

**BELL SYSTEM PRACTICES**  
**Outside Plant Construction**  
**and Maintenance**

**SECTION G63.205.1**  
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## **ELECTROLYSIS TESTING**

### **INSTRUMENTS AND APPARATUS**

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#### **1. GENERAL**

1.01 This section describes the instruments and apparatus ordinarily used in electrolysis testing work. The apparatus described, other than the meters, will usually be made up locally. Instruments other than those indicated may be used provided they have the same general characteristics as those listed in this section.

#### **2. DUPLEX METER**

2.01 For routine or other electrolysis tests where it is necessary to observe the correlation of voltage and current on an underground structure, the Weston Model No. 56 Duplex Meter has been found to be generally satisfactory. This instrument consists of a voltmeter and a millivoltmeter movement contained in a common case with binding posts to indicate the polarity of the two movements. Both movements have center zero scales and their periods approximate each other so closely that simultaneous readings are conveniently correlated.

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### **Millivoltmeter Movement**

2.02 The scale ranges of the millivoltmeter movement are 5, 10, 50 and 100 millivolts and 5 volts. External shunts are available to give direct current values for the 50 millivolt range.

- (a) A dial switch is provided to enable shifting from one range to another as desired.
- (b) The sensitivity of the millivoltmeter movement is 300 ohms per volt.

### **Voltmeter Movement**

2.03 The scale ranges of the voltmeter movement are 1, 5, 10, 50 and 250 volts.

- (a) A dial switch is provided to enable shifting from one range to another as desired.
- (b) The sensitivity of the voltmeter movement is 1000 ohms per volt.

2.04 When taking simultaneous readings on the two movements it will greatly facilitate observation if the two needles are made to swing in the same direction. Because of its low resistance the millivolt scale of the duplex meter should not be used when obtaining potential measurements between cable and earth.

## **3. VOLTMETERS**

3.01 Additional voltmeters may sometimes be required in connection with testing work such as for taking simultaneous potential readings. For the sake of uniformity and flexibility of equipment, it is desirable that any additional meters be of the duplex type described above.

3.02 **High Sensitivity Voltmeter:** Where potential values of very small magnitude are encountered the use of a d-c voltmeter having greater sensitivity than the Model No. 56 Duplex Meter is desirable. Instruments of this type are available with a resistance of 200,000 or 400,000 ohms per volt, either of which is considered satisfactory. The scale ranges recommended for both meters are: .05, .10, .50, 1.0, 5.0 and 10.0 volts.

## **4. RECORDING METERS**

4.01 Recording meters are advantageous when a series of potential or current readings are to be taken over long periods of time, as for instance, in determining 24-hour conditions. The recording meter most widely used in electrolysis work is the model No. 524 circular smoke chart instrument of the Bristol Company. It has a center zero scale Weston volt-

meter movement and is normally furnished with a two-speed clock movement covering one-hour and 24-hour periods. It may also be obtained with a six-hour in place of the one-hour movement. The meter is available in various sensitivities such as 400, 1000, 2000, and 10,000 ohms per volt and with eight scale ranges as follows:

2.5-0-	2.5 millivolts	
10 -0-	10	"
50 -0-	50	"
250 -0-	250	"
1 -0-	1	volt
5 -0-	5	volts
25 -0-	25	"
125 -0-	125	"

4.02 For current measurements, shunts of various ranges are available for use externally with the 50 millivolt range.

## 5. VOLT-OHM-METERS AND MEGGER RESISTANCE TESTERS

5.01 There are available various portable testing sets such as the Western Electric Company M9B portable volt-ohm-milliammeter and Weston Models No. 365 and No. 564, which are suitable for obtaining measurements of contact resistance between the ground electrode and earth. They may also be used in connection with duct surveys or in other cases where resistance measurements are desirable, but where extreme accuracy is not a requirement.

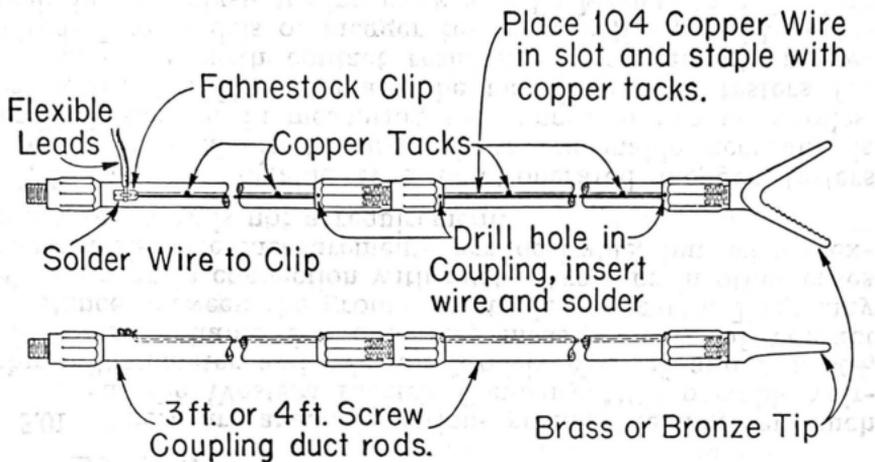
5.02 Several portable type hand-operated megger testers are available for use where reasonable accuracy is required, such as in measuring resistances of ground anodes, test leads, etc. Use may also be made of these testers for obtaining the earth contact resistance measurements as required. Two models of megger testers which are used extensively in electrolysis testing work are the Model No. 593 which has three scale ranges of 0-3, 0-30, 0-300 ohms and the improved Model No. 597 which has an additional scale range of 0-3000 ohms.

5.03 Soil and ground resistance readings can also be made with one of the new type instruments such as the Vibro-ground which within ranges of 0-1, 0-10, 0-100 and 0-1000 ohms gives direct readings to an accuracy of about three per cent.

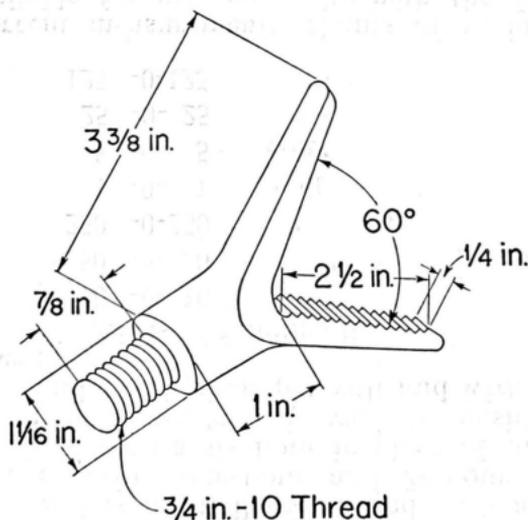
## 6. APPARATUS

### Electrolysis Test Pole

6.01 Sheath contacts on underground cables can be made by means of an electrolysis test pole equipped as shown in the illustration below. Two or more standard duct rods of the screw type can be used to make a suitable test pole. Three such test poles should be carried by the electrolysis tester to facilitate tests on the cable sheath from the street level.



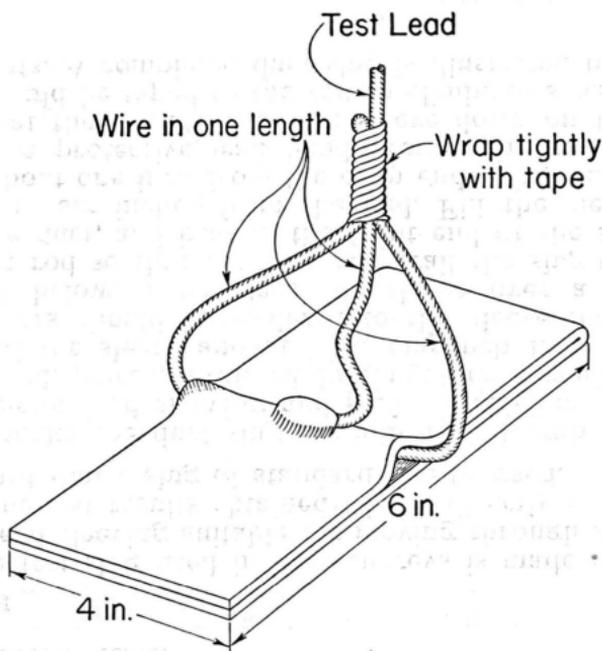
6.02 The forked tip illustrated below should be cast in brass or bronze and made to fit into the coupling on the duct rod.



6.03 To obtain a sheath contact place the forked tip end of the test pole on the cable to be tested and oscillate the free end at right angles to the cable. As the sides of the forked tip which come in contact with the cable are provided with teeth, care should be exercised when oscillating the test pole not to damage the cable sheath.

### Ground Electrode

6.04 A ground electrode consisting of a piece of lead-antimony cable sheath about 4 inches by 6 inches to which is soldered a length of flexible rubber insulated wire, affords a convenient means of obtaining a good ground connection. The soldered area should be painted with asphalt paint. The ground plate may also be used to obtain connections to structures such as railroad tracks, water mains, etc., that are close by. A typical ground electrode is illustrated below.



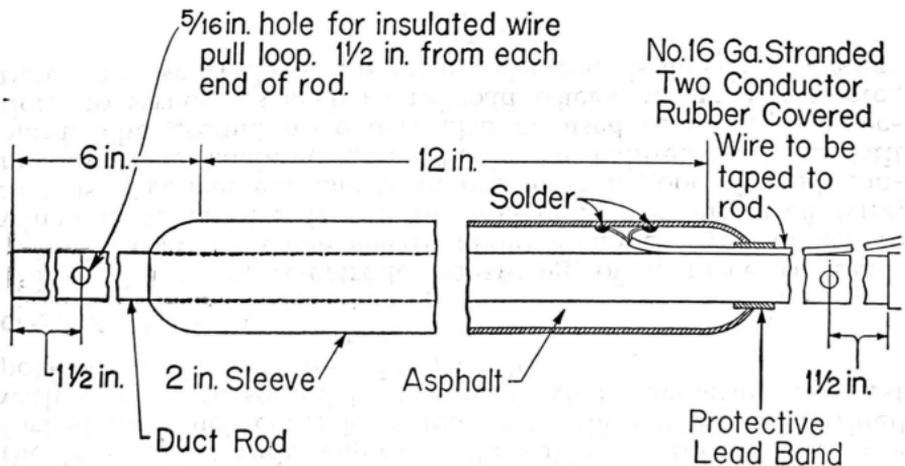
## Type S Ground Rods

6.05 These ground rods consist of ungalvanized round steel rods, 5 feet long by 1/2 inch diameter with chisel points and equipped with a 12-inch 104 copper terminal connection. The rods are used for making ground connections to earth as, for instance, when making trial grounds in connection with voltage reduction tests.

### Duct Slug

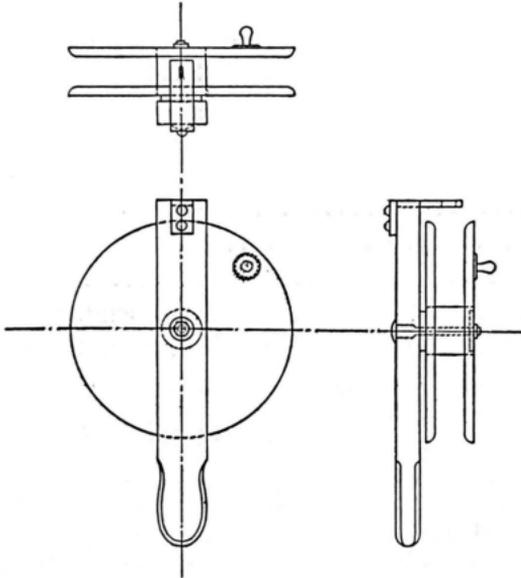
6.06 The test slug used in duct surveys is made of a piece of lead sleeving suitable for moving through a duct. In order that the test results obtained will be directly comparable, it is important that a slug of standard size be used.

6.07 To make the duct slug cut a 14-inch length of 2-inch diameter lead sleeving and solder a six-foot length of rubber covered, paired, stranded 16-gauge (or larger) wire to the inside of the sleeve and at least one inch from the end. The conductors should be soldered to the sleeve individually as indicated below. Then place the sleeve over a standard wooden duct rod so that the wire will trail the slug when inserted in the duct, and beat in the front end of the sleeve on the rod about six inches from the end. Fill the sleeve with asphalt to about one inch from the open end. After the asphalt cools, place a protective lead band around the rod and the wire and beat the open end of the sleeve down on the band. The wire should be taped to the rod to eliminate stress on the soldered joints. A completed duct slug is illustrated below.



## Reels

6.08 The hand reel illustrated below offers a convenient means of carrying small gauge wire for making potential readings between cable and other structures such as water mains, tracks, etc.



6.09 For handling the test wire used in connection with duct surveys or experimental drainage tests the B Drop Wire Reel which will accommodate approximately 800 feet of HD wire, may be conveniently used.

## Switch Panel

6.10 A small wooden switch panel equipped with binding posts or Fahnestock connectors and switches can frequently be used to advantage in taking simultaneous readings. The board should be so wired that with the leads from the cable, ground, trolley tracks and pipes and from the meters attached to the binding posts the instruments may be thrown quickly from circuit to circuit as desired. The use of a switch panel also minimizes the number of instruments required.