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ANSI C84.1-2016

# American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hz)

National Electrical Manufacturers Association

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# *American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hertz)*

Secretariat:

**National Electrical Manufacturers Association**

Approved: June 9, 2016

**American National Standards Institute, Inc.**

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## TABLES

## **Foreword** (This Foreword is not part of American National Standard C84.1)

This standard supersedes ANSI C84.1-2011 *American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60Hz)*.

With the 2016 revision, a 690/400V category has been added to the Low Voltage Class in table 1, and a paragraph discussing Conservation Voltage Reduction (CVR) has been added to Annex B.

In 1942, the Edison Electric Institute published the document *Utilization Voltage Standardization Recommendations*, EEI Pub. No. J-8. Based on that early document, a joint report was issued in 1949 by the Edison Electric Institute (EEI Pub. No. R6) and the National Electrical Manufacturers Association (NEMA Pub. No. 117). This 1949 publication was subsequently approved as American National Standard EEI-NEMA Preferred Voltage Ratings for AC Systems and Equipment, ANSI C84.1-1954.

American National Standard C84.1-1954 was a pioneering effort in its field. It not only made carefully considered recommendations on voltage ratings for electric systems and equipment, but also contained a considerable amount of much-needed educational material.

After ANSI C84.1-1954 was prepared, the capacities of power supply systems and customers' wiring systems increased and their unit voltage drops decreased. New utilization equipment was introduced and power requirements of individual equipment were increased. These developments exerted an important influence both on power systems and equipment design and on operating characteristics.

In accordance with American National Standards Institute policy requiring periodic review of its standards, American National Standards Committee C84 was activated in 1962 to review and revise American National Standard C84.1-1954, the Edison Electric Institute and National Electrical Manufacturers Association (NEMA)being named cosponsors for the project. Membership on the C84 Committee represented a wide diversity of experience in the electrical industry. To this invaluable pool of experience were added the findings of the following surveys conducted by the committee:

a) A comprehensive questionnaire on power system design and operating practices, including measurement of actual service voltages (approximately 65,000 readings were recorded, coming from all parts of the United States and from systems of all sizes, whether measured by number of customers or by extent of service areas)
b) A sampling of single-phase distribution transformer production by kilovolt-amperes and primary voltage ratings to determine relative uses of medium voltages
c) A survey of utilization voltages at motor terminals at approximately 20 industrial locations

The worth of any standard is measured by the degree of its acceptance and use. After careful consideration, and in view of the state of the art and the generally better understanding of the factors involved, the C84 Committee concluded that a successor standard to ANSI C84.1-1954 should be developed and published in a much simplified form, thereby promoting ease of understanding and hence its acceptance and use. This resulted in the approval and publication of American National Standard C84.1-1970, followed by its supplement, ANSI C84.1a-1973, which provided voltage limits established for the 600V nominal system voltage.

The 1977 revision of the standard incorporated an expanded Foreword that provided a more complete history of this standard’s development. The 1970 revision included a significantly more useful table 1 (by designating “preferred” system voltages), the 1977 revision provided further clarity, and the 1982 revision segmented the system voltages into the various voltage classes.

With the 2006 revision, the scope expanded to include voltages above 230 kV. This increased voltage range was previously covered by IEEE Std 1312-1993 (R2004), IEEE Standard Preferred Voltage Ratings for Alternating-Current Electrical Systems and Equipment Operating at Voltages Above 230 kV Nominal, and its predecessor, ANSI C92.2-1987. In addition, standard nominal system voltages and voltage ranges were extended to include maximum system voltages of up to and including 1200 kV.

With the 2011 revision, table 1 was modified to reflect changes in lighting characteristics. Note 1 allowed lower utilization voltages for non-lighting circuits. Modern lighting equipment does not need this special treatment. Note 1 was dropped and the table was updated with the lower voltages. This treats lighting equipment like all other utilization equipment.

Suggestions for improvement of the standard are welcome. They should be sent to NEMA, 1300 North 17th Street, Rosslyn, VA 22209.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Preferred Voltage Ratings for AC Systems and Equipment, C84. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the C84 Committee had the following members:

**Daniel Ward, Chairman**
Khaled Masri (NEMA), Secretary

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# 1 Scope and Purpose

## 1.1 Scope

This standard establishes nominal voltage ratings and operating tolerances for 60Hz electric power systems above 100 volts. It also makes recommendations to other standardizing groups with respect to voltage ratings for equipment used on power systems and for utilization devices connected to such systems.

This standard includes preferred voltage ratings up to and including 1200 kV maximum system voltage, as defined in the standard.

In defining maximum system voltage, voltage transients and temporary overvoltages caused by abnormal system conditions such as faults, load rejection, and the like are excluded. However, voltage transients and temporary overvoltages may affect equipment operating performance and are considered in equipment application.

## 1.2 Purpose

The purposes of this standard are to:

a) Promote a better understanding of the voltages associated with power systems and utilization equipment to achieve overall practical and economical design and operation
b) Establish uniform nomenclature in the field of voltages
c) Promote standardization of nominal system voltages and ranges of voltage variations for operating systems
d) Promote standardization of equipment voltage ratings and tolerances
e) Promote coordination of relationships between system and equipment voltage ratings and tolerances
f) Provide a guide for future development and design of equipment to achieve the best possible conformance with the needs of the users
g) Provide a guide, with respect to choice of voltages, for new power system undertakings and for changes in older ones

# 2 Definitions

**2.1 system or power system:** The connected system of power apparatus used to deliver electric power from the source to the utilization device. Portions of the system may be under different ownership, such as that of a supplier or a user.

**2.2 system voltage terms:** As used in this document, all voltages are rms phase-to-phase, except that the voltage following a slant-line is an rms phase-to-neutral voltage.

**2.2.1 system voltage:** The root-mean-square (rms) phase-to-phase voltage of a portion of an alternating-current electric system. Each system voltage pertains to a portion of the system that is bounded by transformers or utilization equipment.

**2.2.2 nominal system voltage:** The voltage by which a portion of the system is designated, and to which certain operating characteristics of the system are related. Each nominal system voltage pertains to a portion of the system bounded by transformers or utilization equipment.

NOTE: The nominal voltage of a system is near the voltage level at which the system normally operates. To allow for operating contingencies, systems generally operate at voltage levels about 5–10% below the maximum system voltage for which system components are designed.