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Requirements and Test Code for
OUTDOOR APPARATUS BUSHINGS

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FOREWORD

(This Foreword is not part of American Standard Requirements and Test Code for Outdoor Apparatus Bushings C76.1—1964)

This publication represents standard practices in the United States relating to outdoor apparatus bushings. The Sectional Committee on Standardization of Apparatus Bushings, C76, of the American Standards Association, Inc., has for a number of years been developing and correlating Standards on bushings. The data used in this work have been gathered principally from the Standards and other documents of the American Institute of Electrical Engineers (now the Institute of Electrical and Electronic Engineers) and the National Electrical Manufacturers Association. This work resulted in the publication of Standards in 1943 which were subsequently revised and expanded in 1958.

The original American Standard, ASA C76.1—1943, was a document prepared by the Joint Committee on Bushing Standardization of the Electric Machinery, Power Transmission and Distribution, and Protective Devices Committees of the American Institute of Electrical Engineers. It was approved by the AIEE Standards Committee in 1942 as AIEE No. 21. The following year the document was also approved, in toto, as an American Standard by the American Standards Association and published July 23, 1943 as the joint ASA C76.1—1943 and AIEE No. 21 titled, "American Standard for Apparatus Bushings and Test Code for Apparatus Bushings."

In 1958 a supplement and partial revision was approved and published. This was "American Standard Electrical and Dimensional Characteristics of Outdoor Apparatus Bushings (used with Power Circuit Breakers and Outdoor Transformers)" C76.1a—1958. It was prepared to fulfill the need by users for bushings with dimensional interchangeability and resulted from work undertaken and promoted by regional associations of electrical utilities. This document was prepared by the National Electrical Manufacturers Association Joint Sections Committee on Outdoor Apparatus Bushings consisting of representatives of the High-Voltage Insulator Section, Power Circuit Breaker Group—Switchgear Section and the Transformer Section. C76.1a—1958 was subsequently made a requirement, by reference, of C37.4a—1958 "Electrical Characteristics of Power Circuit Breaker Bushings and Dimensions of Power Circuit Breaker Bushings, Their Mountings and Bushing Current Transformers" and, by reproduction, of C57.12.00—1958 "American Standard Requirements, Terminology and Test Code for Distribution, Power and Regulating Transformers, and Reactors Other Than Current-Limiting Reactors."

At the time of this supplement, ASA Sectional Committee C76 foresaw the need for a general revision and up-dating of the Standard and directed the American Institute of Electrical Engineers and National Electrical Manufacturers Association to submit recommendations. Implementation of this request in NEMA was undertaken by a Subcommittee of the Joint Sections Committee on Outdoor Apparatus Bushings and resulted in a proposal which was approved February 18, 1960 by the Codes and Standards Committee for submission to C76 as the NEMA recommendation. In AIEE a Joint Working Group consisting of members of the Transformer and Dielectric Test Committee of the Transformer Committee and of the Power Circuit Breaker Committee was established. This Working Group developed a recommendation which was submitted to C76 on July 11, 1960. The AIEE proposal was subsequently reviewed by the West Coast Subcommittee of the Transformers Committee (AIEE) which developed additional recommendations and submitted them to C76 on November 4, 1960.

On January 26, 1962 ASA Sectional Committee C76 appointed a special Working Group for Revision of C76.1 to consolidate the several proposals and recommendations. This Standard has evolved from the editorial and mediation results of that Working Group.

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Suggestions for improvement gained in the use of this Standard will be welcomed. They should be sent to the American Standards Association, 10 East Fortieth Street, New York 16, New York.

The organizations which participated in this work and the names of the representatives as listed at the time the major work was in process are:

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American Standard
Requirements and Test Code for
OUTDOOR APPARATUS BUSHINGS

1. SCOPE

1.1 This Standard covers the following:

- (1) Electrical requirements for outdoor power apparatus bushings having basic impulse insulation levels 110 through 1300 kilovolts.
- (2) Mechanical requirements for the outdoor power apparatus bushings listed in Table 7.4.
- (3) Dimensions of the outdoor power transformer and alternating-current power circuit breaker apparatus bushings listed in Tables 7.1(a), 7.1(b), and 7.1(c).

1.2 This Standard does not apply to bushings for indoor apparatus, dry type instrument transformers, air-blast transformers, dry type regulators, oil-less and oil-poor apparatus, roof, floor, wall and generator bushings, potheads, distribution type circuit breakers and back-connected switch insulators.

1.3 Bushing requirements as set forth in this Standard apply to bushings when mounted for testing, according to requirements outlined in Section 9.3.

2. DEFINITIONS

2.1 Bushing. A bushing is an insulating structure, including a through conductor or providing a central passage for such a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

2.2 Interchangeable Bushing. An interchangeable bushing is a bushing designed for use in both power transformers and circuit breakers.

2.3 Condenser Bushing. A condenser bushing is a bushing in which cylindrical conducting layers are arranged coaxially with the conductor within the insulating material.

Note: The length and diameter of the cylinders are designed with the object of controlling the distribution of the electric field in the bushing. Condenser bushings may be one of several types

- (1) Resin-bonded paper-insulated
- (2) Oil-impregnated paper-insulated
- (3) Other

2.4 Oil-Filled Bushing. An oil-filled bushing is a bushing in which the space between the inside surface of the porcelain and the major insulation (or conductor where no major insulation is used) is filled with oil.

2.5 Compound-Filled Bushing. A compound-filled bushing is a bushing in which the space between the inside surface of the porcelain and the major insulation (or conductor where no major insulation is used) is filled with compound.

2.6 Oil-Impregnated Paper-Insulated Bushing. An oil-impregnated paper-insulated bushing is a bushing

in which the major insulation is provided by paper impregnated with oil.

2.7 Resin-Bonded Paper-Insulated Bushing. A resin-bonded paper-insulated bushing is a bushing in which the major insulation is provided by paper bonded with resin.

2.8 Solid Bushing. A solid bushing is a bushing in which the major insulation is provided by a ceramic or analogous material.

2.9 Composite Bushing. A composite bushing is a bushing in which the insulation consists of several coaxial layers of different insulating materials.

2.10 Bushing Potential Tap. A bushing potential tap is an insulated connection to one of the conducting layers of a bushing providing a capacitance voltage divider to indicate the voltage on the bushing. The tap is accessible from outside the bushing.

2.11 Bushing Test Tap. A bushing test tap is an insulated connection to one of the conducting layers of a bushing for the purpose of making ungrounded specimen power factor tests. The tap is accessible from outside the bushing.

2.12 Capacitance of Bushing.

(1) The main capacitance, C_1 , of a bushing is the value in picofarads between the high-voltage conductor and the potential tap or the test tap.

(2) The tap capacitance, C_2 , of a bushing is the value in picofarads between the potential tap and ground.

Note: The ratio $\frac{C_1}{C_1 + C_2}$ is the ratio of the potential tap voltage to ground to the voltage of the high-voltage terminal to ground.

(3) The capacitance, C , of a bushing without a potential or test tap is the value in picofarads between the high-voltage conductor and the ground flange.

2.13 Radio Influence Voltage. A radio influence voltage is a high-frequency voltage generated as a result of ionization which may be propagated by conduction, induction, radiation or a combined effect of all three.

2.14 Ionization.

(1) Ionization is the formation of charged particles.

(2) Ionization current is the result of the movement of charged particles in an insulating medium under the influence of an electric field.

Note: The occurrence of such currents may cause:

- (1) Radio noise.
- (2) Damage to insulation.

2.15 Ionization Measurement. Ionization measurement is the measurement of the electric current result-