

**AIEE
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Standard
for
**AIR SWITCHES, INSULATOR UNITS,
and BUS SUPPORTS**

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Development of the Standards of the American Institute of Electrical Engineers

Recognizing the importance in the development of electrical engineering, of standardization in the electrical field, the AIEE in 1898 appointed a Committee on Standardization, consisting of seven members having qualifications and experience from designing, manufacturing and operating standpoints. The report of this Committee was accepted at a meeting of the Institute in June 1899.

Experience gained in applications of the standards and further developments in electric apparatus and methods showed the necessity of revision, and a committee was appointed which after consultation with manufacturing and operating engineers presented the first revised report on Standardization Rules of the AIEE in June 1902.

The next revision was undertaken by a committee of ten, which presented its report in May 1906.

In September 1906, a Standards Committee of eleven members was appointed for further revision, and its report was presented in June 1907.

The appreciation of the importance and value of standardization resulted in the formation of a Standing Committee, with the title of Standards Committee of the AIEE. This became effective in the Constitution of June 1907. The scope and amount of work necessitated increasing the number of members from time to time until in 1922 there were 37 members divided into a number of subcommittees specializing on various subjects.

AIEE Standards published in a single volume as each revision was adopted were generally accepted as standards of the electrical industry of the United States since the adoption of the first report in 1899. Subsequent reports on standards were made and published, in some cases in several editions. The dates of adoption by the Board of Directors of such reports are as follows: June 20, 1902; June 21, 1907; June 27, 1912; July 10, 1914; June 30, 1915; June 28, 1916; November 8, 1918; October 8, 1920, and June 29, 1922.

On June 29, 1922, in view of the increasing complexity of the work, a reorganization of the Standards Committee was effected, and a working organization established which provided for an increase in standardization work and for the appointment on Working Committees of the Standards Committee of non-Institute members.

The present plan under which the Institute Standards are being issued involves the separation of the complete body of standards into more than forty sections, each published as a separate pamphlet and dealing with a specific subject. Each section of the standards has been formulated either by a subcommittee of the Standards Committee which was made as representative as possible for the work in hand, by an AIEE Technical Committee or subcommittee, or by a Sectional Committee organized according to the procedure of the American Standards Association. The division of the standards into a number of separate publications simplifies the process of keeping the standards revised to conform with the latest development and enables those interested in a particular field to obtain in concise form the material relating to that field. In framing the Institute Standards the chief purpose has been to define terms and conditions which characterize the rating and behavior of electric machinery and apparatus, with special reference to the conditions of acceptance tests.

The AIEE Standards Committee takes this occasion to draw attention to the value of suggestions based upon experience gained in the application of the standards to general practice. Any suggestions looking toward improvements in the standards will be welcomed for the guidance of the Committee in preparation of future editions, and should be communicated to the Secretary of the AIEE Standards Committee, 33 West 39th Street, New York 18, N. Y.

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INTRODUCTION

The AIEE standards on certain related devices have been grouped into this one standard. This saves duplication and serves to set off important differences when they exist.

Essential data from Reports and Standards of AIEE, as well as definitions from the American Standard Definitions of Electrical Terms, C42 have been incorporated for ready reference. These terms are followed by their C42 designating number in parentheses. Specific definitions have also been included. If there is need for further clarification, reference should be made to the following:

AIEE	Standards Manual
AIEE 1	Introduction to AIEE Standards General Principles Upon Which Temperature Limits are Based in The Rating of Electric Machines and Apparatus.
AIEE 1B	Report on Guiding Principles for the Specification of Service Conditions in Electrical Standards.
AIEE 3	Guiding Principles for the Selection of Reference Values for Electrical Standards.
AIEE 4	Measurement of Test Voltage in Dielectric Tests.
AIEE 29	Wet Tests
ASA C29.1	Insulator Tests
ASA C42	Definitions of Electrical Terms
EEI-NEMA	Report on Preferred Voltage Ratings

There are other committees of the AIEE working on various reports and standardization problems such as impulse ratings, simplified calculation of short-circuit currents, definitions, etc. When they are completed and approved some changes in this standard may be advisable.

ACKNOWLEDGMENT

The Institute wishes to acknowledge its indebtedness to those who have so freely given their time and knowledge, and have conducted experimental work on which many of the AIEE Standards are based.

The work of preparing this standard was carried out by members of the Subcommittee on Switches, Fuses and Insulators of the AIEE Committee on Switchgear. The members of the subcommittee are:

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Standard of the American Institute of Electrical Engineers

AIR SWITCHES, INSULATOR UNITS, AND BUS SUPPORTS

SCOPE

This standard applies to the following types of devices designed for operation above 600 volts whether for indoor or outdoor service.

(a) Air switches such as disconnecting, grounding, etc., for manual or automatic operation. (See 22-73, 75 and 79)

(b) Air interrupter switches. (See 22-79.3)

(c) Insulator units and bus supports. (See 22-119 and 71)

SERVICE CONDITIONS

22-1 Usual Temperature and Altitude Service Conditions—Equipment conforming to this standard shall be suitable for operation at its standard rating, provided that:

(a) The temperature of the cooling air (ambient temperature) does not exceed 40C if the equipment has copper-to-copper contacts or equivalent.

(b) The temperature of the cooling air (ambient temperature) does not exceed 55C if the equipment has all contacts silver surfaced or equivalent, and in addition has all conducting joints, including terminal connections, either

(1) Separately held mechanically, and either soldered or silver surfaced, or

(2) Brazed, welded or silver soldered and provided that such operation does not result in temperatures in excess of 90C for class O, 105C for class A or 130C for class B insulations.

(c) The altitude does not exceed 3300 feet (1000 meters).

22-2 Unusual Temperature and Altitude Service Conditions—The application of equipment at higher ambient temperatures or at higher altitudes than specified in *Usual Service Conditions* shall be considered as special.

Standard equipment may be applied at higher ambient temperatures or at higher altitudes than specified, but its performance may be affected and special consideration should be given to these applications.

22-3 Other Conditions Which May Affect Design and Application—Where other unusual conditions exist they should be brought to the attention of those responsible for the design and application of the equipment. Examples of such conditions are:

(a) Damaging fumes or vapors, excessive or abrasive dust, explosive mixtures or dust or gases, steam, salt spray, excessive moisture or dripping water, etc.

(b) Abnormal vibration, shocks, or tilting.

(c) Excessively high or low temperatures.

(d) Unusual transportation or storage conditions.

(e) Unusual space limitations.

(f) Unusual operating duty, frequency of operation, difficulty of maintenance, poor wave form, unbalanced voltage, special insulation requirements, etc.

22-4 Applications at Altitudes Greater Than 3300 Feet (1000 Meters)—Equipment that depends on air for its insulating and cooling medium will have a higher temperature rise and a lower dielectric strength when operated at altitudes above 3300 feet.

Dielectric strength and current ratings should be multiplied by factors shown in Tables 1a and 1b.

Equipment designed for standard temperature rise may be used at its normal current rating without exceeding ultimate standard temperature limits provided that the ambient temperature does not exceed the ambient allowed in paragraph 22-1 multiplied by the factor shown in Table 1c.

**TABLE I
ALTITUDE CORRECTION**

Altitude		Altitude Correction Factor to be Applied To		
Feet	Meters	a	b	c
		Dielectric Strength	Current Rating	Ambient Temperatures
3300	1000	1.00	1.00	1.00
4000	1200	0.98	0.995	0.992
5000	1500	0.95	0.99	0.980
6000	1800	0.92	0.985	0.968
7000	2100	0.89	0.98	0.956
8000	2400	0.86	0.97	0.944
9000	2700	0.83	0.965	0.932
10000	3000	0.80	0.96	0.920
12000	3600	0.75	0.95	0.896
14000	4200	0.70	0.935	0.872
16000	4800	0.65	0.925	0.848
18000	5400	0.61	0.91	0.824
20000	6000	0.56	0.90	0.800

If the derating as determined from the table is serious, equipment of a suitably higher rating should be chosen to meet requirements after derating factors have been applied. The correction factors in Table I columns b and c are not to be applied at the same time.

DEFINITIONS

Definitions as given herein apply specifically to the apparatus treated in this standard. These and other standard definitions may be found in the "American Standard Definitions of Electrical Terms," C42. The numbers in parentheses following many of the definitions are the C42 designating numbers.

General

- 22-50 Air (used as a prefix)**—The prefix "air" applied to a device indicates one in which air is the insulating medium between contacts in the open position. (95.90.005 modified)
- 22-51 Proof (used as a suffix)**—Apparatus is designated as splashproof, dustproof, etc., when so constructed, protected or treated that its successful operation is not interfered with when subjected to the specified material or condition. (95.90.015)
- 22-52 Tight (used as a suffix)**—Apparatus is designated as watertight, dust-tight, etc., when so constructed that the enclosing case will exclude the specified material. (95.90.025)
- 22-53 Resistant (used as a suffix)**—Apparatus is designated as moisture-resistant, fume-resistant, etc., when so constructed, protected or treated that it will not be injured readily when subjected to the specified material. (95.90.020)
- 22-54 Outdoor (used as a prefix)**—The prefix "outdoor", applied to a device, indicates that the device has been designed for outdoor service. (95.90.192 modified)
- 22-55 Indoor (used as a prefix)**—The prefix "indoor", applied to a device, indicates that the device has been designed for indoor service. (95.90.190 modified)

Properties and Characteristics

- 22-56 Gasproof Apparatus**—Gasproof apparatus is apparatus so constructed or protected that the specified gas will not interfere with its successful operation. (95.90.105)
- 22-57 Gastight Apparatus**—Gastight apparatus is apparatus so constructed that the specified gas will not enter the enclosing case under specified conditions of pressure. (95.90.110)
- 22-58 Fume-Resistant Apparatus**—Fume-resistant

apparatus is apparatus so constructed that it will not be injured readily by the specified fumes. (95.90.115)

- 22-59 Dustproof Apparatus**—Dustproof apparatus is apparatus so constructed or protected that the accumulation of dust will not interfere with its successful operation. (95.90.125)
- 22-60 Dust-Tight Apparatus**—Dust-tight apparatus is apparatus so constructed that the dust will not enter the enclosing case. (95.90.130)
- 22-61 Moisture-Resistant Apparatus**—Moisture-resistant apparatus is apparatus so constructed or treated that it will not be injured readily by a moist atmosphere. Such apparatus shall be capable of operating in a very humid atmosphere, such as that found in mines, evaporating rooms, etc. (95.90.140 modified)
- 22-62 Drip-Proof Apparatus**—Drip-proof apparatus is apparatus so constructed or protected that its successful operation is not interfered with when subjected to falling moisture or dirt. (95.90.150)
- 22-63 Driptight Apparatus**—Driptight apparatus is apparatus so protected as to exclude falling moisture or dirt. Driptight apparatus may be semi-enclosed apparatus if it is provided with suitable protection integral with the apparatus, or so enclosed as to exclude effectively falling solid or liquid material. (95.90.155 modified)
- 22-64 Splashproof Apparatus**—Splashproof apparatus is apparatus so constructed and protected that external splashing will not interfere with its successful operation. (95.90.160)
- 22-65 Watertight Apparatus**—Watertight apparatus is apparatus so constructed that a stream of water from a hose (not less than 1 inch in diameter) under a head of about 35 feet and from a distance of about 10 feet can be played on the apparatus for several minutes without leakage.
- 22-66 Submersible Apparatus**—Submersible apparatus is apparatus so constructed that it will operate successfully when submerged in water under specified conditions of pressure and time. (95.90.195)
- 22-67 Weatherproof Apparatus**—Weatherproof apparatus is apparatus so constructed or protected that exposure to the weather will not interfere with its successful operation. (95.90.185)
- 22-68 Sleetproof (Glazeproof) Apparatus**—Sleetproof apparatus is apparatus so constructed or protected that the accumulation of sleet will

not interfere with its successful operation. (95.90.170)

- 22-69 Explosionproof Apparatus**—Explosionproof apparatus is apparatus so constructed that explosion of gas within the casing will not injure it or ignite flammable gas outside it. (95.90.235 modified)

Miscellaneous Terms

- 22-70 Ambient Temperature**—Ambient temperature is the temperature of the surrounding cooling medium, such as gas or liquid, which comes in contact with the heated parts of the apparatus. (25.95.005)

Classification

- 22-71 Bus Support**—A bus support is an insulating support for a bus. It includes one or more insulator units with fittings for fastening to the mounting structure and for receiving the bus.
- 22-72 Switch**—A switch is a device for making, breaking or changing the connections in an electric circuit. (25.05.090)
- 22-73 Air Switch**—An air switch is a switch in which air is the insulating medium between contacts in the open position. (20.10.010 modified)
- 22-74 Isolating Switch**—An isolating switch is a switch intended for isolating an electric circuit or device from the source of power. It is intended to be operated only when the circuit has been opened by some other means. (25.05.110 modified)
- 22-75 Disconnecting Switch**—A disconnecting switch is a form of air switch used for changing connections in a circuit or system, or for isolating purposes. (20.10.130)
- 22-76 Selector Switch**—A selector switch is a form of air switch arranged so that a conductor may be connected to any one of several other conductors. (20.10.135)
- 22-77 Transfer Switch**—A transfer switch is a form of air switch arranged so that a conductor connection can be transferred from one circuit to another without interrupting current. (20.10.140)
- 22-78 Horn Gap Switch**—A horn gap switch is a form of air switch provided with arcing horns. (20.10.145)
- 22-79 Grounding Switch**—A grounding switch is a form of air switch by means of which a circuit or a piece of apparatus may be connected to ground. (20.10.150)

- 22-79.3 Air Interrupter Switch**—An air interrupter switch is a switch combining the function of a disconnecting switch and circuit interrupter for interrupting in air, currents not exceeding the continuous rating of the switch.

Construction Arrangements and Parts

- 22-80 Single-Break Switch**—A single-break switch is a switch which opens each conductor of the circuit at one point only. (20.10.175 modified)
- 22-81 Double-Break Switch**—A double-break switch is a switch which opens each conductor of the circuit at two points. (20.10.180 modified)
- 22-82 Single-Throw Switch**—A single-throw switch is a switch by means of which the circuit can be closed or opened by moving the switch blade into or out of one set of contacts only. (20.10.185)
- 22-83 Double-Throw Switch**—A double-throw switch is a switch by means of which a change in circuit connections can be obtained by closing the switch blade into either of two sets of contacts. (20.10.190)
- 22-84 Pole**—A pole of a switch consists of the parts necessary to control one conductor of a circuit. A switch may be a singlepole or multipole, depending upon the number of single poles that are operated simultaneously. (20.10.195)
- 22-85 Rotating-Insulator Switch**—A rotating-insulator switch is a switch in which the opening and closing travel of the blade is accomplished by the rotation of one or more of the insulators supporting the conducting parts of the switch. (20.10.200)
- 22-86 Tilting-Insulator Switch**—A tilting-insulator switch is a switch in which the opening and closing travel of the blade is accomplished by a tilting movement of one or more of the insulators supporting the conducting parts of the switch. (20.10.205)
- 22-87 Lifting-Insulator Switch**—A lifting-insulator switch is a switch in which a third insulator remains attached to the blade, moves with it, and lifts it to the open position.
- 22-88 Rolling-Insulator Switch**—A rolling-insulator switch is a switch on which the insulators are mounted on rollers and moved in directions parallel with the base.
- 22-89 Vertical-Break Switch**—A vertical-break switch is a switch in which the travel of the blade is in a plane perpendicular to the plane of the base mounting. (20.10.210)