

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

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ELECTROLYSIS TESTING
GENERAL

Contents	Page
1. General	1
2. Type of Tests	2
3. Interpretation of Test Results	3
4. Tests and Inspections of Insulating Joints	5
5. Tests and Inspections of Condensers	5
6. Tests on Corrosion Protection Systems	5
7. Records	5

1. GENERAL

1.01 This section covers information regarding corrosion of underground cable sheath in conduit, and buried, and describes conditions under which electrolysis tests shall be made. It also outlines the various types of electrolysis tests required and covers general procedures regarding interpretation of test data.

1.02 Every employee who has occasion to work in manholes shall be thoroughly familiar with and shall observe the recommendations contained in the Bell System Practices covering "Testing Manhole Atmosphere," and shall at all times adhere to the instructions contained therein. He shall also observe and follow the practices and local regulations for the protection of the public and fellow employees against accidents due to open manholes.

1.03 The objective in all electrolysis test operations is to determine something about current since it is current which causes cable sheath corrosion. Methods are not now available for measuring directly the pickup or loss of current at a given point on the sheath. For this reason, it is necessary to resort to indirect measurements.

1.04 Potential differences between cable sheaths and earth have long been regarded as indicative of current leakage (corrosion) conditions. Such information, however, must be subjected to careful analysis, and due consideration must be given to the resistivity or coupling between cables and earth at any point, the effect which extraneous galvanic influences in the testing circuit may have on the readings, and other such factors.

1.05 Another method of approximating current leakage conditions involves direct readings of current and potentials between cable sheaths in manholes and an exploratory electrode inserted in a spare duct.

1.06 The observations should be entered on standard forms or charts and these should be dated and signed by the tester, with accurate information as to the location, day, and hour tests were made.

1.07 It is also extremely important that all electrolysis testing work be carefully executed. Exercise of good judgment and active interest on the part of the tester are as essential to the successful completion of the job as the use of dependable and appropriate testing instruments.

2. TYPE OF TESTS

2.01 The tests needed to determine the electrolytic conditions of underground and buried cables include Preliminary Tests, Routine Tests and Special Investigations.

2.02 **Preliminary Tests:** Preliminary tests are made to determine the condition of a new cable as soon as practicable after the cable is placed.

2.03 **Routine Tests:** Routine tests are, in general, made annually after the installation of a cable, to detect any electrolysis exposures which may have developed due to changes in electrolytic conditions.

2.04 **Special Investigations:** When preliminary or routine tests have shown that a portion of cable is in an unsatisfactory electrolytic condition, a special investigation is usually required in order to determine the magnitude and extent of the exposure and the measures necessary to secure relief. The various types of evidence and tests which may be required in connection with such investigations will generally include stray current analyses, duct survey, etc.

3. INTERPRETATION OF TEST RESULTS

3.01 No definite rule can be given as to what constitutes a hazardous electrolytic condition on a cable, because of differences in local conditions where exposures occur. In general, any positive condition or any negative condition where the potential exceeds .5 volt, in areas where stray current might be expected warrants special consideration even though the positive interval is short and the potentials between cable and earth are small. For example, conditions have been encountered where positive potentials were of small magnitude, but due to very low earth resistance, considerable current was leaving the cable and consequently rapid corrosion of the sheath was taking place. The following table may be used as a guide in classifying existing cable conditions for reports and for determining areas where remedial measures are or are not warranted.

CLASSIFICATION OF ELECTROLYTIC CONDITIONS

Classification

Cable Potentials to Earth

	<u>Positive</u>	<u>Negative</u>
1. Cable is considered satisfactory.	1(a) With steady positive potentials between 0 and .1 volt, inclusive, with no sheath current and no evidence of sheath corrosion.	1(b) Constantly negative between 0 and .2 volt, inclusive, with no evidence of sheath corrosion. 1(c) Constantly negative between .2 and 1.5 volts, inclusive, where it is known that the ground is not alkaline and there is no evidence of sheath corrosion.
2. Corrective measures are considered warranted.	2(a) Where steady positive potentials between 0 and .1 volt, inclusive, are observed with sheath current. 2(b) Where positive potentials greater than .1 volt are observed regardless of sheath current and present condition of sheath. 2(c) Where corrosion is observed with the cable either positive or neutral.	2(d) Where negative potentials exceed .2 volt and the ground is known to be alkaline. 2(e) Where negative potentials of more than 1.5 volts exist and the degree of corrosion is unknown. 2(f) Where corrosion is observed with negative potentials regardless of their magnitude.
3. Corrective measures are not considered warranted.	3(a) Where fluctuating positive potentials of .1 volt or less due to stray currents are observed but no corrosion has resulted and it is not considered practicable to eliminate the positive potentials. 3(b) Where positive potentials are due to galvanic or local action and inspections do not disclose enough sheath corrosion to warrant corrective measures.	3(c) Where negative cable to earth potentials greater than 1.5 volts exist but where inspections have shown no corrosion is occurring and the ground is not alkaline.

4. TESTS AND INSPECTIONS OF INSULATING JOINTS

4.01 Insulating joints installed in underground or buried cables may, under certain conditions, cause objectionable electrolytic conditions unless closely watched. The frequency of the tests and inspections in connection with insulating joints except in buildings or entrance cables to buildings should, therefore, be determined by local conditions but, in general, should be not less than once every six months.

4.02 If any considerable change in conditions is found in consecutive tests, resulting in unsatisfactory electrolytic conditions, arrangements shall be made to investigate and eliminate the cause.

5. TESTS AND INSPECTIONS OF CONDENSERS

5.01 Condensers are frequently used for bridging insulating joints to provide a low impedance path for alternating currents on the cable sheath and at the same time present a barrier to direct currents.

5.02 An inspection and test of each condenser installed at insulating joints shall be made periodically. This shall be done following the season in which lightning is most likely to cause damage to the condensers.

6. TESTS ON CORROSION PROTECTION SYSTEMS

6.01 In general, tests on the corrosion protection systems in service shall be made once each month to determine their operating condition.

6.02 A field inspection and test of all corrosion protection systems and equipment in service shall be made periodically regardless of whether or not alarm wires are in service. The inspection and test shall cover all apparatus installed in connection with drainage wires, reverse current switches, fuses, forced drainage systems, etc., and shall involve maintenance procedures for the various types of apparatus.

7. RECORDS

7.01 Records in the form of graphs, maps, drawings, etc., shall be made as necessary so that comparisons and studies may be made subsequent to the tests, and to provide permanent records for future reference. It is also important that all records be maintained up to date in order to facilitate interpretation of current data and future studies.

7.02 It is also helpful to maintain an electrolysis study map on which the following types of information may be indicated.

- Main underground conduit or buried cable routes.
- Central Offices.
- Underground dips, private undergrounds and subsidiary entrances affected by electrolysis or electrolysis mitigation.
- D-C substations, power houses and track systems.
- A-C substations used for single phase track systems.
- Electrolysis mitigation such as drainage wires, anodes, etc.
- Insulating joints.
- Routine survey test data.
- Corrosion failures, by years of failure and case numbers.

7.03 The above records will be used as the basis for analyzing corrosion conditions in the area, and preparing such electrolysis reports as may be required from time to time.