BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G63.251.1
Issue 1, April, 1952
AT&T Co Standard

ELECTROLYSIS TESTING
ROUTINE UNDERGROUND—PREPARATION

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1. GENERAL

1.01 This section includes general information in connection with the preparations for routine electrolysis tests on underground cables and outlines the data to be obtained on routine surveys.

2. REQUIREMENTS FOR MAKING ROUTINE TESTS

2.01 Routine electrolysis testing on underground cable shall be conducted in accordance with the following requirements.

SUMMARY OF REQUIREMENTS FOR MAKING ROUTINE TESTS

Condition	Initial Survey	Subsequent Survey
1. Electric railways (D.C.) or cathodically protected pipe lines within 1/2 mile of cable run or non-protected substructures located in same highway or street.	Every M.H. Current Flow and Cable potential to earth, gas, water and other substructures. Every 3rd M.H. Cable potential to rail when near-by.	Every 2nd M.H. Current Flow and Cable potential to earth, gas, water and other substructures. Every 4th M.H. Cable potential to rail when near-by.
2. Electric railways (D.C.) or cathodically protected substructures within 1/2 to 3 miles of cable run.	Every 2nd M.H. Current Flow and Cable potential to earth, gas, water and other substructures.	Every 4th M.H. Current Flow and Cable potential to earth, gas, water and other substructures.
3. Electric railways (D.C.) or cathodically protected substructures over 3 miles away from cable run.	Every 4th M.H. Current Flow and Cable potential to earth, gas, water and other substructures.	Every 4th M.H. Current Flow and Cable potential to earth, gas, water and other substructures.
4. Where drainage wires or cathodic protection systems are employed.	Every other manhole for a distance of 1/2 mile each side of drainage point. Same tests as for Condition (1) including potential to rail if near-by.	
5. Where cable is crossed by tracks (steam or electric) or by a large pipe line.	Each manhole on both sides of crossing. Same tests as for Condition (1) including potential to rail or pipe lines.	

Note: 1. Where practicable, the manholes chosen for a routine test should be those which were omitted in the previous routine tests.

2. Where special surveys have been made within one year or are scheduled for a section of a cable route, routine tests may be omitted in that section.

2.02 Routine tests and inspections shall, in general, be made annually, preferably in the spring, to detect any electrolysis exposures which may have developed due to changes in electrolytic conditions. Under the wet earth conditions generally found in the spring, a lower resistance path is offered to electric railway or other stray currents and also increased leakage from rails or other current carrying subsurface structures results.

2.03 Routine tests should not be made when the ground is frozen, since the high resistance introduced by the frozen electrolyte to the flow of shallow earth currents will not give a true picture of the electrolytic condition.

2.04 Before commencing routine testing operations in any area, it will be essential to determine that all electrolysis mitigation systems having influence over cable potentials in that area are functioning properly. In the event that drainage conditions are not normal, corrective measures shall be effected before proceeding with the tests.

2.05 As plant conditions will determine the procedure to be followed in some instances, advance knowledge of cable and conduit system layouts should be obtained by reference to plant engineering and construction records. Data on sheath bonding, duct arrangement, mitigative equipment, previous survey results and the like, will prove especially helpful in planning the test program at a given location.

2.06 All testing equipment, meters, leads, etc., should be in good working condition.

3. DATA TO BE OBTAINED

3.01 Information regarding potential and current readings shall be recorded on field record Form E-1110 or similar type form.

3.02 The maximum and minimum cable to earth potentials, both positive and negative, shall be obtained with indicating type meters, and any correlation with current on cable sheaths noted.

3.03 Where cable potentials are influenced by stray current in the earth, recording meter charts of cable to earth potentials shall be obtained at selected manholes as directed by supervision. It may also be advisable in some instances to run charts of current on cable sheaths at the same time.

3.04 The total amount and direction of current on cable sheaths shall be determined for each duct bank in the manhole, and the results shall be separately recorded. However, where cables route straight through a hole and are in a single

duct bank in either direction, only one such set of readings will be necessary.

3.05 Where current is found on a subsidiary or lateral cable, the amount and direction shall be reported and a separate investigation made to determine if contacts with other structures exist.

3.06 Where insulating joints are installed in cables in manholes, potential measurements shall be taken between cable and earth on each side of the joint. The effectiveness of each insulator shall be checked by taking current readings on either side of the joint.

3.07 Where cable to earth potential measurements are taken with other than a high sensitivity voltmeter, the effect of earth contact resistance must be observed and the results recorded.

3.08 In addition to the above data, potential readings shall be taken between cables and near-by surface rails, railway structures, water and gas mains, d-c neutrals, etc. Any correlation observed between these potential readings and current flow on cable sheaths should be noted. Potential differences between cable sheaths in the manhole shall also be checked, and potentials in excess of 50 millivolts between any two cables reported for a review of bonding conditions.

3.09 The following information shall also be recorded on the field forms at the time the tests are made:

(a) Condition of cables and manhole—dry or wet. Cables under water. Manhole pumped for test. pH of duct electrolyte, etc.

(b) The resistance of the voltmeter scale used in making the potential measurements of cable to earth.

(c) The number of cables in the manhole at the point where the current measurements are made. Report sizes and cable numbers where important variations in current magnitude exist in the same bank of ducts.

(d) Under "Remarks" indicate other items of interest, such as, need for bonding, presence of current on branch cable laterals, insulating joints, defective rail bonds and any item which may have an electrolytic or chemical effect on the cable sheath.

4. ARRANGEMENT OF TESTING EQUIPMENT

4.01 The practice of using a standard apparatus setup at each manhole will save time and will also reduce the liability of error in the matter of polarity and the direction of

current. The arrangements suggested for use in connection with routine measurements at a manhole are indicated in the following paragraphs.

4.02 When making potential drop measurements on the cable sheath for determination of the current flow, two electrolysis test poles should be placed on the cable, making contact at points about four feet apart. There should be preferably no sheath discontinuities such as sleeves, bonds to other cables, etc., between the points of connection. Particular care should be taken to place the two electrolysis test pole contacts on the same cable.

4.03 In addition to the two electrolysis test poles mentioned above, a third test pole should be placed on the cable for use in obtaining potential measurements between cable and the earth or cable and other underground structures. The use of a third test pole is unnecessary at gas pressure valve points where contact may be made with the cable by means of the lead pipe which extends from the cable.

4.04 In making a ground connection in manholes where no permanent ground electrode is installed, the test electrode should be placed in the sump of the manhole, when available, or on the wettest part of the manhole floor. Where loading coil cases or other metallic objects are buried in the floor of the manhole, the ground connection should be made at a suitable point farthest removed from the metallic objects. Any copper wire clippings in the sump should be removed.

4.05 Where the manhole is dry and reliable potential readings can not be obtained, it will be satisfactory to place the ground electrode in the earth outside the manhole. When obtaining potential readings between cable and an outside ground, the best arrangement is to place the earth contact directly over the conduit, at a point approximately ten feet away from the manhole, if good earth contact can be obtained. If, on account of paving or other conditions, a good contact is not obtainable directly over the conduit, readings should be taken to suitable points on one side of the conduit system, checking these readings by corresponding readings on the opposite side of the conduit system in the event that there is any possibility of transverse current in the earth at the testing point.

4.06 In manholes where the cables and galvanized cable hangers are submerged, the galvanizing on the hangers may affect the potential readings of the cables in the manholes. In addition, in the case of positive areas, the hangers also serve, to a certain extent, as ground electrodes by means of

which current is discharged into the earth, thereby affecting the potential of the earth in the manhole. Under these conditions the indicated cable to earth potentials would be at variance with those actually existing in the duct line. In view of this, in all cases where manholes contain sufficient water to immerse a part or all of the cables and where the cable to earth readings between the cable and the bottom of the manholes show potentials of small magnitude, a check test should be made between the cable in the manhole and earth outside the manhole in order to eliminate the effect of the cable hangers on the cable to earth potentials.

4.07 After the completion of cable to earth readings, a fifth test lead (reel lead) should be substituted for the ground electrode lead on the voltmeter and run out in turn to surface rails, pipe lines and other available structures.

4.08 Where simultaneous readings of the above potentials are desired, such data can be approximated with one meter by the use of a simple switching arrangement, such as that described in another section of these practices. In employing this method, individual leads must be connected between the device and each test point and the voltmeter. Where the potentials involved are of sufficient magnitude, simultaneous readings can be obtained directly by using the 5-volt scale of the millivoltmeter movement in conjunction with an appropriate scale of the voltmeter movement.