

American Standard

Insulator Tests

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American Standards Association

SPONSOR

Electrical Standards Committee

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Foreword

The standards included in this publication comprise a manual of procedures for tests to determine the characteristics of insulators used on electric power systems. The standards do not cover test procedures for apparatus bushings. They are not intended as complete insulator specifications, but rather as test procedures for incorporation in such specifications.

This American Standard, Insulator Tests, C29.1-1944, is a revision of the American Standard Insulator Tests, C29a-1930. Sectional Committee C29, which is in charge of the work, requested the Lightning and Insulator Subcommittee of the American Institute of Electrical Engineers Committee on Power Transmission and Distribution to prepare a proposed revision for consideration by the sectional committee. The AIEE committee prepared a document designated as AIEE No. 41a, dated March, 1941 which served as the basis for this standard.

Acknowledgment is made to the American Society for Testing Materials for the material contained in 5.5.3 and 5.5.6.2, page 18, which is identical in substance with that contained in Section 5, paragraphs (a) through (f) of Standard Methods of Testing Pin-Type Lime-Glass Insulators, ASTM D 468-42.

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American Standard Insulator Tests

1. Scope and Purpose

1.1 These standards comprise a manual of test procedures to be followed in making tests to determine the characteristics of insulators to be used on electric power systems. They are not intended to include test procedure for apparatus bushings.* Since these standards are not intended to be insulator specifications, the individual tests may be made a part of an insulator specification only when specifically designated in contract specifications. In all cases where these standards include high voltage measurements, the methods, equipment, and technique shall be in accordance with American Standards for Measurement of Test Voltage in Dielectric Tests, C68.1-1942 or latest revision thereof.

2. Definitions

2.1 For the purpose of these specifications the following definitions are used to clarify the procedure.

2.2 Insulators and Parts

2.2.1 Shell. A shell is a single insulating member without cement or other connecting devices.

2.2.2 Pin-Type Insulator. A pin-type insulator is any insulating unit, the function of which is to support rigidly and insulate a line conductor as on a crossarm.

2.2.3 Suspension Insulator

2.2.3.1 Unit. A suspension insulator unit is an assembly of 1 or more shells with the necessary metal parts for flexibly attaching other insulators or hardware.

2.2.3.2 String. A suspension insulator string is a chain of 2 or more units coupled together.

2.2.4 Switch and Bus Insulator. (Indoor and Outdoor)

2.2.4.1 Unit. A switch and bus insulator unit is the assembly of 1 or more insulating elements with attached metal parts, the function of which is to support rigidly a conductor on a structure or base member.

2.2.4.2 Stack. A stack is a rigid assembly of 2 or more switch and bus units.

2.2.5 Guy Insulator. A guy insulator is an insulating element, generally of elongated form with

two transverse holes or slots used, for the purpose of insulating a guy or cable.

2.2.6 Spool Insulator. A spool insulator is an insulating element of generally cylindrical form having an axial hole and a circumferential groove or grooves for the attachment of a conductor.

2.2.7 Bushing. A bushing is any insulating unit, usually of elongated form with an axial hole, the function of which is to insulate a conductor passing through a barrier.

2.2.8 Tube. A tube is a single element bushing without hardware.

2.2.9 Unit and Shell Identification

2.2.9.1 Insulating Units. Insulating units when used in a string or stack, and the individual shells of multi-part roof and wall bushings shall be referred to by consecutive numbers starting with the energized electrode.

2.2.9.2 Individual Shells. The individual shells of multi-part assemblies, other than roof and wall bushing assemblies, shall be referred to by consecutive numbers, starting with the uppermost shell in the normal position.

2.3 Low-Frequency Voltages

2.3.1 Low Frequency. "Low frequency" as used in these standards is understood to mean any frequency between 15 and 100 cycles per second. Any available commercial frequency within this range will be acceptable for making low-frequency tests outlined in these standards.

2.3.2 Low-Frequency Dry-Flashover Voltage. The low-frequency dry-flashover voltage is the root-mean-square (rms) voltage causing a sustained disruptive discharge through the air between electrodes of a clean, dry test specimen, the test being made as described in 4.1, page 9.

2.3.3 Low-Frequency Wet-Flashover Voltage. The low-frequency wet-flashover voltage is the root-mean-square (rms) voltage causing a sustained disruptive discharge through the air between electrodes of a clean, wet test specimen, the test being made as described under 4.2, page 9.

2.3.4 Low-Frequency Withstand Voltage. A low-frequency withstand voltage of a test specimen is a root-mean-square (rms) low-frequency voltage which does not cause a sustained disruptive discharge when applied to the test specimen for a specified time.

* For apparatus bushings see American Standards for Apparatus Bushings and Test Code for Apparatus Bushings, C76.1-1943 or latest revision thereof.

2.3.5 Low-Frequency Rated-Withstand Voltage. The low-frequency rated-withstand voltage of a test specimen is the root-mean-square (rms) low-frequency voltage which can be applied under specified conditions without sustained disruptive discharge on the test specimen.

2.3.6 Puncture Voltage. The puncture voltage of a test specimen is the voltage at which the test specimen is electrically punctured, the test being made as described under 4.7, page 15.

2.4 Impulse Voltages

2.4.1 Impulse-Flashover Voltage. The impulse-flashover voltage of a test specimen is the crest voltage of a wave causing a complete disruptive discharge through the air between electrodes of the test specimen, the test being made as described under 4.3, page 12.

2.4.2 Impulse Critical-Flashover Voltage. The impulse critical-flashover voltage of a test specimen is the crest value of a wave causing flashovers on 50 percent of the applications, the test being made as described under 4.3, page 12.

2.4.3 Impulse-Withstand Voltage. An impulse-withstand voltage of a test specimen is the crest value of an applied impulse voltage which does not cause a complete disruptive discharge on the test specimen.

2.4.4 Impulse Rated-Withstand Voltage. The impulse rated-withstand voltage of a test specimen is the crest value of an impulse voltage which can be applied under specified conditions without complete disruptive discharge on the test specimen, the test being made as described under 4.4, page 13.

2.5 Mechanical Loading

2.5.1 Ultimate Mechanical Strength. The ultimate mechanical strength of an insulator is the loading in pounds at which any part of the insulator fails to perform its function of providing a mechanical support without regard to electrical failure, the test being made as described under 5.1, page 15.

2.5.2 Combined Mechanical and Electrical Strength. The combined mechanical and electrical strength of an insulator is the loading in pounds at which any part of the insulator fails to perform its function either electrically or mechanically, when voltage and mechanical stress are applied simultaneously as described under 5.2, page 17.

2.5.3 Time-Load Test. A time-load test is a continuous mechanical loading test, held for a pre-

scribed time, at a fixed load value followed by momentary application of flashover voltage to detect electrical failure.

2.5.4 Mechanical Impact Strength. The mechanical impact strength of an insulator is the impact blow in inch-pounds which the insulator can withstand without chipping, breaking, cracking, or being otherwise damaged, the test being made as described under 5.1.2.2, page 15.

2.6 Miscellaneous

2.6.1 Leakage Distance. The leakage distance of an insulator is the sum of the shortest distances measured along the surface of the insulator between the conductive parts when arranged for dry-flashover test. Surfaces coated with semi-conducting glaze shall be considered as effective leakage surfaces, and leakage distance over such surfaces shall be included in the leakage distance.

2.6.2 Dry-Arcing Distance. The dry-arcing distance of an insulator is the sum of the shortest distances, through air or over the surface, between the live metallic and grounded parts of an insulator when arranged for dry-flashover test.

2.6.3 Radio-Influence Voltage. The term "radio-influence voltage" is used to designate the radio frequency voltage measured with a noise meter in accordance with Joint Coordination Committee on Radio Reception of Edison Electric Institute, National Electrical Manufacturers Association and Radio Manufacturers Association as set forth in EEI Publication G9 (NEMA Publication 107, RMA Engineering Bulletin 32) of February, 1940.

2.6.4 Radio-Influence Characteristics. The radio-influence voltages associated with several different values of normal-frequency potential across the insulator shall be known as the radio-influence characteristics of that insulator.

3. Specimen Mounting for Electrical Test

3.1 Suspension Insulators

3.1.1 Supporting Method. The test specimen (unit or string) shall be suspended vertically by the makers' standard crossarm suspension hardware carried at the end of a grounded wire or suitable conductor suspended so that the vertical distance from the uppermost point of the insulator hardware to the supporting structure shall be not less than 3 feet.

3.1.2 Bottom Electrode. The bottom electrode or conductor shall be a straight smooth rod

or tube having an outside diameter of not less than 1 inch, nor more than $1\frac{1}{2}$ percent of the specimen dry-arcing distance. It shall be coupled to the lower integral fitting of the specimen so that the distance from the lowest edge of the insulator shell to the upper surface of the electrode shall be between 0.5 and 0.7 of the diameter of the lowest insulator. The conductor shall be horizontal and at right angles to the axis of the test specimen. The conductor shall be of such length that arc-over will not be initiated at the electrode ends.

3.1.3 Proximity of Other Objects. No grounded objects other than grounded parts of the test assembly shall be nearer the test specimen or live electrodes than $1\frac{1}{2}$ times the specimen dry-arcing distance, with a minimum allowable spacing of 3 feet.

3.2 Pin-Type Insulators

3.2.1 Mounting Arrangement (Crossarm). The supporting crossarm shall be a horizontal, straight, smooth, grounded, metallic tube or structural member having a horizontal width not less than 3 inches nor more than 6 inches. It shall be of such length that arc-over will not be initiated at its ends.

3.2.2 Mounting Pin (If Required). When a separable pin is required, the test specimen shall be mounted vertically on a 1-inch-diameter metal pin of such length that the shortest dry-arcing distance from the upper electrode and connected metallic parts to the supporting crossarm shall be 25 percent greater than the similar distance to the pin. The pin shall be coaxial with the insulator. Insulators having integrally assembled means for mounting on a crossarm shall be mounted on the test crossarm directly as in service.

3.2.3 Top Electrode. The top electrode or conductor shall be a horizontal round rod or tube placed at right angles to the supporting crossarm and of a diameter not less than 0.5 inch. It shall be of such length that arc-over will not be initiated at its ends. The conductor shall be placed in the top wire groove of the insulator or any other means provided for the conductor support as in service. If a tie wire is to be used, the conductor rod or tube shall be secured by means of at least 1 turn of wire having a diameter not smaller than No. 8 Awg, the ends being closely wrapped about the rod on each side of the insulator.

3.2.4 Proximity of Other Objects. No grounded objects other than grounded parts of the

test assembly shall be nearer the test specimen or live electrodes than $1\frac{1}{2}$ times the specimen dry-arcing distance, with a minimum allowable spacing of 3 feet.

3.3 Switch and Bus Insulators

3.3.1 Mounting Arrangement. The test specimen shall be mounted vertically upright on a horizontal, grounded 10-inch channel, with the channel flanges projecting down. A sub-base may be used if required. The supporting channel shall be of such length that arc-over will not be initiated at its ends, and its top surface shall be not less than 3 feet above the ground.

3.3.2 Top Electrode. The top electrode or conductor shall be a horizontal round rod or tube at right angles to the supporting channel and of a diameter approximately 5 percent of the specimen dry-arcing distance within the limits of $4\frac{1}{2}$ inches, (4-inch iron pipe size) maximum, and $\frac{1}{2}$ -inch minimum. The length of the conductor shall be such that arc-over shall not be initiated at its ends. It shall be mounted directly in contact with the top integral fitting of the test specimen and with its horizontal axis in the same vertical plane as the vertical axis of the specimen.

3.3.3 Proximity of Other Objects. No grounded objects other than grounded parts of the test assembly shall be nearer the test specimen or live electrodes than $1\frac{1}{2}$ times the specimen dry-arcing distance, with a minimum allowable spacing of 3 feet.

3.4 Guy Insulators

3.4.1 Mounting Arrangement. The test specimen shall be mounted in a position with its major axis at 45 degrees from the vertical, using attachment fittings used in service or a flexible metal conductor of approximately 75 percent of the hole diameter of the specimen which shall be clamped back on itself with standard guy clamps. The clamps shall be spaced from the test specimen at a distance not less than the specimen length. Mechanical tension shall be applied to the specimen sufficient to avoid appreciable sag in the set-up. The lower attaching fitting or guy-strand section shall be grounded.

3.4.2 Proximity of Other Objects. No grounded objects other than grounded parts of the test assembly shall be nearer the test specimen or live electrodes than $1\frac{1}{2}$ times the dry-arcing dis-