

BELL SYSTEM PRACTICES  
Outside Plant Construction  
and Maintenance

SECTION G31.180.2  
Issue A, September, 1952-S  
TPT&TCO

OPEN WIRE  
HIGHER VOLTAGE JOINT USE  
99A PROTECTOR - INSTALLATION

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## 1. GENERAL

1.01 This section provides instructions for the installation of 99A Protectors on exchange open wire circuits on jointly used poles carrying higher voltage power circuits. The general considerations governing the location of 99A Protectors are covered in Section G31.180.1.

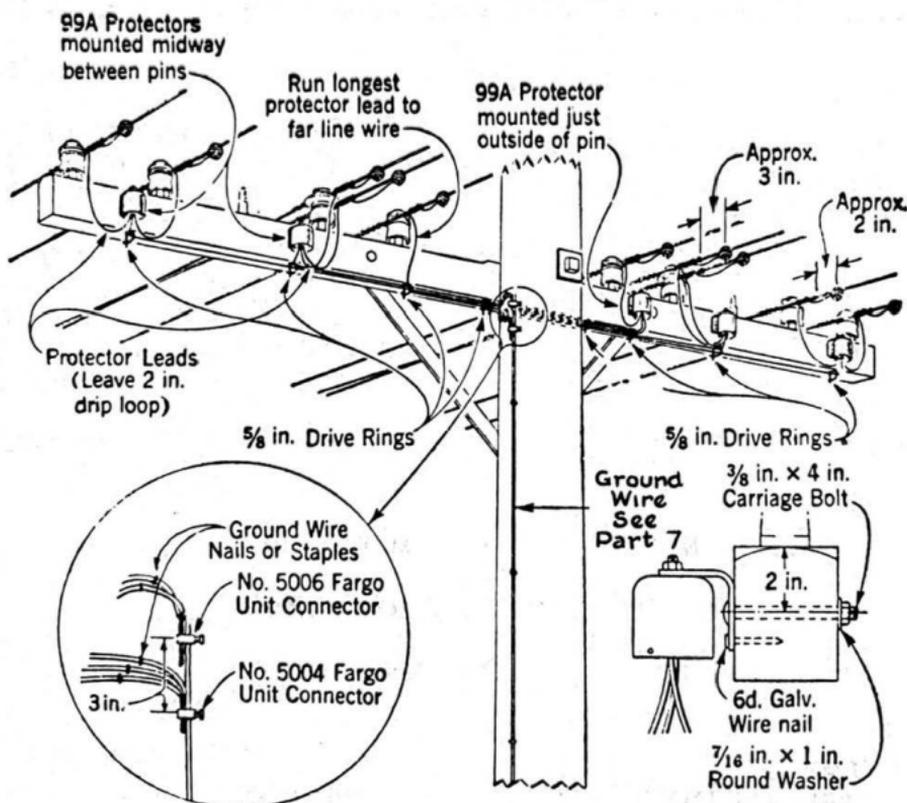
1.02 In joint use leads, where the detail plans specify connecting the 99A protectors to a ground structure which requires ground resistance measurements (certain types of water pipes, all sectional ground rods, and all special structures) the construction work shall be arranged so that all work incident to the ground structure (such as installation of the structure, connection of the ground wire thereto and ground resistance measurements) shall be completed and approved by the Construction Cable Testing group before aerial wire is placed in the lead, or 99A protectors are mounted on the poles or crossarms.

## 2. INSTALLATION OF 99A PROTECTORS

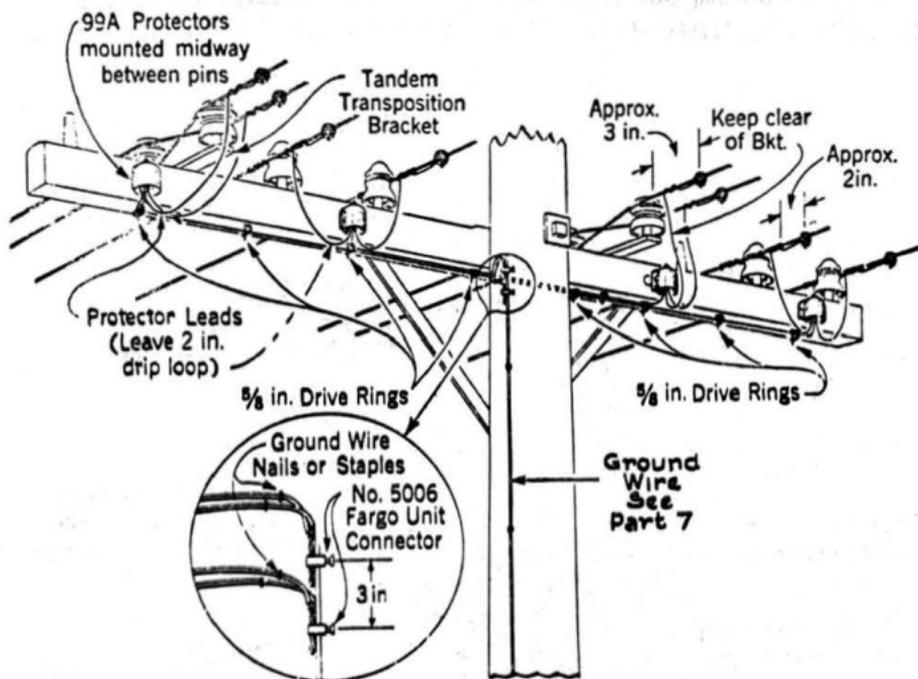
2.01 The manner of mounting and connecting 99A protectors to open wires is shown in the following illustrations. The mounting bracket must be removed from the protector housing to permit installation of the bracket on the crossarm or pole. Each protector lead shall be wrapped twice around the line wire adjacent to the insulator before being connected to the line wire with a standard bridging connector. If practicable, 99A protectors should be mounted on the side of the crossarm opposite that to which a subscriber's drop may be attached,

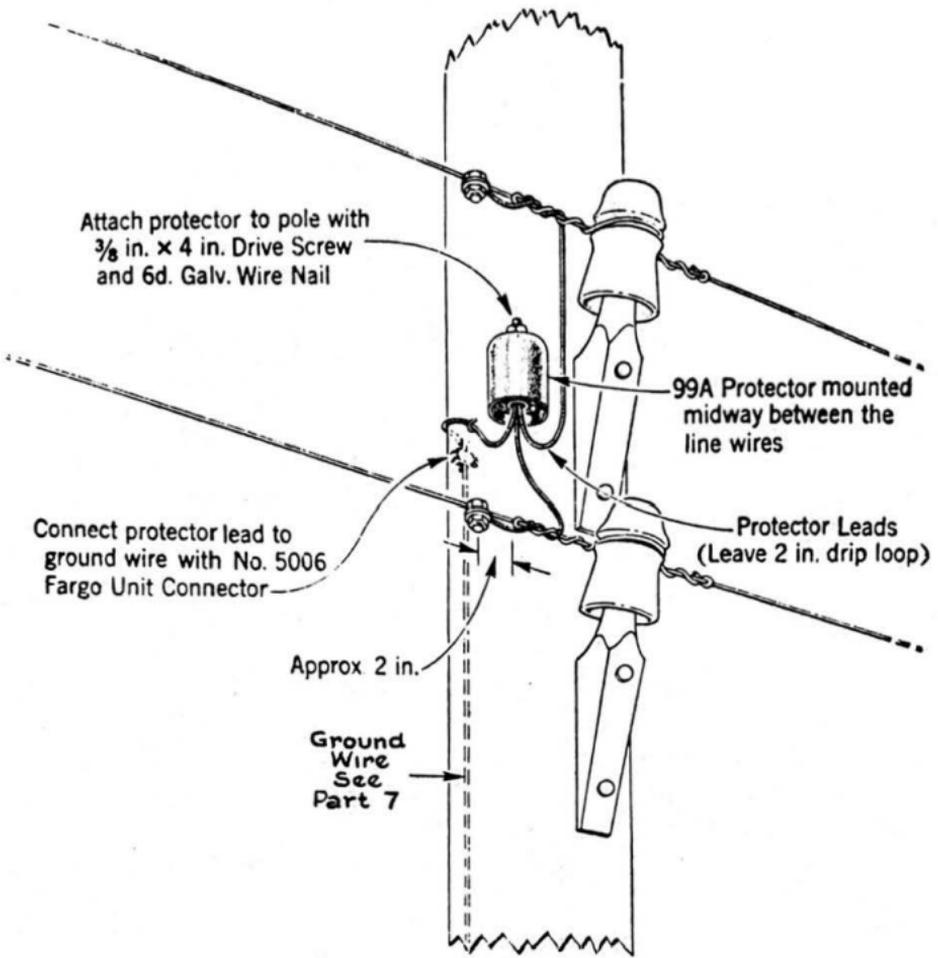
**Note:** Where Power Systems with multigrounded neutral are involved, do not place ground wire as illustrated below. See Paragraph 3.01 for details relative to grounding the 99A under this condition.

### INSTALLATION OF 99A PROTECTORS ON IOB CROSSARM



**INSTALLATION OF 99A PROTECTORS ON CROSSARM  
WHERE POLE PAIR IS NOT USED**





### 3. GROUNDING - POWER SYSTEMS WITH MULTIGROUNDED NEUTRAL (Imperial Irrigation District and Mountain Empire Electric Cooperative only)

3.01 Where Power Systems with multigrounded neutral are involved the grounding of the 99A protectors shall be made in accordance with the following:

- (a) At each specified 99A protector location, the ground lead from the protector should preferably be connected to a power system vertical grounding conductor that is connected to both the power system multigrounded neutral wire and to a ground electrode. Grounding conductors on transformer poles which meet the above requirements are satisfactory. Grounding con-

ductors from power system lightning arrestors shall not be used unless they are connected to the power neutral wire. The connection between the ground wire of the 99A protector and the vertical grounding conductor shall be made by the power company workman, unless otherwise specified in the detail plans.

(b) If the 99A protector is to be installed at a location where there is no power system vertical grounding conductor, install the 99A protectors as described in Paragraph 2.01, leaving the ground leads from the protectors coiled under the crossarm at the pole. Report all such cases to your supervisor immediately in order that arrangements may be made with the power company to install a vertical grounding conductor on the pole and to connect the protector ground leads to the grounding conductor as soon as practicable.

**CAUTION:** Do not under any circumstances perform work in the power space on the pole.

#### 4. GROUNDING - POWER SYSTEMS WITH NO MULTIGROUNDED NEUTRAL (All Power Companies except Imperial Irrigation District and Mountain Empire Electric Cooperative)

4.01 At each specified protector location, the 99A protectors shall be connected to one of the following ground structures as prescribed by the Plant Engineer. These ground structures are listed in the order of preference.

- (a) A public water system consisting of buried metallic pipe, See Part 5.
- (b) A local water system which consists of 100 feet or more of buried metallic pipe. See Part 5.
- (c) Copperweld sectional ground rods. See Part 6.
- (d) Special ground structures.

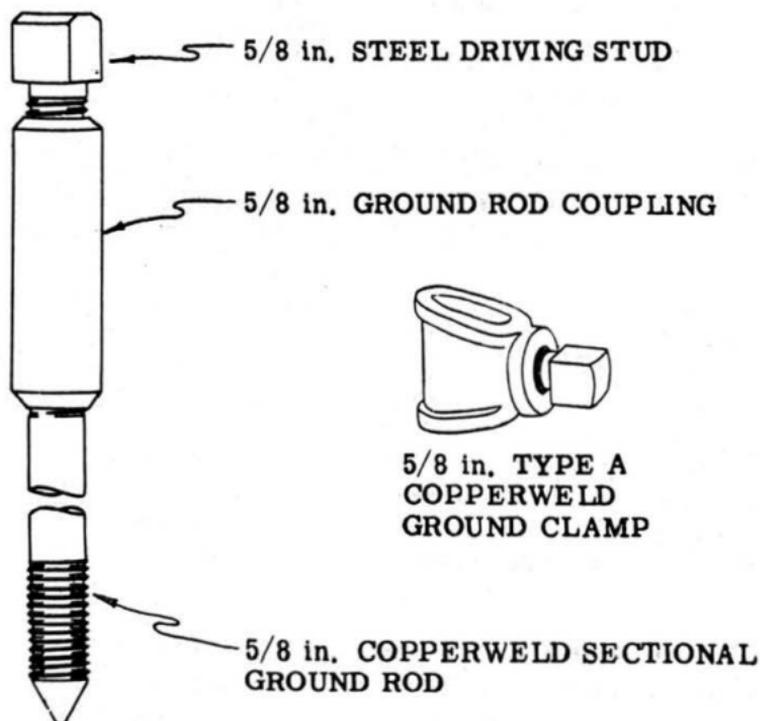
#### 5. WATER PIPE GROUNDS

5.01 Where a water service pipe from a public water system is used, the point of attachment of the ground wire shall be on the street side of the water meter and shut-off valve. When

a connection is to be made to a fire hydrant, it may be made between the shut-off valve and the fire hydrant plug. When connecting to a local water system, select, wherever possible, a pipe that appears to be permanent, such as a main service pipe from a well or tank. Avoid connecting to pipes serving isolated faucets in the yards, as these pipes may be removed,

## 6. COPPERWELD SECTIONAL GROUND RODS

6.01 Where suitable water pipes are not available, a satisfactory ground for 99A protectors can usually be provided by driving 5/8 inch Copperweld Sectional Ground Rods. These rods are supplied in 5 and 10 foot lengths. Each section is threaded at both ends and bronze couplings are provided to permit assembling the sections into a ground rod of the required length. A Steel Driving Stud is screwed to the top of the rod to take the blows of the power hammer during the driving operation. The ground wire is attached to the rods by means of a 5/8 inch Type A Copperweld Ground Clamp.



6.02 The conductivity (capacity for conducting electricity) of the soil into which the rods are driven will largely determine whether a satisfactory low resistance ground can be obtained. The conductivity depends upon the chemical composition, moisture content and temperature of the soil. The conductivity will vary from point to point at the same depth and at different depths in one location. It is further influenced by special local conditions such as the irrigating and fertilizing of cultivated areas. However, better conducting soils usually are found at lower depths due to more constant moisture content and temperature. The types of soil found in the Southern California Area may be roughly grouped in accordance with their conductivity as follows:

- (a) Soils with Good Conductivity (Usually produce low resistance grounds) - Clay, adobe, loam, decomposed granite (well decomposed, where penetration of more than 10 feet can be obtained).
- (b) Soils with Poor Conductivity (Usually produce high resistance grounds) - Sandy loam (where sand content is high), sand and rock conglomerate, sand, rock, decomposed granite (not well decomposed-penetration of more than 10 feet cannot be obtained).

#### SELECTION OF LOCATIONS FOR DRIVING SECTIONAL GROUND RODS

6.03 The most favorable locations for driving sectional ground rods shall be selected by the Plant Engineer in accordance with the following:

- (a) Soil with good conductivity as determined by appearance, color and feel.
- (b) Low ground preferably near a water course.
- (c) Proximity to areas which are regularly irrigated and fertilized.
- (d) Absence of subsurface rock which would interfere with driving the rods.

## GROUND RESISTANCE OBJECTIVE

6.04 At each 99A protector location where sectional ground rods are specified on the detail plans, the Plant Engineer shall indicate the "Ground Resistance Objective" as supplied by the Protection Engineer. This objective represents the maximum ground resistance which can be allowed in the 99A protector ground without impairing the effectiveness of the protector.

## DRIVING SECTIONAL GROUND RODS

6.05 Information about the personnel responsible for making the ground resistance measurements is covered in Plant Instructions. The methods to be used will be covered in other sections of the Practices.

6.06 In all cases the procedure to be followed in driving sectional ground rods shall be determined by the supervisor in charge and shall be such as affords maximum safety to the workman and a minimum of inconvenience to the public. The general methods to be used are outlined below:

- (a) Dig a starting hole about 2 feet deep at the designated location.
  - (b) Screw a coupling and steel driving stud on the blunt end of the sectional rod. Remove any coating of grease on the rod.
  - (c) Hold the rod upright in the starting hole and use a shovel handle to press against it at the ground level to prevent lateral movement during the driving operation.
  - (d) A Barco Gasoline Hammer equipped with a special driving head should be used to drive the rods. The hammer should be suspended from a suitable structure such as a pole, cross-arm or truck mounted derrick. It may be operated by an employee from a pole, truck-bed, or ladder provided the proper safety precautions are observed in each case.
- 6.07 10-foot ground rod sections should be used in preference to the 5-foot length except under the following conditions:
- (a) As the last section of a ground rod when the resistance measurements indicate the shorter length will be sufficient to obtain the objective.

(b) When the workman cannot get in a safe position to operate the Barco Hammer in driving a 10-foot section,

6.08 The first sectional ground rod should be located approximately 2 feet from the pole and in line with the lead. The first section should be driven to the ground line, the soil tamped firmly about the rod, and ground resistance measurements made.

(a) If the tests show that the Ground Resistance Objective has been met, the ground wires shall be attached as shown in Part 7.

(b) If the tests show that the resistance is greater than the Ground Resistance Objective, a second section shall be coupled to the first and driven to ground level. The upper end of the second rod should be twisted with a pipe wrench to insure that it is tightly coupled to the first before tamping the soil and making the resistance measurements. This procedure should be repeated until the Ground Resistance Objective is met or the rod cannot be driven deeper.

6.09 Additional sectional ground rods, up to a maximum of five, shall be placed as required to meet the Ground Resistance Objective. They shall be located in line with the lead and separated by 10 feet or more. Each rod shall be driven as outlined above for the first rod except that they shall be connected together by test leads for the purpose of making the ground resistance measurements.

6.10 After each rod has been driven, the tester should estimate how many rods will be required to obtain the necessary objective, by using the following "rule of thumb,"

$$n = \frac{R_s}{R_o}$$
 Where  $n$  = the estimated number of rods required to obtain the objective.

$R_s$  = the average ground resistance obtained in driving the rods already installed.

$R_o$  = the ground resistance objective as specified in the detail plans.

OR IMPOSSIBLE TO OBTAIN  
PROCEDURE WHERE SUBSTANTIAL GROUNDS ARE DIFFICULT

**PROCEDURE WHERE SATISFACTORY GROUNDS ARE DIFFICULT OR IMPOSSIBLE TO OBTAIN**

6.11 If it is estimated in accordance with Paragraph 6.10 that the number of rods required to obtain the objective is greater than five, consideration should be given to abandoning the site. A new location may then be selected within the limitations set forth in Section G31.180.1 and Paragraph 6.03 of this section.

6.12 If, after five rods have been installed without reaching the objective, it is estimated that the objective can be met by installing one more rod, the additional rod may be placed.

6.13 In extreme cases, where it appears impossible or impracticable to obtain satisfactory protector grounds, the matter should be referred to the Plant Engineer and all construction work on the joint use lead deferred until other protective measures can be specified.

6.14 When a location is abandoned because a satisfactory resistance cannot be obtained, as many rods as possible should be salvaged.

**7. PLACING GROUND WIRE**

7.01 The ground wire between the 99A protector lead and a water pipe ground or ground rods shall consist of a continuous No. 6BRC Solid R Wire (without splices) placed as follows:

(a) A 2-foot deep trench should be dug between the pole and the water pipe or ground rods.

(b) Place sufficient ground wire to reach from the protector, down the pole and along the trench to the water pipe or the farthest ground rod allowing sufficient wire to make connections and about 6 inches slack at each intermediate ground rod.

(c) Where water pipe grounds are involved proceed as follows:

(1) Clean the water pipe at the point of attachment, using abrasive cloth or file to clean the contact surface. Do not use file on copper or brass tubing.

(2) Place L ground clamp around pipe and insert the ground wire in the proper loop. Care must be taken when placing ground

clamps on copper or brass service pipes as they are easily dented or flattened.

(3) In order to prevent corrosion, paint the connection with No. 2 asphalt paint. Apply two layers of friction tape and paint again with asphalt paint. The tape and paint shall completely cover all bare parts of the clamp and ground wire, extending along the water pipe at least 1-inch beyond the clamp in both directions.

(d) Where ground rods are involved proceed as follows:

(1) Remove about 6 inches of the insulation from the wire at the points where the connections are to be made to the ground rods and connect the end of the wire to the ground rod farthest from the pole as illustrated below:



(2) At the intermediate ground rods bend the bare wire into a tight inverted "U" loop about 3 inches long and attach to the side of each ground rod near the top by sliding a 5/8 inch copperweld type A ground wire clamp over both the loop and the rod. Tighten the square head set screw.

**Note:** The ground rods should be driven to the bottom of the trench or bent down.

(1) Before installing the ground rods, the trench should be prepared.

When specified on the design plans.

(6) Clearances between ground rods should be maintained.

- (e) Creosoted plank shall be placed over the buried ground wire when specified on the detail plans.
- (f) Backfill trench and replace sod as required.
- (g) Attach the ground wire to the pole at 18-inch intervals with galvanized guy staples or No. 6 cable clamps and 1-1/2-inch strap nails. Whenever practicable, place the ground wire on the pole in a quadrant which will locate the upper end of the ground wire under the crossarm.

Note: Where required, the ground wire shall be protected by wooden ground wire moulding fastened to the pole with No. 16 cable straps and 1-1/2-inch strap nails at 4-foot intervals.

- (h) Attach ground wire to 99A protector leads as shown in Paragraph 2.01.