a) The cold water pipe of a private water system which is in service and which has 10 feet or more of bare metallic pipe buried directly in contact with the ground on the immediate premises.

(b) The pipe of a public gas system where permitted locally. If the meter is located inside or just outside of the building grounding connection must be made on the street side of the meter. If the meter is at the property line some distance from the building connection may be made to the pipe at any point in the building. For either location of the meter it must be made certain that the grounding connection achieves metallic connection to 10 feet or more of bare metallic pipe buried directly in contact with the ground on the immediate premises.

(c) A metallic pipe connecting to a buried metallic tank which gives the equivalent of 10 feet or more of bare metallic pipe buried directly in contact with the ground on the immediate premises.

(d) Driven ground rods or pipes of the power company.

Whenever electric power service is on the premises and this power service **is supplied through a multi-grounded neutral system** the telephone station protector ground connection must be made to the same structure which the power company utilizes. This connection may be made either by a ground clamp directly on the structure or by way of a rigid metallic conduit system (as in 2.02) where the latter is bonded effectively to the grounding structure. If the power service **is not supplied through a multi-grounded neutral system** then the most attractive of structure (a), (b) or (c) from the standpoint of effective grounding must be selected. The structure employed by the power service should be the first choice unless visual inspection discloses a fault that raises doubt as to its effectiveness. If there is no choice except structure (d) ground the station protector in accordance with 2.04.

2.04 **A Telephone Ground Rod** is a third and last choice for a station protector ground, and shall be used only where none of the structures mentioned in 2.02 and 2.03 is available. If the installation involves an M1 carrier station bond the telephone and power ground rods together as covered in Fig. 4 of the section. **Do not use ground rods with 109A, 116A or 117A Protectors.**

2.05 Where insulated joints are found (usually at meters, valves, pumps, etc.) the ground wire connection should be made at a point in which the insulating joint will not break continuity to ground. Where pumps, meters, etc., may be removed for seasonal overhaul the ground wire connection should be made at a point at which the continuity to ground will not be broken.

2.06 It shall be the responsibility of the installation foreman to learn through lines of organization whether there is a multi-grounded neutral power system in part or all of his district, and to inform his men by appropriate means as to where the multi-grounded neutral system is used.

PROTECTOR AND SIGNALING GROUNDS

1. GENERAL

1.01 This section covers the selection and installation of protector and signaling grounds and ground connecting devises. It is reissued to cover grounding of the telephone protector to the power system ground in certain cases.

1.02 The installation of ground wires is covered in the sections dealing with the placing and fastening of wire and cable in buildings, and the termination of ground wires at protectors, connecting blocks, distributing terminals, etc., is included in the sections covering the installation or wiring of such apparatus.

2. SELECTION OF PROTECTOR GROUND

2.01 The approved grounds for station protectors and the principal precautions to be observed in their use are given below. In establishing the order of preference shown it is intended that the best ground available at a given location will normally be employed. **For this reason a station ground rod should not be used as the protector ground where other approved grounds are available even though some increase in length of wire runs is necessary in those cases where wire entrance and protector are not located close to the preferred grounding point.**

(1) **Public Water System**

(a) In the absence of any special local instructions use a public water system wherever practicable in preference to any other ground.

(b) Make connection to cold water pipe only and only when it is in service.

(c) Connect to street side of insulating joint if present in the water pipe.

(d) If a supply tank is used in a building, connect ground wire to inlet pipe only.

(2) Public Gas System

(a) In the absence of any special local instructions, pipes of public gas systems may be used for protector grounds where there is no suitable public water system ground available on the premises.

(b) The pipe must be in service.

(c) Connect ground wire on street side of meter if present. If there is an insulating joint between the meter and the supply pipe from street, connect to street side of insulating joint even though meter is located on the outside of the building.

(3) Private Water System

(a) Do not use a private water system for protector grounds if a suitable public water or gas system is available.

(b) Use private water system in preference to a ground rod except in cases of wells and cisterns having little or no metallic pipe buried in the earth. In general a private system is preferable to a ground rod if ten feet or more of metallic pipe is buried in earth to a depth where it is always moist.

(c) When used, connect to cold water pipe on the same basis as for public water systems. Where the pipe is connected to service pump by a flexible non-metallic joint, connect on well side of pump.

(d) In localities where premises are occupied only in certain seasons and motor driven pumps or equivalent may be removed for overhaul and cleaning, connect to pipe on well side of pump.

(4) Grounded Metallic Structures

(a) Where grounds described in (1), (2) and (3) are not available, grounded metallic structures such as buried tanks, conduits and pipes may be used for protector grounds when it is evident that such structures are of a permanent nature and will provide a better ground than a ground rod. If the electric power service is grounded to such a metallic structure the telephone

protector ground should be connected to the same structure.

(5) **Ground Rod**

(a) Use standard "S" type ground rod one for each protector where grounds described in (1) to (4) are not available, are not suitable or their use is contrary to local rules or regulations.

(b) Where a driven rod or pipe is connected to the grounded conductor of a multi-grounded neutral power system the telephone protector ground wire (No. 14) should be directly connected to this driven rod or pipe with a station ground clamp. When connecting the telephone ground wire to the rod or pipe care should be taken **not to disturb any** power system wire connections thereto.

(c) Where the power system is not of the multi-grounded type described in (b) above, a separate ground rod must be used for the telephone protector ground. However, where local instructions so specify for special cases the telephone ground rod and the power system driven pipe or rod may be bonded together as described in 5.12 herein.

3. SELECTION OF SIGNALING GROUND

3.01 Any of the following are satisfactory for a signaling ground:

(a) Any ground specified in Part 2.

(b) Any ground strip in a distributing or cross-connecting cable terminal that is connected to a grounded cable sheath or to (a) above.

(c) Connecting blocks or punchings connected to (a) or (b) above.

4. GROUND WIRE CAPACITY

4.01 The following table indicates the number of protectors that may be connected to ground through certain types of wire. The wires listed will care for any number of signaling grounds in addition to the number of protectors indicated.

Wire	No. of Protectors
**Single inside, duct or bridle wire	None
**Pair inside, duct or bridle wire	None
**One cable pair	None
No. 14 Ground Wire	*3
No. 12 BRC Solid R Wire	*5
No. 6 BRC Solid R Wire	*Any Number

*When a ground rod is used for a protector ground use one No. 14 Ground Wire and one ground rod for each station protector and strap ground terminals of station protectors installed at the same location in accordance with instructions in sections covering installation and maintenance of station protectors. One ground rod with No. 14 Ground Wire run to a ground strip, connecting blocks or punchings is adequate for any number of signaling grounds.

**Not to be used for coin collector ground serving more than six coin collectors in one group.

5. INSTALLATION OF GROUND CONNECTING DEVICES

5.01 The installation of ground strips in distributing and cross-connecting cable terminals is covered in the Outside Plant Construction and Maintenance Practices.

5.02 **Ground Clamps:** Locate ground clamp where it will be least liable to be disturbed or damaged by plumbers or others, preferably on a cold water pipe in cellar or basement or under the house. When located under sink or other fixture, place on cold water pipe close up under the fixture or as close as practicable to the wall. On pipes subject to vibration locate ground clamp near a pipe support.

5.03 Clean galvanized, black and lead pipes with emery paper or other abrasive before installing the clamp. Scrape rust or paint from rusty or painted pipes before using the abrasive paper or cloth. Scrape off only enough paint to permit the clamp to be in contact with the pipe all the way around. Abrasive material need be used only lightly on brass and copper pipes. Do not use file on brass or copper tubing. Clean finished pipes such as nickel or chromium plated pipes with a damp cloth. If finish is tarnished use any available polishing material and wipe clean with a dry cloth.

5.04 Install ground clamp on cleaned pipe surface as follows:

(1) Back off lock nut to head of set-screw.

(2) Back off set-screw to where it does not project through soldered nut.

(3) Form copper shoe to contour of pipe. It comes formed for a small pipe. To form for larger pipe place it on pipe and press it down firmly against the pipe. The shoe will bend to fit the contour of the pipe.

(4) With a pair of long nose pliers bend the strap sharply on each side of the soldered nut as shown in Fig. 1.

(5) Bend strap around the pipe and place strap on the rivet using the hole that will provide the least slack in the strap.

(6) Bend strap sharply at next hole beyond the rivet. Hold clamp in place by grasping it between the thumb and forefinger with the thumb holding the strap firmly on the rivet.

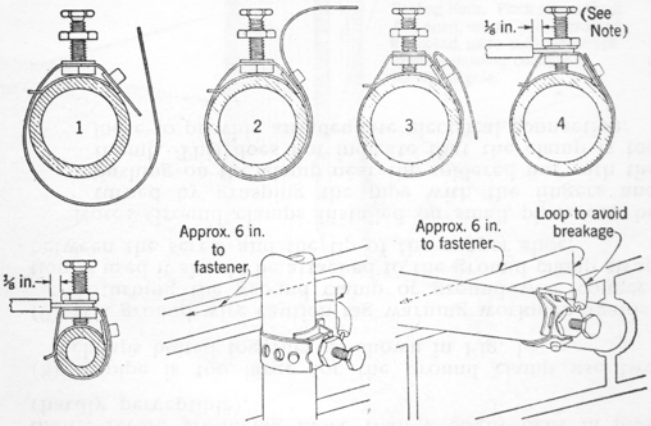
(7) Tighten set-screw with No. 216-B tool. Tighten firmly but clamp will break if set-screw is tightened beyond reasonable limits. On pipes of brass or copper tubing set-screw will unduly dent pipe if tightened beyond reasonable limits. Avoid producing more than a slight dent in pipe (hardly perceptible).

(8) If pipe is too large for the ground clamp use two clamps bolted together as shown in Fig. 1.

(9) If a ground wire caution tag warning workmen against disturbing the ground clamp or ground wire connection is used it should be attached to the ground clamp strap between the screw and the tip of the copper shoe.

Note: Ground clamps installed on small pipes can be turned by grasping the pipe with the fingers and pushing on the clamp near the soldered nut with the thumb. This does not indicate that the clamp is too loose to provide an adequate electrical connection.

INSTALLATION ON SMALL PIPES



Note: Place ground wire under washer and tighten lock nut firmly.

INSTALLATION ON LARGE PIPES

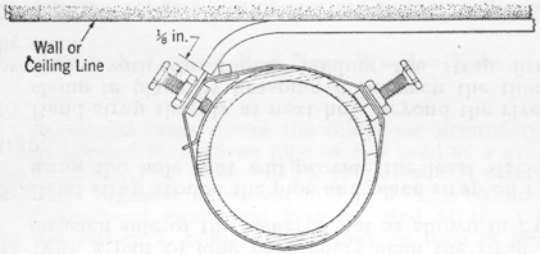


Fig. 1—Typical Ground Clamp Installations

5.05 Only one protector ground wire shall be connected to a ground clamp. Place wire under the washer on the ground clamp.

5.06 Do not connect a signaling ground wire to a ground clamp having a protector ground wire connected to it. Not more than two signaling ground wires shall be connected to one ground clamp. Place first wire under the washer and the second wire immediately above the washer.

5.07 **Ground Rods:** Locate ground rod where it will be least liable to damage or tampering. Avoid wherever practicable placing ground rod in public alleys, or on the street or sidewalk side of a building.

5.08 Inspect ground rod before and after driving to make sure that the tail wire is not broken loose from the rod. If broken use another rod.

Note: While driving the rod be sure that it is held so that the tail wire is on the side opposite that from which the rod is struck.

5.09 Space telephone ground rods at least 12 inches apart. Place them about 24 inches away from wooden poles and about 12 inches away from other structures except as covered in 5.10.

Caution: Do not install telephone ground rod where the rod or any buried wire attached to it will be less than 6 feet from the ground rod or buried wire used in connection with any electrical service or device other than for Bell Telephone Service.

5.10 The basement of a building is the preferred location for ground rods. In this case drive rod as near as practicable to masonry wall. See Fig. 2 and associated notes.

5.11 When ground rod is installed bury splice between ground wire and ground rod tail wire as shown in Figs. 2 and 3.

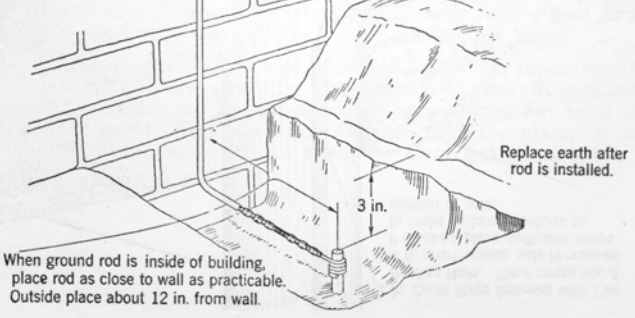


Fig. 2—Ground Rod Near Wall

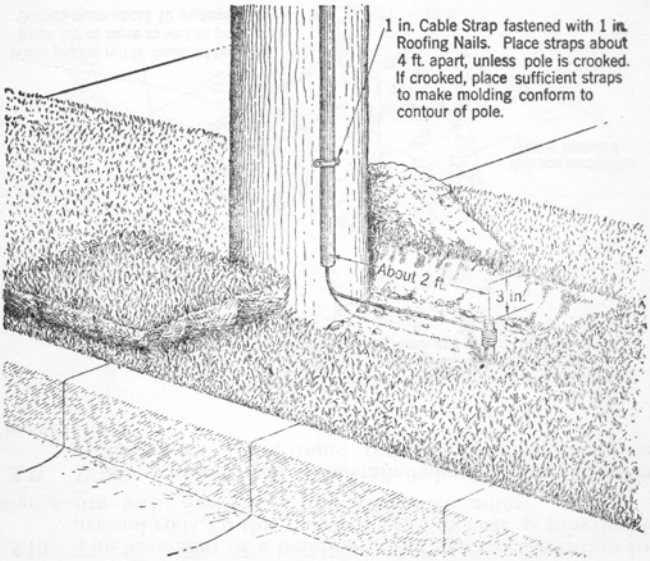


Fig. 3—Ground Rod Near Wooden Pole

5.12 In special cases where the telephone ground rod is to be bonded to a driven pipe or rod used as a ground for the power service, use a No. 6 BRC single solid R wire **to bond the two rods together** as shown in Fig. 4. The strand ground clamp or approved equivalent may be used at the telephone ground rod and an L ground clamp may be used at the power ground rod.

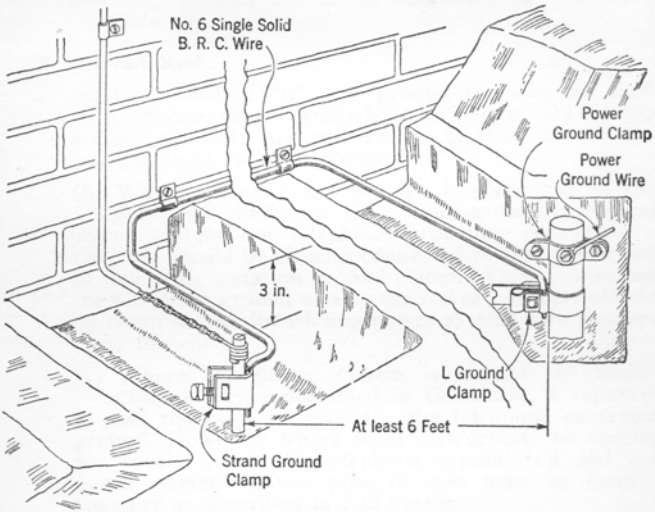


Fig. 4—Bonding Telephone and Power Service Ground Rods

5.13 No. 14 ground wire only should be spliced to the tail wire of a telephone ground rod. The splice may be made with an 064 sleeve in the same manner as covered for other wire splices in sections in the C30 Division or with a 104 x 064 brass sleeve and the sleeve rolling tool as covered in the Outside Plant Construction and Maintenance Practices. In either case do not make sharp bends in the wires where they leave the ends of the sleeve when wrapping turns of wires at either end of the sleeve. Also do not tape splice.

5.14 **Other Ground Connecting Devices:** When a protector cabinet is provided, a conduit for the protector ground wire is sometimes extended from the cabinet to a cold water pipe where the conduit is grounded on the cold water pipe by means of a commercial conduit grounding device. The protector ground wire shall be connected to the commercial conduit grounding device if it provides a set-screw and washer or a ground post with a nut and washer for this purpose. Otherwise a station ground clamp shall be installed on the cold water pipe as near as practicable to the point where the ground wire comes out of the conduit. The latter arrangement shall also be used in all other cases where a ground wire is brought out of a conduit.

BELL SYSTEM PRACTICES
Station Installation and
Maintenance

ADDENDUM(C33.004
(C63.504
Issue A, Aug. 1941
N.Y.Tel.Co.,L.I.

PROTECTOR AND SIGNALING GROUNDS

1. GENERAL:

1.01 This Addendum to Section C33.004 - C63.504, Issue 1 covers the use of the 10 Ft. Ground Rod for signaling purposes, and the Form P-2473 Tag for cautioning workmen ageinst disturbing telephone ground connections.

3. SELECTION OF SIGNALING GROUND:

3.01 Supplementing paragraph 3.01. A ten-foot rod for ground signaling purposes is available for use where the five-foot rod does not provide a sufficiently low ground resistance. The ten-foot rod shall be used as follows:

a. When ringing or coin relay tests indicate that the five-foot ground rod is inadequate, place a ten-foot rod not less than 12 inches away, and arrange both ground rod tails for test purposes so that they may be temporarily connected to the #14 ground wire by means of bridging connectors.

b. Request a loop resistance test of both rods connected together. If the resistance with both rods satisfies the allowable limit, connect the tails permanently to the ground wire by placing two .104 x .064 sleeves on the wire about 3 inches apart. Insert a tail in each end make the required number of turns in the sleeves.

c. If the loop resistance is still too high but the decrease in resistance effected by the addition of the ten-foot rod is great enough to indicate that a second ten-foot rod will provide the required low resistance, it may be placed but not less than 6 feet from the first rod. Connect the rods in the manner described in (b) above by means of a length of ground wire buried in a six-inch trench between the rods.

d. If a ground rod is required in connection with a station installation in localities where it has been found that five-foot rods are inadequate, ten-foot rods shall be placed initially.

e. In those cases where two ten-foot rods do not provide an adequately low resistance, advice shall be obtained as to further procedure from your supervisor.

The installation of a ten-foot ground rod generally requires the services of two men, one to hold the rod while it is being driven and another to drive the rod from a ladder. A 4-pound hammer should be used to drive the rod into the ground.

CAUTION: When the rod is being driven, do not attempt to steady it by grasping it with the hands. Instead, use a wire raising tool and hold the rod in the crotch of the tool by steadying it with a piece of wire or rope looped around the rod and held in one hand near the extremity of the wire raising tool.

5. INSTALLATION OF GROUND CONNECTING DEVICES:

5.04 Supplementing sub-paragraph 5.04 (9). To warn workmen against disturbing the ground

clamp or ground wire connection, the ground wire caution tag shall be attached to ground clamps placed for the grounding of telephone equipment. Place the tag when making new installations, and also when making reinstallations, reconnections and repair visits, if the tag is not already in place. Order the tag as Form P2473L. Remove the tag from the ground clamp when a disconnection is being made, if there is no further requirement for the ground connection.