

American National Standard

IEEE
Standard
No. 18

Institute of
Electrical and
Electronics
Engineers

shunt power capacitors

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ANSI, 1430 Broadway, New York, N.Y. 10018

American National Standard Shunt Power Capacitors

Secretariat

**Institute of Electrical and Electronics Engineers
National Electrical Manufacturers Association**

Approved February 16, 1968

American National Standards Institute

American National Standard

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Foreword

(This Foreword is not a part of the USA Standard for Shunt Power Capacitors, C55.1-1968.)

During the past three decades or more, two separate parallel standards publications on shunt power capacitors have been current. The National Electrical Manufacturers Association has sponsored a standard on shunt capacitors (NEMA Publication No. CP 1-1965 is the latest version) with frequent revisions related to changes in industry practice. The American Institute of Electrical Engineers* sponsored a standard publication for capacitor units (AIEE No. 18-1964 and USAS C55.1-1951) with long delays between revisions and not closely related to industry practice. An increasing number of power capacitor users developed their own power capacitor specifications to supplement obsolete and inadequate national standards.

The Chairman of the USA Standards Committee on Capacitors, C55, initiated action in 1962 toward establishing:

- (1) Balanced representation for national capacitor standards by both manufacturers and users.
- (2) Development of a single new national standard which could be readily revised consistent with current practice.
- (3) Co-sponsorship of USAS C55.1 by the Institute of Electrical and Electronic Engineers and National Electrical Manufacturers Association.

In 1963 a working group was appointed by the chairman of the C55 committee. A proposed new capacitor standard was developed by the working group during 1964. The initial proposal included both shunt and series capacitors. Later revisions of the proposal omitted the series capacitor category with recognition of rapid changes in series capacitor practice to conform with the new extra-high-voltage systems requirements. A separate Series Capacitor Standard should be developed when the requirements of use are adequately established. After numerous revisions during 1965-1966, the C55 standard was approved by its sponsors in 1967, and by the Standards Institute in 1968.

This new shunt capacitor standard is expected to supersede previous AIEE and NEMA standards on the subject. Suggestions for improvement gained in use of this standard will be welcomed. They should be sent to the USA Standards Institute.

The USA Standards Committee on Capacitors, C55, had the following personnel at the time it approved this standard:

M. E. Scoville, <i>Chairman</i>	C. A. Parris, <i>Secretary</i>
<i>Organization Represented</i>	<i>Name of Representative</i>
American Society for Testing and Materials	H. A. Davis
Electric Light and Power	V. P. Rader
Institute of Electrical and Electronics Engineers	J. P. Markey (<i>Alt</i>)
	D. C. Keezer
	R. M. Decker
	M. E. Scoville
National Electrical Manufacturers Association	C. F. Elbert
	E. G. Hammer
	J. F. Kuzela
	C. A. Parris
	R. T. Innis (<i>Alt</i>)
	E. J. Kleine (<i>Alt</i>)
	R. W. Lord (<i>Alt</i>)
	J. A. Sevigny (<i>Alt</i>)

*Now the Institute of Electrical and Electronics Engineers.

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American National Standard

Shunt Power Capacitors

1. Scope

This standard applies to capacitors designed for shunt connection to alternating current power transmission and distribution systems operating at a nominal frequency of 60 cycles or less.

2. Definitions

Ambient Temperature. The temperature of the surrounding cooling medium, usually air, before coming in contact with the external parts of the capacitors.

Capacitor Bank. An assembly at one location of capacitors and all necessary accessories, such as switching equipment, protective equipment, controls, etc., required for a complete operating installation. It may be a collection of components assembled at the operating site or may include one or more factory-assembled equipments.

Capacitor Equipment. An assembly of capacitors with associated accessories such as fuses, switches, etc., all mounted on a common frame for handling, transportation, and operation as a single unit.

Discharge Device. An internal or external device intentionally connected in shunt with the terminals of a capacitor for the purpose of reducing the residual voltage after the capacitor is disconnected from an energized line.

Enclosed Capacitor. A capacitor having enclosed terminals. The enclosure is provided with means for connection to a rigid or flexible conduit.

Fused Capacitor. A capacitor having fuses mounted on its terminals, or inside a terminal enclosure, or inside the capacitor case for the purpose of interrupting a failed capacitor.

Indoor (used as a prefix). Indicates a capacitor or equipment suitable only for indoor service or for use in a weatherproof housing.

Kilovar (1000 vars). The practical unit of reactive power, equal to the product of the rms voltage in kilovolts (kV), the rms current in amperes, and the sine of the angle between them.

Metal-Enclosed or Housed Equipment. A capacitor equipment assembly enclosed in a metal enclosure or metal house to prevent accidental contact with live parts.

Outdoor (used as a prefix). Indicates a capacitor or equipment suitable for use without weather protection and under conditions of unrestricted ventilation.

Power Capacitor. An assembly of dielectric and electrodes in a container (case), with terminals brought out, which is intended to introduce capacitance into an electric power circuit.

NOTE: The abbreviated term "capacitor" is used interchangeably with "power capacitor" throughout this standard.

Proof (used as a suffix). Indicates a capacitor or equipment which has been constructed, protected, or treated to permit successful operation under normal service conditions (e.g., dust, weather, etc).

Other Terms. The meanings of other terms used in this standard shall be as defined in USA Standard Definitions of Electrical Terms, the C42 Series.

3. Service Conditions

NOTE: For additional information on service conditions, see Section 7, Guide for Application and Operation of Capacitors.

3.1 Normal Service Conditions. Capacitors shall be suitable for operation at their specified rating when:

(a) The ambient temperature is within the limits specified in 4.7. (Capacitors may be exposed to the direct rays of the sun.)

(b) The altitude does not exceed 6,000 feet. See 5.6.

(c) The voltage applied between terminals

does not exceed the rated voltage by more than the tolerance specified in 4.2.3.

(d) The voltage applied between terminals and case does not exceed the insulation class specified in 4.5.

(e) The applied voltage does not contain harmonics in excess of the limits specified in 4.2.2(b).

(f) The nominal frequency is 60 hertz.

3.2 Abnormal Service Conditions. If capacitors are required to operate under abnormal service conditions such as the following, the application should be brought to the attention of the manufacturer:

(a) Exposure to damaging fumes or vapors.

(b) Exposure to conducting or explosive dust.

(c) Exposure to abnormal mechanical shock or vibration.

(d) Exposure to radiated heat from surfaces (other than the sun) which are hotter than the ambient temperature limits for capacitors given in 4.7.

(e) Mounting and arrangement which prevents adequate ventilation.

(f) Operation in ambient temperatures outside the range specified in 4.7.

(g) Altitude higher than 6,000 feet above sea level. See 5.6.2.

(h) Service conditions other than listed in 3.1.

4. Ratings

4.1 Standard Ratings. This standard establishes the following ratings:

(a) Terminal-to-terminal voltage.

(b) Terminal-to-case (or ground) insulation class.

(c) Reactive power.

(d) Number of phases.

(e) Frequency.

4.2 Tolerances in Ratings

4.2.1 Capacitors shall give not less than the rated reactive power at rated sinusoidal voltage and frequency, and not more than 115 percent of this value, measured at 25 degrees Celsius uniform case and internal temperature.

4.2.2 Capacitors shall be suitable for continuous operation at 135 percent of rated reactive power. This maximum reactive power

shall include the following factors, the combined effects of which shall not exceed 135 percent:

(a) Reactive power due to voltage in excess of nameplate rating at fundamental frequency but within the permissible voltage limitations described in 4.2.3.

(b) Reactive power due to harmonic voltages superimposed on the fundamental frequency.

(c) Reactive power in excess of nameplate rating due to manufacturing tolerance within the limits specified in 4.2.1.

4.2.3 Capacitors shall be capable of continuous operation up to 110 percent of rated terminal voltages (including harmonics but excluding transients).

4.2.4 Capacitors shall be capable of continuous operation at 180 percent rated rms current, including fundamental and harmonic currents. (See 7.5.1 for limitations on abnormal currents.)

4.3 Momentary Ratings. Capacitors shall be capable of withstanding the momentary overvoltages and overcurrents shown in the tables of 4.3.1, 4.3.2, and 4.3.3.

4.3.1 Momentary Power Frequency Overvoltage. A capacitor shall be capable of withstanding, during normal service life, a combined total of 300 applications of power frequency terminal-to-terminal overvoltages without superimposed transients, of the magnitudes and durations listed in the following table:

Duration	Maximum Permissible Voltage (Multiplying Factor to be Applied To Rated rms Voltage)
½ cycle	3.00
1 cycle	2.70
6 cycles	2.20
15 cycles	2.00
1 second	1.70
15 seconds	1.40
1 minute	1.30
5 minutes	1.20
30 minutes	1.15

NOTE: The limitations shown in this table, as well as those shown in 4.3.3, are based on the occurrence of overvoltages when internal temperatures of the capacitor are less than zero degrees Celsius.

4.3.2 Transient Overcurrent: Capacitors shall be capable of withstanding the peak discharge currents listed in the following table: