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Test Procedure
for
RADIAL POWER FACTOR TESTS
on INSULATING TAPES in
PAPER-INSULATED POWER CABLE

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TEST PROCEDURE FOR RADIAL POWER FACTOR TESTS ON INSULATING TAPES IN PAPER-INSULATED POWER CABLE

1. SCOPE

- 1.1 This method of test covers the procedure for determining the radial power factor of insulating tapes in power cable.

2. DEFINITIONS

- 2.1 Radial Power Factor. Radial power factor is the power factor of individual insulating tapes of a power cable as a function of the radial location of the insulating tapes through the insulation wall.
- 2.2 Other Definitions.—Other pertinent definitions will be found in the ASTM Tentative Methods of Tests for Alternating-Current Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials (ASTM Designation D-150).

3. SIGNIFICANCE

- 3.1 The radial power factor of insulating tapes in power cables, as determined by this test method, is of practical importance as a measure of (1) the power factor uniformity of new cable, (2) the deterioration of insulating tapes in a power cable due to normal or abnormal service, or accelerated aging tests, and (3) the contamination of insulating tapes in a power cable with moisture or other foreign matter.

4. ELECTRODES

- 4.1 Three-terminal type electrodes should be used for radial power factor tests. The surfaces of the electrodes should be lapped flat to minimize voids between the test specimen and the electrodes. The spacing between the guard and measuring electrodes should be as small as practical, preferably not greater than 1 mil. Disc type measuring electrodes should be approximately $\frac{1}{2}$ inch in diameter. Rectangular type measuring electrodes should be not less than $\frac{3}{8}$ inch wide and not less than 5 inches long.
 - 4.1.1 Half-inch disc type electrodes have the advantage that (1) they permit the measurement of radial power factor of a small area of an insulating tape, (2) detect variations in radial power factor along an insulating tape, (3) provide more complete contact with insulating tape than larger electrodes, particularly tape from conductors of small diameter, and (4) reduce the time required to manipulate the tape into the electrode system, thus reducing the exposure of the tape to the atmosphere.

- 4.1.2 The rectangular type electrodes have the advantage that less sensitive measuring equipment is required. The fact that they measure average values of power factor for a relatively large area of an insulating tape may, under some conditions, be an advantage.

5. TEST CELL

- 5.1 The electrodes should be mounted in a test cell that will insure that they will (1) align in a manner that will minimize voids between the test specimen and the electrodes, (2) permit the rapid insertion of the test specimen, (3) apply a pressure of 15 ± 5 pounds per square inch to the test specimen, (4) maintain the electrodes at $80C \pm 1C$, and (5) permit the application of 50 volts per mil to the test specimen.

6. MEASURING EQUIPMENT

- 6.1 The measuring equipment should have an accuracy of not less than ± 0.01 percent power factor or ± 10 percent of the measured power factor, whichever is greater. Detailed descriptions of suitable measuring equipment will be found in the ASTM Tentative Methods of Tests for Alternating-Current Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials (ASTM Designation D-150).

7. SAMPLING

- 7.1 The sample, not less than 18 inches long, should be taken from a portion of the cable having no abnormal or lengthy exposure to (1) air due to an open end or (2) heat due to the application of pulling eyes, splices, or potheads, except where the effects of an abnormal condition are being investigated.
- 7.2 The cable sample should be promptly sealed (1) with metal foil, (2) with a solder seal or (3) in a clean, dry metal container of minimum dimensions.
 - 7.2.1 Foil should not be used for sealing cable samples that will not be tested within 24 hours.

8. PROCEDURE

- 8.1 Test Conditions.
 - 8.1.1 Tests should be made with the electrodes at a temperature of $80C \pm 1C$.
 - 8.1.2 A pressure of 15 ± 5 pounds per square inch should be maintained between the electrodes.

- 8.1.3 An average stress of 50 volts per mil is recommended.
- 8.2 After the temperature of the electrodes has been adjusted to $80\text{C} \pm 1\text{C}$, and all other preparations for the test have been completed the sealed cable sample should be opened in a room or chamber with relative humidity of less than 50 percent.
- 8.3 The tapes (test specimens) to be tested should be removed one at a time from the sample of cable without disturbing any tape below it and immediately inserted between the electrodes without treatment of any kind, without touching the part of the tape to be measured.
- 8.4 Tests should be made as fast as practical on the second, fourth, and sixth tapes, then every tenth tape (or every fifth tape, if there are fewer than 40 tapes in the wall of insulation) and finally every other of the last six tapes.
- 8.4.1 It may be advantageous under some conditions to test more than the minimum number of tapes specified above, particularly when there are wide variations in power factor of the individual tapes.
- 8.5 When half-inch disc type electrodes are used, three tests should be made on each tape at spots so located that they represent three radial paths (1) approximately equally spaced around a single-conductor cable, or (2) toward each of the adjacent conductors and toward the sheath of a three-conductor cable. The average of the three measurements should be reported, unless due to wide variations of the three measurements it is advantageous to report all readings.
- 8.6 With rectangular type electrodes a single test should be made on each tape.

9. REPORT

- 9.1 The report should include the following:
- (a) Size and type of electrodes.
 - (b) Pressure applied to tapes.
 - (c) Power factor and identification of each tape tested.
 - (d) Voltage stress applied to tapes.