AIEE
No. 21
June 1942

Standards

for

APPARATUS BUSHINGS

AND

TEST CODE FOR APPARATUS BUSHINGS

Published by
THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West Thirty-ninth Street, New York

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 electrical 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 Working Committee 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 electrical 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 improvement 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.

TABLE OF CONTENTS

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 major work of preparing this standard was carried out by the AIEE Joint Committee on Bushing Standardization of the Electrical Machinery, Power Transmission and Distribution and Protective Devices Committees. The personnel of this group was as follows:

R. T. Henry, Chairman
F. S. Brown
J. E. Clem
I. W. Gross
L. H. Hill
J. T. Lusignan
A. C. Monteith
J. R. North
E. Piepho
M. S. Oldacre
A. J. A. Peterson
R. E. Pierce
C. B. Springer
P. C. Turk
F. J. Vogel
L. Wetherill

STANDARDS

OF THE

American Institute of Electrical Engineers

APPARATUS BUSHINGS

(Adopted by Board of Directors, June 24, 1942)

SCOPE

21-1 These standards specifically cover the following types of bushings:

(*a*) Outdoor bushings for large apparatus.

(*b*) Cover type bushings for small apparatus.

(*c*) Indoor bushings for all types of apparatus except dry type instrument transformers, air-blast transformers, dry type regulators, and circuit breakers rated below 5,000 volts, and non-oiltight oil circuit breakers rated 50,000 kva or less.

These standards are not intended to apply to wall bushings, cable potheads, nor insulators for back-connected disconnecting switches, although many of the principles may be applicable.

The bushing requirements as specified in these standards apply to bushings when mounted for testing in accordance with specified arrangements as given in the Test Code (**Appendix I**). Requirements when installed in apparatus should be covered by standards for such apparatus.

SERVICE CONDITIONS

21-5 Usual Service Conditions—Apparatus bushings conforming to these standards shall be suitable for operation at their standard ratings:

(*a*) When and where the temperature of the external cooling medium does not exceed 40C maximum.

(*b*) Where the altitude does not exceed 3300 feet (1000 meters).

21-6 Unusual Service Conditions—The use of apparatus in external cooling media having temperatures higher than 40C maximum, or at altitudes greater than 3300 feet (1000 meters) should be considered as special.

Temperature Rise: For apparatus intended for service at altitudes greater than 3300 feet (1000 meters) it is provisionally agreed that the permissible temperature rises (as determined by test at low altitude, 3300 feet or less) shall be less than those specified in these standards by four-tenths of one per cent of the specified rise for each 330 feet (100 meters) of altitude in excess of 3300 feet (1000 meters) at which the actual installation is to be made.

21-7 Conditions Affecting Construction or Protecting Features—Unusual conditions may require special construction or operation, and these should be brought to the attention of those responsible for the application, manufacture, and operation of the equipment. Among such unusual conditions are:

Exposure to damaging fumes or vapors.

Exposure to excessive moisture or dripping water.

Exposure to excessive dust, abrasive dust or magnetic dust.

Exposure to steam.

Exposure to salt air.

Exposure to abnormal vibration, shocks or tilting.

Exposure to unusual transportation or storage conditions.

Exposure to oil vapors.

Unusual space limitations.

Unusual insulation requirements.

DEFINITIONS

21-25 Bushing—A bushing is an insulating structure including a central conductor, or providing a central passage for 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.

21-26 Flashover of a Bushing—Flashover of a bushing is the disruptive discharge through air or over the surface of a bushing from live parts to ground, produced by the application of voltage wherein the breakdown path becomes sufficiently ionized to maintain an electric arc.

21-27 Withstand Test Voltage—Withstand test voltage is the voltage which the bushing must withstand without flashover or other electrical failure when voltage is applied under specified conditions. For low-frequency voltage the values are expressed as rms and for a specified time; for impulse voltages the values are expressed in crest of a specified wave.

21-28 Critical Impulse Flashover Voltage—The critical impulse flashover voltage of a bushing under an impulse of a given wave shape and polarity is the crest value of that impulse when its amplitude is adjusted to cause flashover on 50 per cent of the applications.

RATING

21-50 Rating—The rating of an apparatus bushing shall include the following items:

(*a*) Rated voltage.

(*b*) Rated frequency.

(*c*) Rated continuous current.

21-51 Rated Voltage—The rated voltage of an apparatus bushing is the voltage at which it is designed to operate.

21-52 Rated Frequency—The rated frequency of an apparatus bushing is the frequency of the circuit for which it is designed.

21-53 Rated Continuous Current—The rated continuous current of an apparatus bushing is the current expressed in amperes which the bushing can carry continuously without exceeding the allowable temperature rise. (See paragraphs **21-75** and **21-76.**)

HEATING

21-75 Bushing Furnished as an Integral Part of the Apparatus—When the bushing is furnished as an integral part of the apparatus, the thermal performance shall be such that it will meet the thermal requirements for the apparatus on which it is used as demonstrated by heat run on complete apparatus with bushing assembled, when such heat run is made.

21-76 Bushing Furnished as a Separate Device—When the bushing is furnished as a separate device or whenever it is necessary to make a heat run on an apparatus bushing separate from the apparatus, it shall be tested in accordance with the Test Code for Apparatus Bushings (Appendix I, Section **H-3**) and the following rules regarding temperature rise apply:

(*a*) The temperature rise over ambient air of the current carrying part of a bushing when tested with rated current shall not exceed 30C.

(*b*) The temperature rise over ambient air of other parts of a bushing accessible to mercury or alcohol thermometers shall (1) conform with Section **21-75** when it is known with which apparatus the bushing is to be used, and (2) shall not exceed 30C when tested with rated current if it is not known with which apparatus the bushing is to be used.

DIELECTRIC TESTS

21-100 Dielectric Tests—The standard dielectric test voltages for apparatus bushings shall be in accordance with the following Table I. Dielectric tests shall be made in accordance with the Test Code for Apparatus Bushings (Appendix I).

NAMEPLATE MARKINGS

21-125 Nameplate Markings—The following information shall appear on all apparatus bushing nameplates:

(*a*) Manufacturer's name and address.

(*b*) Manufacturer's type and designation number.

(*c*) Year of manufacture.

(*d*) Impulse withstand kv.

(*e*) Rated voltage.

(*f*) Rated continuous current.

(*g*) Rated frequency (if suitable for frequencies up to 60 cycles, rated frequency may be omitted).

Note: On small bushings nameplates need not be used if impracticable. In such cases each bushing shall be marked in some conspicuous place with at least the catalog number.

TABLE I

STANDARD WITHSTAND TEST VOLTAGES FOR APPARATUS BUSHINGS

(a) Insulation Classification Kv	Low-Frequency Test Rms Kv (b)					Impulse Test 1.5 x 40 Ms—Full-Wave Crest Kv (b) (d)		
	Outdoor Bushings				Indoor Bushings (g) 1 Min Dry (c) (i)	Outdoor Bushings		
	Large Apparatus (e)		Small Apparatus (f)			Large Apparatus (e)	Small Apparatus (f)	Indoor Bushing (g) (i)
	1 Min Dry	10 Sec Wet	1 Min Dry	10 Sec Wet				
1.2	...	...	10	6	..	...	30	...
2.5	21	20	15	13	20	60	45	45
5.0	27	24	21	20	24	75	60	60
8.7	35	30	27	24	30	95	75	75
15	50	45	35	30	50 (h)	110	95	110 (h)
23	70	60	70	60	60	150	150	150
34.5	95	80	95	80	80	200	200	200
46	120	100	120	100	..	250	250	...
69	175	145	175	145	..	350	350	...
92	225	190	225	190	..	450	450	...
115	280	230	280	230	..	550	550	...
138	335	275	335	275	..	650	650	...
161	385	315	385	315	..	750	750	...
196	465	385	465	385	..	900	900	...
230	545	445	545	445	..	1050	1050	...
287	680	555	680	555	..	1300	1300	...
345	810	665	810	665	..	1550	1550	...

Notes:

(a) Bushings of a given insulation classification are in general recommended for apparatus having a rating up to and including the insulation classification of the bushing and may be used for apparatus of a higher voltage rating when adequate for the particular application.

(b) All values are withstand-test values without negative tolerance.

(c) Wet test values are not assigned to indoor bushings.

(d) The required impulse values must be met with either positive or negative impulse waves.

(e) Bushings for use in large apparatus are those intended for use in transformers rated above 500 kva, outdoor circuit breakers, and other apparatus of corresponding importance.

(f) Bushings for use in small apparatus are those intended for use in transformers rated 500 kva and less and other apparatus of corresponding importance.

(g) Bushings for use in indoor apparatus are those intended for use in indoor type circuit breakers, instrument transformers, and other indoor apparatus except dry type instrument transformers, air-cooled transformers, air-cooled regulators, and bushings used primarily for mechanical protection of insulated cable leads.

(h) Bushings for small indoor apparatus may be supplied to withstand a low-frequency test of 38 kv and an impulse test of 95 kv.

(i) For certain small indoor bushings which will not meet these requirements, these values are not mandatory until January 1, 1943; prior to that time these values apply to all new designs or redesigns.

APPENDIX

TEST CODE FOR APPARATUS BUSHINGS

GENERAL

SCOPE

A-1 This test code pertains to tests on apparatus bushings themselves apart from tests on the assembled apparatus.

CLASSIFICATION OF BUSHING TESTS

B-1 **Routine Tests** are dry one-minute low-frequency* withstand tests made by the manufacturer at the factory on a sufficient number of bushings in each lot to assure quality of manufacture.

B-2 **Design Tests** include a wet ten-second low-frequency withstand test and a dry impulse withstand test. They are made for design application data or on specific bushings at the request of the purchaser when specified and agreed upon.

TEST PROCEDURE

PREPARATION OF BUSHINGS FOR TESTS

C-1 Tests shall be made only on bushings assembled with all elements normally considered essential insulating parts of the bushing.

C-2 The bushing shall be clean.

C-3 Bushings suitable for vertical mounting shall be tested with the bushing mounted vertically on a relatively flat tank cover so as to prevent an arc from striking to the edge of the cover or to any grounded object other than grounded parts of the bushing or the relatively flat portion of the tank cover. Bushings not suitable for vertical mounting shall be tested under conditions approximating normal service.

C-4 Bushings may be subjected to routine tests under convenient conditions of immersion or without immersion. Bushings subjected to design tests should have expected conditions of immersion. For bushings with ground sleeves the ground sleeve may be immersed to any convenient depth. For bushings without ground sleeves the minimum expected immersion should be used.

C-5 For design tests, the test connection to the bushing shall leave the bushing terminal in a direction approximately parallel to the axis of the bushing for a distance not less than the arcing distance of the bushing, and no other objects, except the tank and cover, shall be close enough to the bushing to appreciably affect the test results.

ADJUSTMENT OF CONDITIONS FOR WET TEST

D-1 **Precipitation**

(*a*) *Spray Nozzle*

The bushing being tested shall be placed in an area supplied with a reasonably uniform artificial precipitation produced by a suitable number of spray nozzles of the design shown in **Fig. 1** or equivalent.

(*b*) *Direction of Spray*

The spray shall be directed to strike the bushing downward at an angle of 45 degrees from the vertical and parallel to the vertical plane through its axis within practical limitations. In the case of large bushings, over 6 feet in length, the spray shall be 45 degrees from the vertical at the center of the bushing and as near to this angle at the ends as possible, consistent with good uniformity of precipitation throughout its length.

(*c*) *Rate of Precipitation*

The standard rate of precipitation at the bushing shall be 0.2 inch per minute (5.08 mm) when measured as directed in paragraph **D-2** below.

(*d*) *Resistivity of the Spray Water*

The standard resistivity of the spray water shall be 7000 ohms per inch cube (17800 ohms per cm cube) at the temperature at which the water strikes the bushing. The resistivity of the spray water shall not deviate more than 15 per cent from the standard. If water of the above resistivity is not readily available, water of other resistivity may be used, if suitable and agreed upon correction factors are applied.

(*e*) *Temperature of Spray Water*

The temperature of the spray water when it strikes the bushing shall not deviate more than 15C from room temperature.

Note: No exact data is available on the effect of variation in water temperature. Experience indicates, however, that normal variations in water temperature are unimportant provided the correct resistivity is maintained.

* In this Test Code, "low-frequency" is taken to mean any available frequency from 16 to 100 cycles.

(f) Pressure of Spray Water

The spray water shall be delivered to the nozzles at a pressure of not less than 35 pounds per square inch (2.46 kg per square cm) and at not more than 60 pounds per square inch (4.22 kg per square cm) measured near the nozzle.

(g) Area Sprayed

The bushing shall be centrally located by inspection in a uniformly-sprayed area having a width at least 2 times and a length at least 1¼ times that of the bushing being tested.

(h) Location of Spray Equipment

Spray nozzles, supply pipes, and the supporting structure for them shall be located not closer than three feet from the bushing and in the case of large bushings where this minimum clearance is not sufficient, they shall be located far enough from the bushing so that no flashover shall occur to them during test.

D-2 Measurement of Precipitation

(a) Measuring Vessel

The vessel used to collect the water for measuring the precipitation, resistivity, and temperature, shall have a top opening of 6 to 12 inches inside diameter with an upstanding rim at least 1 inch high having an edge thickness not exceeding 1/16 inch.

(b) Position of Measuring Vessel

1. Bushings having a height or length not exceeding 18 inches: During measurements of precipitation the measuring vessel shall be held opposite the top of the bushing in line between the spray nozzle and the axis of the bushing and at a point approximately three inches outside the largest diameter of the insulating element. The vessel shall be held with its top opening horizontal.

2. Bushings having a height or length exceeding 18 inches: Separate measurements shall be made opposite the top, middle and bottom of the bushing with the measuring vessel held in a line between the spray nozzles and the axis of the bushing, the side of the rim of the vessel being approximately three inches outside the largest diameter of the bushing. The vessel shall be held with its top opening horizontal.

(c) Duration of Individual Measurements

Final measurements of the rate of precipitation shall be accurately timed and shall be of a duration of at least one minute for each measurement.

(d) Tolerance on Rate of Precipitation

For precipitation measured in accordance with par. (b) part 1, the measurement shall not deviate more than 10 per cent from the standard.

For precipitation measured in accordance with par. (b) part 2, the average of the three measurements shall not deviate more than 10 per cent from the standard and no single measurement shall deviate more than 25 per cent from the standard.

(e) Constancy of Spray Conditions

Care shall be exercised to see that the nozzle pressure and other spray conditions remain practically constant while the tests are being made after final adjustments of the precipitation are completed.

D-3 Preparation of the Bushing

(a) Preliminary Wetting

The entire surface of the bushing shall be given a thorough preliminary wetting not more than one minute prior to placing in the spray, using water having the same characteristics as the spray water.

STANDARD TEST CONDITIONS

E-1 Standard atmospheric and precipitation conditions are as follows:

Air Temperature	77F	25C
Barometric Pressure	29.92 in.	760 mm
Humidity-Vapor Pressure	0.6085 in.	15.45 mm
Water Resistivity	7000 ohm/in^3	17800 ohm/cm^3
Rate of Precipitation ..	0.2 in./min	5.08 mm/min
Angle of Precipitation ..	45 deg.	45 deg.

Where test conditions differ from those above, suitable corrections shall be made as outlined in Sections **F-1** and **F-2.**

E-2 Rate of Voltage Application for Low-Frequency Tests

The initial applied voltage may be quickly raised to 75 per cent of the expected test value. The continued rate of voltage increase shall be such that the time to reach the expected test voltage shall be between 5 and 30 seconds after the 75 per cent value has been reached.

E-3 Duration of Voltage Application for Low-Frequency Withstand Tests

The required voltage shall be held for the specified time after the full value has been reached.

E-4 Application of Impulse Test Voltage

The 1.5 x 40 microsecond wave shall be used for impulse tests. The time to crest shall be measured from the virtual time zero and shall not exceed 2.0 microseconds. The time to 0.5 crest value point on the tail of the wave shall be measured from the virtual time zero and shall not be less than 40 microseconds.

NOTE: The virtual time zero is the intersection of the zero voltage line and a line drawn through points on the front of the wave at 30 per cent and 90 per cent of the crest value.

E-5 Testing Equipment and Voltage Measurements

The character of the test equipment and the method of measuring voltage shall conform to AIEE Standard No. 4, "Standards for the Measurement of Test Voltage in Dielectric Tests".

CORRECTION FACTORS

F-1 Correction Factor (D) for Variation in Air Density

The air temperature at the time of test should be between 50F and 104F, (10C and 40C).

The correction factor for variation in air density is determined as follows:

$$D = \frac{18B}{459 + F} = \frac{0.392\ b}{273 + C}$$

D = Correction Factor
B = Barometric pressure in inches
b = Barometric pressure in millimeters
F = Temperature in degrees Fahrenheit
C = Temperature in degrees Centigrade

F-2 Correction Factor (H) for Variation in Vapor Pressure-Humidity

Vapor pressure at the time of test should preferably be between 0.3 inch and 0.7 inch (7.6 mm and 18.0 mm), to minimize the errors when corrections for vapor pressure are approximated by the use of humidity correction factor (H) taken from curves, B, D, and E, of "Recommendations for High-Voltage Testing", Elec. Eng'g., Oct. 1940, pages 601-602. No correction for humidity shall be made on wet tests.

NOTE: Correction curves strictly applicable to bushings are not as yet available and the curves mentioned may be used until data are obtained upon which to base new correction curves.

F-3 Recorded Data

All data used in determining correction factors shall be recorded.

ROUTINE TESTS

G-1 Dry One-Minute Low-Frequency Withstand Test

(*a*) The bushing should be tested in accordance with paragraphs **E-1** through **E-5.**

(*b*) No adjustment for variation from standard atmospheric conditions shall be made.

(*c*) The routine test shall be made after all design.

DESIGN TESTS

H-1 Wet 10-Second Low-Frequency Withstand Test

(*a*) The bushing shall be tested in accordance with paragraphs **D-1** through **D-3** and **E-1** through **E-5.**

(*b*) The applied voltage shall be the specified voltage multiplied by correction factor D as determined from paragraphs **F-1** through **F-3.**

H-2 Impulse Withstand Test

(*a*) The bushing shall be tested in accordance with paragraphs **E-1** through **E-5.**

(*b*) The required impulse values must be met with either positive or negative impulse waves.

(*c*) Three consecutive impulses shall be applied to the bushing. If a flashover does not occur, the bushing shall be considered as having met the test.

If two or three of the applied impulse waves cause flashover, the bushing shall be considered as having failed.

If one of the applied impulses causes flashover, three additional impulses shall be applied. If flashover does not occur, the bushing shall be considered as having met the test.

(*d*) The applied voltage shall be not less than the specified voltage multiplied by D/H as determined from paragraphs **F-1** through **F-3.**

H-3 Thermal Tests

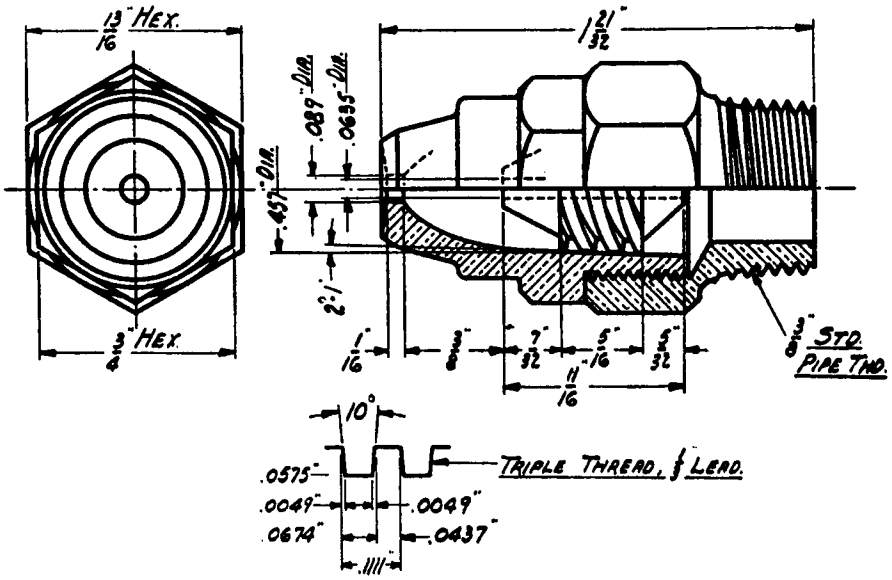
(*a*) *Mounting and Current Connections*

For heat runs, apparatus bushings shall be mounted in the expected operating position with the expected condition of oil immersion. Current-carrying connections to the bushing terminals shall be no bulkier than necessary and should duplicate as closely as possible the type of connection expected in service.

(*b*) *Ambient Temperature*

The test may be made at any ambient temperature, preferably not below 10C. The average temperature of immersion oil, if used, shall be at approximately the temperature of the ambient air. It shall be assumed that the temperature rise is the same for all ambient temperatures between the limits of 10C and 40C.

SPRAY NOZZLE



Detail of Threads on
Internal Element

Fig. 1

AIEE STANDARDS
REPORTS ON STANDARDS AND RELATED PUBLICATIONS

(List correct to August, 1942)

Available Adopted Standards

Number AIEE	Number ASA	Edition	Title of Section
1		(June 1940)	General Principles Upon Which Temperature Limits are Based in the Rating of Electrical Machinery. Price 40 cents.
4		(June 1940)	Measurement of Test Voltage in Dielectric Tests. Price 40 cents.
**11	(C35)	(Mar. 1937)	Railway Motors. Price 50 cents.
	C57.1		Transformers, Regulators and Reactors.
	C57.2	(1940)	Test Code for Transformers, Regulators and Reactors.
	C57.3		Guides for Operation of Transformers. (C57.1, C57.2, C57.3, published as one booklet, supersedes AIEE Nos. 12, 13, 14, 100 and Test Code for Transformers. The member discount does not apply on price of this publication which is 75 cents net.)
*16	(C48)	(Jan. 1933)	Electric Railway Control Apparatus. Price 40 cents.
*17f	(Z10f)	(Feb. 1928)	Mathematical Symbols. Price 30 cents.
*17g1	(Z10g1)	(Nov. 1928)	Letter Symbols for Electrical Quantities. Price 20 cents.
**17g2	(Z10g2)	(Jan. 1934)	Graphical Symbols for Electric Power and Wiring. Price 20 cents.
**17g3	(Z10g3)	(Jan. 1934)	Graphical Symbols for Radio. Price 20 cents.
**17g5	(Z10g5)	(Jan. 1934)	Graphical Symbols for Electric Traction Including Railway Signaling. Price 40c.
*18	(C55)	(June 1934)	Capacitors. Price 20 cents.
19		(Apr. 1938)	Oil Circuit Breakers. Price 40 cents.
	C37.4		Alternating-Current Power Circuit Breakers.
	C37.5		Methods for Determining the Rms Value of a Sinusoidal Current Wave and a Normal Frequency Recovery Voltage.
	C37.6	(1941)	Schedule of Preferred Circuit-Breaker Ratings.
	C37.7		Operating Duty (Duty Cycle) for Standard and Reclosing Service.
	C37.8		Standard Rated Control Voltages.
	C37.9		Test Code for Oil Circuit Breakers. (C37.4 through C37.9 published in one booklet as a proposed revision of AIEE No. 19. The member discount does not apply on price of this publication which is 60 cents net.)
20		(May 1930)	Air Circuit Breakers. Price 30 cents.
21		(June 1942)	Apparatus Bushings. Price 40 cents.
22		(June 1942)	Air Switches and Bus Supports. Price 40 cents.
*23	(C37.1)	(1937)	Relays Associated with Power Switchgear. Price 40 cents.
*26	(C37.2)	(1937)	Automatic Stations. Price 40 cents.
27		(Aug. 1942)	Switchgear Assemblies. Price 30 cents.
*28	(C62)	(Mar. 1936)	Lightning Arresters. Price 30 cents.
29		(Nov. 1941)	Wet Tests. Price 40 cents.
*30	(C8.1)	(Apr. 1937)	Wires and Cables (Definitions and General Standards). Price 40 cents.
*33	(C39.1)	(1938)	Electrical Indicating Instruments. Price 40 cents.
*36	(C40)	(Feb. 1928)	Storage Batteries. Price 20 cents.
*38	(C52.1)	(Jan. 1934)	Electric Arc Welding Apparatus. Price 40 cents.
*39	(C52.2)	(Jan. 1934)	Resistance Welding Apparatus. Price 30 cents.
*41	(C29a)	(Mar. 1930)	Insulator Tests. Price 30 cents.
41A		(Mar. 1941)	Insulator Tests. (A proposed revision of No. 41. No charge for copies.)
45		(July 1940)	Recommended Practise for Electrical Installations on Shipboard. Price $1.50.
*46	(C11)	(June 1927)	Hard Drawn Aluminum Conductors. Price 20 cents.
	*C8.5		Specifications for Cotton Covered Round Copper Magnet Wire.
	*C8.6	(1936)	Specifications for Silk Covered Round Copper Magnet Wire.
	*C8.7		Specifications for Enameled Round Copper Magnet Wire. (No. C8.5, C8.6 and C8.7 published as one pamphlet.) Price 30 cents.
	**C8.11	(1936)	Code Rubber Insulation for Wire and Cable for General Purposes. Price 20 cents.
	**C8.12	(1935)	Cotton Braid for Insulated Wire and Cable for General Purposes. Price 20 cents.
	**C8.16	(1936)	Tree Wire Coverings. Price 20 cents.
	**C8.17	(1936)	Class AO 30 Per Cent Rubber Insulation for Wire and Cable for General Purposes. Price 20 cents.
	**C8.18	(1936)	Weather-Resistant Wire and Cable URC Type. Price 20 cents.
	*C8.19	(1939)	Weather-Resistant Saturants and Finishes for Aerial Rubber-Insulated Wire and Cable. Price 20 cents.
	*C8.20	(1939)	Heavy-Walled Enameled Round Copper Magnet Wire. Price 20 cents.

*Approved as American Standard. **Approved as Tentative American Standard.

(50% discount to Institute members from above prices. Member discount not allowable on extra copies unless ordered for other members.)

For "Reports on Standards" and "Related Publications" see inside rear cover.