ANSI C84.1-1970

American National Standard

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voltage ratings for electric power systems and equipment (60 Hz)

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ANSI
C84.1-1970
Revision of
C84.1-1954

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

Sponsors

Edison Electric Institute
National Electrical Manufacturers Association

Approved January 20, 1970
American National Standards Institute, Inc

American National Standard

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Foreword

[This Foreword is not a part of American National Standard Voltage Ratings for Electric Power Systems and Equipment (60 Hz), C84.1-1970.]

This standard supersedes American National Standard C84.1-1954, EEI-NEMA Preferred Voltage Ratings for AC Systems and Equipment. Originally published in May 1949, by its sponsors, Edison Electric Institute (EEI Pub. No. R-6), and the National Electrical Manufacturers Association (NEMA Pub. No. 117), it was based largely on an earlier EEI document titled Utilization Voltage Standardization Recommendations (EEI Pub. No. J-8) published in October 1942. The 1949 publication was approved as an American Standard in 1954.

Since American National Standard C84.1-1954 was prepared, the capacities of both power supply systems and customers' wiring systems have increased and their unit voltage drops have decreased; new utilization equipment has been introduced and power requirements of individual equipments have increased. These developments have an important influence on both power systems and equipment design and operating characteristics.

In accordance with American National Standards Institute policy requiring periodic review of its standards, Standards Committee C84 was activated in 1962 to review and revise American National Standard C84.1-1954, EEI and NEMA being named cosponsors for the project. Since the subject affects most, if not all, elements of the electrical industry, the Standards Committee has a wide range of representation.

American National Standard C84.1-1954 was a pioneering effort in its field; it not only made carefully considered recommendations as to voltage ratings for electric systems and equipment, but also contained a considerable amount of much-needed educational material. The report has admirably served its purpose.

The worth of any standard is measured by the degree of its acceptance and use. After careful consideration, and in view of the present state of the art and the generally better understanding of the factors involved, Standards Committee C84 concluded that this successor standard should be published in a much simplified form, thereby promoting ease of understanding and hence its acceptance and use.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the American National Standards Institute, Inc, 1430 Broadway, New York, N.Y. 10018.

The C84 Standards Committee which developed this standard had the following personnel at the time of approval:

K. S. Garrett, *Chairman* N. R. Schultz, *Vice-Chairman*

J. J. Kark, *Secretary*

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	W. E. Macbeth (*Alt*)
	E. W. Scott (*Alt*)
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American National Standards Committee on Power Switchgear, C37 (*Liaison*)	V. L. Cox
American National Standards Committee on Electric Lamps, C78 (*Liaison*)	R. F. Townsend
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American National Standard Voltage Ratings for Electric Power Systems and Equipment (60 Hz)

1. Scope and Purpose

1.1 Scope. This standard establishes voltage ratings for 60 Hz electric power supply and utilization systems above 100 volts and through 230 kV, together with operating tolerances from nominal voltages. It also makes recommendations to other standardizing groups with respect to voltage ratings for equipment used on power systems and for utilization devices supplied therefrom.

NOTE: For completeness, information on extra high-voltage systems (345 kV and higher) from American National Standard Preferred Voltage Ratings for Extra High-Voltage Alternating-Current Systems (Voltages Above 230 Kilovolts), C92.2-1967, is also included as a footnote to Table 1.

1.2 Purpose. The purposes of this standard are:

(1) To promote a better understanding of the nature of the voltages which exist on power systems and utilization equipment for over-all practical and economical design and operation

(2) To establish uniform nomenclature in the field of voltages

(3) To promote standardization of nominal system voltages and ranges of voltage variations for operating systems

(4) To promote standardization of equipment voltage ratings and tolerances

(5) To promote coordination of relationships between system and equipment voltage ratings and tolerances

(6) To provide a guide for future development and designs of equipment to the best possible conformance with the needs of the users

(7) To provide a guide for new power system undertakings and for changes in old ones in regard to choice of voltages

1.3 Development. Membership on the Standards 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:

(1) A comprehensive questionnaire on power system design and operating practices, including measurement of actual service voltages (approximately 65000 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 area);

(2) A sampling of single-phase distribution transformer production by kVA and primary voltage ratings, to determine relative uses of medium voltages;

(3) A survey of utilization voltages at motor terminals at approximately 20 industrial locations.

2. Voltage Ratings for 60 Hz Electric Power Systems

2.1 Definitions

nominal voltage of a circuit or system. A nominal value assigned to the circuit or system for the purpose of conveniently designating its voltage class.

service voltage. The voltage at the point where the electric systems of the supplier and the user are connected.

utilization voltage. The voltage at the line terminals of utilization equipment.

2.2 Selection of Nominal System Voltages. When a new system is to be built or a new voltage level introduced in an existing system, it is recommended that one (or more) of the nominal system voltages shown in bold face type in Table 1 be selected. The logical and economical choice for a particular system among the voltages thus distinguished will depend upon a number of factors, such as the character and the size of the system.

Other system voltages that are in substantial use in existing systems are shown in light face type. Economic considerations will require that these voltages continue in use and in some cases may require extension of their use; but they are not generally recommended for new systems or new voltage levels in existing systems.

The 4160, 6900, and 13800 volt three-wire systems are particularly suited for industrial systems that supply predominantly polyphase loads including large motors, because these system voltages correspond to the standard motor ratings of 4000, 6600, and 13200 volts. Two of these systems are shown in bold face type to indicate that their use for this purpose is recommended. It is not intended to recommend the use of these systems for utility primary distribution, for which four-wire systems of 12470Y/7200 volts or higher are recommended.

2.3 Explanation of Voltage Ranges. For any specific nominal voltage, the voltages actually existing at various points at various times on any power system, or on any group of systems, or in the industry as a whole, will be distributed by percentage in a manner such as indicated by Fig. 1. This distribution is characteristic of voltages at any designated class of points, such as points of service delivery and points of utilization. It is important that the design and operation of power systems and the design of equipment to be supplied from such systems be coordinated with respect to these voltage variations so that, insofar as practicable, the equipment will perform satisfactorily throughout the range of actual utilization voltages that will be encountered on the systems. In order to further this objective, this standard establishes for each nominal system voltage, two ranges for service and utilization voltage variations, designated as Range A and Range B, the limits of which are given in Table 1. These limits apply to sustained voltage levels and not to momentary voltage excursions that may result from such causes as switching operations, motor starting currents, etc.

2.4 Application of Voltage Ranges

2.4.1 ***Range A — Service Voltage.*** Electric supply systems shall be so designed and operated that most service voltages are within the limits specified for this range. The occurrence of service voltages outside of these limits is to be infrequent.

2.4.2 ***Range A — Utilization Voltage.*** User systems shall be so designed and operated that, with service voltages within Range A limits, most utilization voltages are within the limits specified for this range.

Utilization equipment shall be designed and rated to give fully satisfactory performance throughout this range.

2.4.3 ***Range B — Service and Utilization Voltages.*** This range includes voltages above and below Range A limits that necessarily result from practical design and operating conditions on supply or user systems or both. Although such conditions are a part of practical operations, they shall be limited in extent, frequency and duration. When they occur, corrective measures shall be undertaken within a reasonable time to improve voltages to meet Range A requirements.

Insofar as practicable, utilization equipment shall be designed to give acceptable performance in the extremes of this range of utilization voltage, although not necessarily as good performance as in Range A.

It must be recognized that, because of conditions beyond the control of the supplier or user, or both, there will be infrequent and limited periods when sustained voltages outside of Range B limits will occur. Utilization equipment may not operate satisfactorily under these conditions, and protective devices may operate to protect the equipment. When voltages occur outside the limits of Range B, prompt corrective action is recommended. The urgency for such action will depend upon many factors, such as location and nature of load or circuits involved, and magnitude and duration of the deviation beyond Range B limits.

Table 1
Standard System Voltages*

NOMINAL SYSTEM VOLTAGE (Note a)			VOLTAGE RANGE A (Note b)			VOLTAGE RANGE B (Note b)		
			Minimum		Maximum	Minimum		Maximum
Two-wire	Three-wire	Four-wire	Utilization Voltage (Note c)	Service Voltage	Utilization and Service Voltage (Note e)	Utilization Voltage (Note c)	Service Voltage	Utilization and Service Voltage
Single-Phase Systems								
120			110	114	126	106	110	127
	120/240		110/220	114/228	126/252	106/212	110/220	127/254
Three-Phase Systems								
		208Y/120	191Y/110	197Y/114	218Y/126	184Y/106 (Note d)	191Y/110 (Note d)	220Y/127
		240/120	220/110	228/114	252/126	212/106	220/110	254/127
	240		220	228	252	212	220	254
		480Y/277	440Y/254	456Y/263	504Y/291	424Y/245	440Y/254	508Y/293
	480		440	456	504	424	440	508
	600		(Limits Not Established)			(Limits Not Established)		
	2400		2160	2340	2520	2080	2280	2540
		4160Y 2400	3740Y 2160	4050Y 2340	4370Y 2520	3600Y 2080	3950Y 2280	4400Y 2540
	4160		3740	4050	4370	3600	3950	4400
	4800		4320	4680	5040	4160	4560	5080
	6900		6210	6730	7240	5940	6560	7260
		8320Y 4800		8110Y 4680	8730Y 5040		7900Y 4560	8800Y 5080
		12000Y 6930		11700Y 6760	12600Y 7270		11400Y 6580	12700Y 7330
		12470Y/7200	(Note f)	12160Y/7020	13090Y/7560	(Note f)	11850Y/6840	13200Y/7620
		13200Y/7620		12870Y/7430	13860Y/8000		12540Y/7240	13970Y/8070
		13800Y 7970		13460Y 7770	14490Y 8370		13110Y 7570	14520Y 8380
	13800		12420	13460	14490	11880	13110	14520
		20780Y 12000		20260Y 11700	21820Y 12600		19740Y 11400	22000Y 12700
		22860Y 13200		22290Y 12870	24000Y 13860		21720Y 12540	24200Y 13970
	23000			22430	24150		21850	24340
		24940Y/14400	(Note f)	24320Y/14040	26190Y/15120	(Note f)	23690Y/13680	26400Y/15240
		34500Y/19920		33640Y/19420	36230Y/20920		32780Y/18930	36510Y/21080
	34500			33640	36230		32780	36510

Higher Voltage Three-Phase Systems in kV

Nominal System Voltage	Maximum Voltage
46	48.3
69	72.5
115	121
138	145
161	169
230	242

For these systems Range A and Range B limits are not shown because, where they are used as service voltages the operating voltage level on the user's system is normally adjusted by means of voltage regulation to suit his requirements

NOTES

a: Three-phase three-wire systems are systems in which only the three-phase conductors are carried out from the source for connection of loads. The source may be derived from any type of three-phase transformer connection grounded or ungrounded. Three-phase four-wire systems are systems in which a grounded neutral conductor is also carried out from the source for connection of loads. Four-wire systems in Table 1 are designated by the phase-to-phase voltage, followed by the letter Y (except for the 240/120-volt delta system), a slant line, and the phase-to-neutral voltage. Single-phase services and loads may be supplied from either single-phase or three-phase systems. The principal transformer connections that are used to supply single-phase and three-phase systems are illustrated in Appendix A.

b: The voltage ranges in this table are illustrated in Appendix B

c: Minimum utilization voltages for 120-480 volt circuits not supplying lighting loads are as follows

Nominal System Voltage	Range A	Range B
120	108	104
208	187	180 Note d
240	216	208
480	432	416

d: Many 220-volt motors were supplied on existing 208-volt systems on the assumption that the utilization voltage would not be less than 187 volts. Caution should be exercised in applying the Range B minimum voltages of Table 1 and Note c to existing 208-volt systems supplying such motors

e: For 120-480-volt nominal systems, voltages in this column are maximum service voltages. Maximum utilization voltages would not be expected to exceed 125 volts for the nominal system voltage of 120 nor appropriate multiples thereof for other nominal system voltages through 480 volts

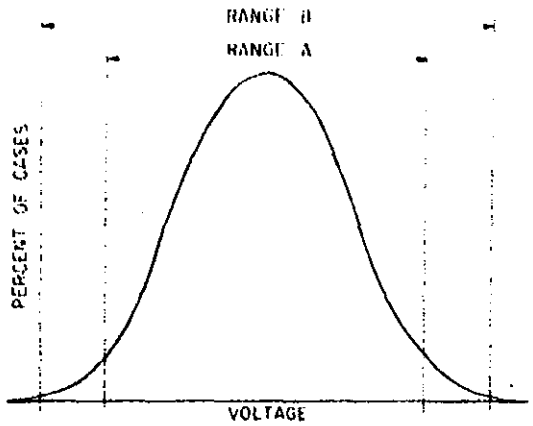
f: Utilization equipment does not generally operate directly at these voltages. For equipment supplied through transformers refer to limits for nominal system voltage of transformer output

* Information from American National Standard C92.2-1967

Extra High Voltage Three-Phase Systems in kV

Preferred Nominal System Voltage	Preferred Maximum Voltage
345	362
500	550
700	765

Fig. 1
Distribution Characteristics of System Voltages



3. Voltage Ratings for 60 Hz Electric Equipment

3.1 General. Voltage ratings and other characteristics of the various classes of 60 Hz electric equipment are established in other standards. A partial list of these standards is given in Appendix D.

For the principal types of electric utilization equipment, nameplate voltage ratings and the corresponding nominal system voltages to which they are applicable are listed in the tables in Appendix C. Detailed tables are not included for electric equipment other than utilization equipment. It is expected that those requiring information on voltage ratings of these other types of equipment will consult the appropriate standards or the manufacturers for necessary detailed information to ensure proper application.

Review of the nameplate voltage ratings in Appendix C and in current equipment standards listed in Appendix D indicates many inconsistencies in the relationships among equipment nameplate ratings and between these ratings and the nominal system voltages to which the equipment is applicable. For 120-volt base systems, equipment voltage ratings are variously based upon 115 volts, 118 volts, 120 volts, and 125 volts. The same one of these bases is not always used consistently for all equipment of the same general class.

Also, these standards include information regarding the voltage ranges for which equipment should be designed to operate that is not in all cases in agreement with the voltage ranges of Section 2.

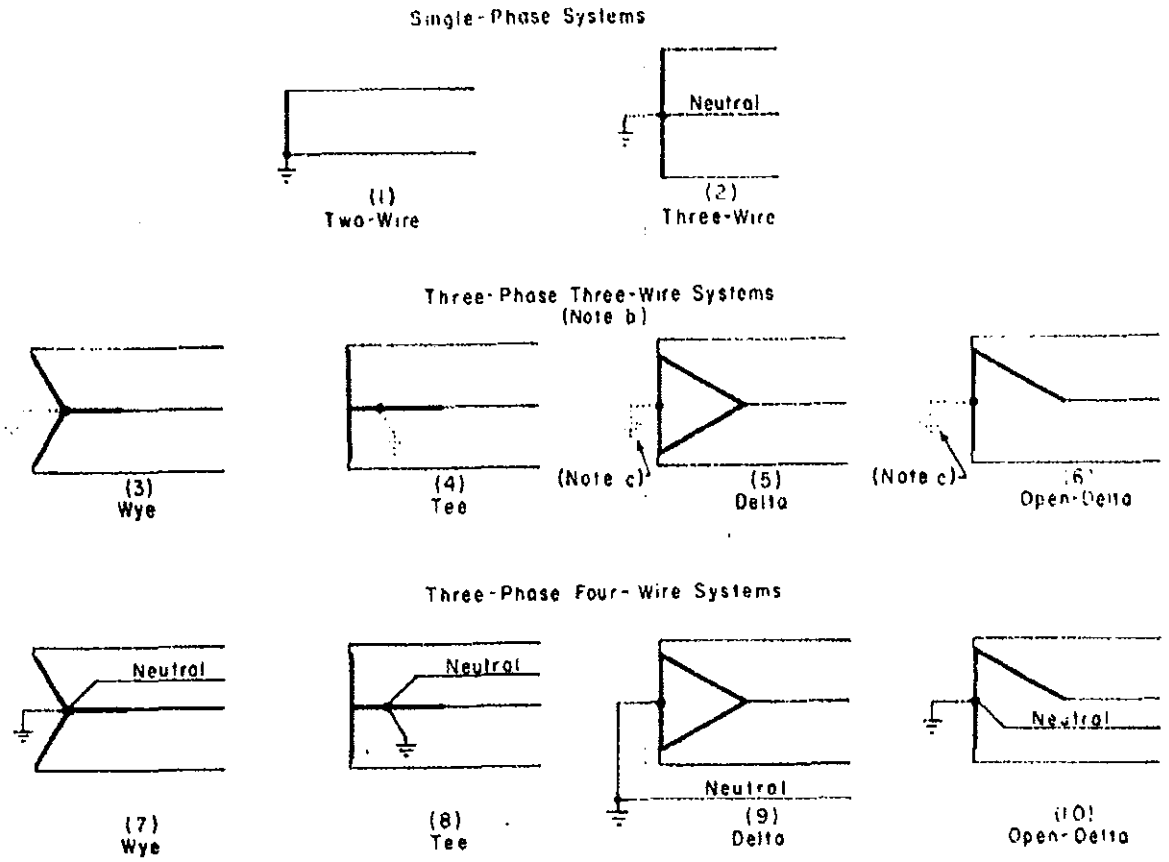
3.2 Recommendation. Insofar as practicable, the inconsistencies among nameplate voltage ratings and between these ratings and nominal system voltages should be eliminated, and the voltage ranges for which equipment is designed should be changed to agree with the ranges in Section 2, whenever electric equipment standards are revised.

Appendixes

(These Appendixes are not a part of American National Standard Voltage Ratings for Electric Power Systems and Equipment (ANSI C84.1-1970) but are included for informational purposes only.)

Appendix A

Principal Transformer Connections To Supply the System Voltages of Table I



NOTES:

(a) The above diagrams show connections of transformer secondary windings to supply the nominal system voltages of Table I. Systems of more than 600 volts are normally three phase and supplied by connections (b), (c), ungrounded or (d). Systems of 120/600 volts may be either single phase or three phase and all of the connections shown are used to some extent for some systems in this voltage range.

(b) Three phase, three-wire systems may be solidly grounded, impedance grounded, or ungrounded, but are not intended to supply loads connected phase to neutral as the four-wire systems are.

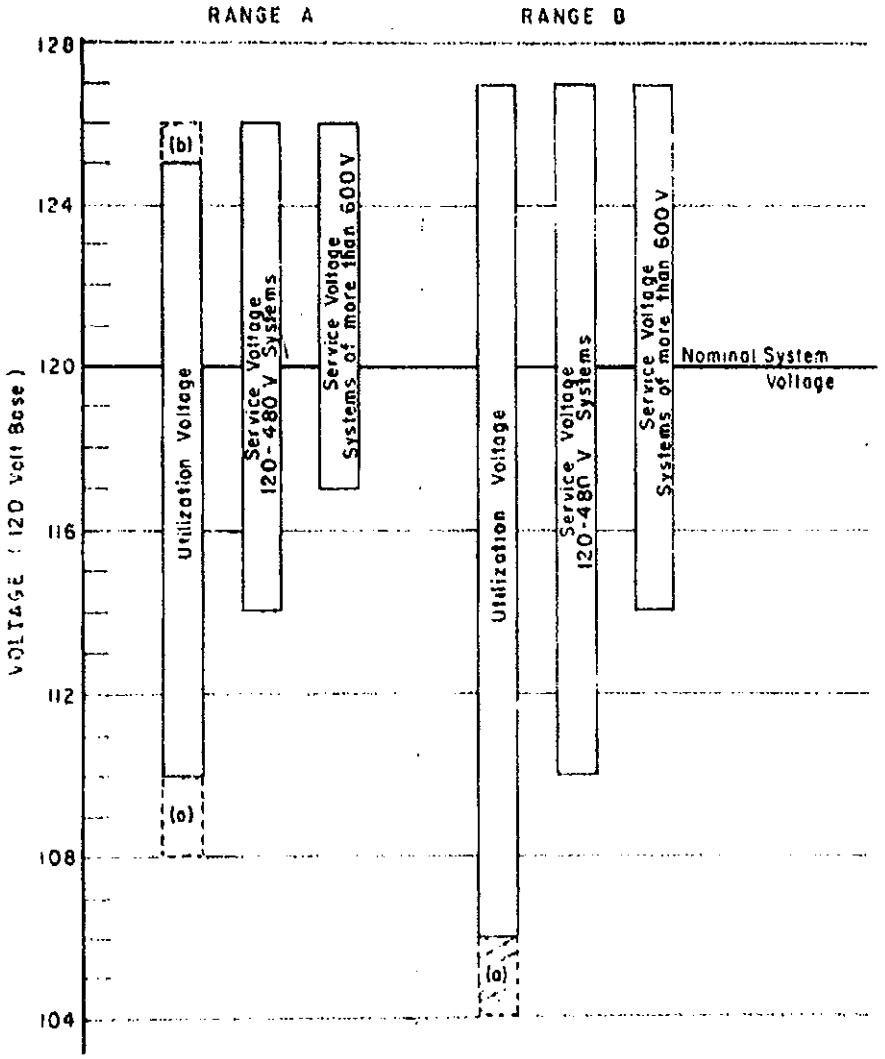
(c) In connections (b) and (c) the ground may be connected to the midpoint of one winding as shown or available for one phase conductor (corner grounded) or omitted entirely (ungrounded).

(d) Single phase services and single phase loads may be supplied from single phase systems or from three phase systems. They are connected phase to phase when supplied from three phase, three-wire systems and either phase to phase or phase to neutral from three phase four-wire systems.

Appendix B

Illustration of Voltage Ranges of Table 1

This chart shows the basis of the Range A and Range B limits of Table 1. The limits in Table 1 were determined by multiplying the limits shown in this chart by the ratio of each nominal system voltage to the 120-volt base. [For exceptions see Note (d).]



NOTES:

(a) These shaded portions of the ranges do not apply to circuits supplying lighting loads. See Note (c) to Table 1.

(b) This shaded portion of the range does not apply to 120-480V systems. See Note (e) to Table 1.

(c) The difference between minimum service and minimum utilization voltages is intended to allow for voltage drop in the customer's wiring system. This difference is greater for service at more than 600V to allow for additional voltage drop in transformations between service voltage and utilization equipment.

(d) The Range B utilization voltage limits in Table 1 for 6900V and 13800V systems are 90 percent and 110 percent of the voltage ratings of the standard motors used in these systems and deviate slightly from this Chart.

Appendix C

Voltage Ratings for 60 Hz Electric Utilization Equipment

(Refer to Appendix D for a partial list of applicable standards.)

In Tables C1 and C2, only representative categories of equipment are listed because the sheer number of present and prospective equipments makes it impracticable to cover all of them.

Table C1
Lamps, Ballasts, and Miscellaneous Appliances

Equipment	Applicable to All Nominal System Voltages Containing This Voltage(s)	Equipment Nameplate Voltage Rating
Lighting Devices		
Incandescent lamps	120	120
Fixtures and ballasts for fluorescent and high-pressure vapor lamps [Notes (a) & (b)]	120 208 240 277 480	120 208 240 277 480
Motor-Operated Appliances [Note (c)]		
Blowers	120	115
Clocks	120	120
Dryers — clothes	120/240, 240/120, 208Y/120	115/230
Fans	120	115
Food mixers		115
Food waste disposers		115
Pumps		115
Refrigerators & freezers		115
Stokers		115
Timers		120
Vacuum sweepers		115
Washers		
Clothes		115
Dishes		115
Communication Appliances		
Projectors, silent & sound		
Small	120	120
Large	120/240, 240/120 208Y/120	120/240 120/208
Phonographs	120	120
Radios		
Tape recorders		
Television		
Heating and Cooking Appliances		
Blankets	120	120
Cooking appliances, table & counter		
Household — small	120	120
Household — large		
Commerical — small		
Commercial — large	240 208 480	240 208 480
Heaters, portable air	120	120
Heating pads		120
Irons		
Hand		120
Ironers		115
Soldering		120
Ranges — household type	120/240, 240/120 208Y/120	120/240 120/208

(Continued)

Table C1 (*Continued*)
Lamps, Ballasts, and Miscellaneous Appliances

Equipment	Applicable to All Nominal System Voltages Containing This Voltage(s)	Equipment Nameplate Voltage Rating
Water heaters Tank — small	120 240	120/240
Tank — large	240 208	240 208

NOTES:

(a) Lighting systems incorporating two ungrounded wires for service may require special ballasts and auxiliaries.

(b) Some ballasts are rated for use on more than one system voltage by use of taps or multiple primary windings.

(c) Attention is called to the fact that under emergency conditions on electric supply systems, voltages below Range B of Table 1 may be encountered. This particularly should be taken into account in the design of motor-operated appliances for automatic starting and in the application of motors and control.

Table C2
Heating, Refrigeration, and Air-Conditioning Equipment

Equipment	Phase	Applicable to All Nominal System Voltages Containing This Voltage(s)	Equipment Nameplate Voltage Rating
Gas and oil furnaces and fractional hp fan coil units	1	120 240	115 230
Room air conditioners	1	120 208 240 208, 240	115 208, (200) * 230 208/230,† (200/230) *†
Unitary air conditioners and heat pumps Motor-compressors Condensing units Water-chilling packages Integral hp fan coil units, etc Duct and auxiliary electric heaters for air-conditioning units and heat pumps	1&3 1&3 1&3 3 3	208 240 208, 240 480 600	208, (200) * 230 208/230† 460 575
Electric furnaces	1&3 3	240 208	230 208, (200) *
Comfort heating	1	120 208 240 277	118 205 236 272
Refrigerated drinking water coolers	1	120	115
Dehumidifiers	1	120	115

* Parenthetical values are under consideration for future design.

† Slant between voltage values denotes "through."

Motor and Motor Control Equipment

For the purposes of this Appendix, the term "motor control equipment" is used in a general sense and includes some types of equipment classified as "switchgear." For applicable standards, see Appendix D.

The single-phase and three-phase motor and control voltage ratings shown in Table C3 are well-suited to the nominal system voltages indicated. It should be generally understood that motors with these ratings are to be considered as suitable for ordinary use on their corresponding system; for example, a 230-volt motor on a nominal 240-volt system. Operation of 230-volt motors on 208-volt systems is not recommended because the utilization voltage encountered will commonly be below the minus 10 percent tolerance on the voltage rating for which the motor is designed.

Suitable measures should be taken by manufacturers and power suppliers to indicate to the purchaser that equipments are intended to be used on the system whose nominal voltage is associated with, but may not be numerically equal to, the equipment nameplate voltage rating; for example, a motor and its control rated 230 volts on a nominal 240-volt system.

It should be noted that successful operation of a motor under given running conditions does not necessarily mean that it will be able to start and accelerate all loads to which it may be applied under these same operating conditions.

It should be recognized that synchronous motors, especially those rated 0.8 power factor, are reactive power sources and consequently may increase the voltage at their terminals to higher values than those experienced for induction motors under similar conditions.

Table C3
Motor and Motor Control Equipment

Applicable to All Nominal System Voltages Containing This Voltage	All Motor and Motor Control Equipment Nameplate Voltage Ratings Containing This Voltage			
	Integral horsepower		Fractional horsepower	
	Three-Phase	Single-Phase	Three-Phase	Single-Phase
120	—	115	—	115
208	200	—	200	—
240	230	230	230	230
480	460	—	460	—
600[1]	575	—	575	—
2400	2300	—	—	—
4160	4000	—	—	—
4800	4600	—	—	—
6900	6600	—	—	—
13800	13200	—	—	—

[1] Certain kinds of control and protective equipment presently available have a maximum voltage limit of 600 volts; the manufacturer or power supplier or both should be consulted to ensure proper application.

Appendix D
Applicable Standards

The following is a partial list of standards (by general number) for equipment from which voltage ratings and other characteristics can be obtained.

Equipment	Standard[1]
Ammonia compressors and compressor units	ARI 511
Automatic commercial ice-makers	ARI 810
Cable terminating devices (power)	IEEE 48
Central forced-air electric heating equipment	ARI 280
Central-station air-handling units	ARI 430
Definite purpose magnetic contactors	ARI 780
Dehumidifiers	AHAM DH1
Electrical measuring instruments	ANSI C39 Series
Electrical power insulators	ANSI C29 Series
Electricity metering	ANSI C12-1965
Forced-circulation air-cooling and air-heating coils	ARI 410
Forced-circulation, free-delivery air-coolers for refrigeration	ARI 420
Gas-fired furnaces	ANSI Z21.47-1968
Industrial control apparatus	ANSI C19.1-1959 NEMA IC1 NEMA AS1
Insulated wire	ANSI C1-1968 ANSI C8 Series AEIC Series IPCEA Series
Lamps	
Bactericidal lamps Electrical discharge lamps Incandescent lamps	ANSI C78 Series
Lamp ballasts	ANSI C82 Series
Lightning arresters	ANSI C62.1-1967
Low-voltage fuses	ANSI C97 Series
Low-voltage molded-case circuit breakers	NEMA AB1
Oil-fired furnaces	CS 195
Packaged terminal air conditioners	ARI 310
Positive displacement refrigerant compressor and condensing units	ARI 520

[1] See list of organizations on p. 18

Equipment	Standard
Power switchgear	
Automatic circuit reclosers	
Automatic line sectionalizers	
Capacitor switches	
Distribution current-limiting fuses	
Distribution cutouts and fuse links	
Distribution enclosed single-pole air switches	
Distribution oil cutouts and fuse links	
Fused disconnecting switches	ANSI C37 Series
High-voltage air switches	
Manual and automatic station control	
Power circuit breakers	
Power fuses	
Relays and relay systems	
Secondary fuses	
Supervisory and associated telemetering equipment	
Switchgear assemblies including metal-enclosed bus	
Reciprocating water-chilling packages	ARI 590
Remote mechanical draft air-cooled refrigerant	ARI 460
Room air conditioners	AHAM CN1
Room fan-coil air conditioners	ARI-AMCA-IBR 441
Rotating electrical machinery	
AC induction motors	ANSI C50 Series and NEMA MG1
Cylindrical rotor synchronous generators	
Salient pole synchronous generator and condensers	
Synchronous motors	
Universal motors	
Self-contained, mechanically-refrigerated drinking-water coolers	ANSI A112.11.1-1968 ARI 1010
Solenoid valves for liquid flow	ARI 760
Shunt power capacitors	ANSI C55.1-1968
Static power conversion equipment	ANSI C34.1-1958
Transformers, regulators and reactors	
Arc furnace transformers	
Constant-current transformers	
Current-limiting reactors	
Distribution transformers, conventional subway-type	
Instrument transformers	
Overhead-type distribution transformers	ANSI C57 Series
Power transformers	
Rectifier transformers	
Secondary network transformers	
Step-voltage and induction-voltage regulators	
Three-phase load-tap-changing transformers	
Unitary air-conditioning equipment	ARI 210
Unitary heat-pump equipment	ARI 240
Wiring devices	ANSI C73 Series

* See list of organizations on p. 18.

Organizations Listed in Appendix D

AEIC	Association of Edison Illuminating Companies 51 East 42nd Street New York, N.Y. 10017
AHAM	Association of Home Appliance Manufacturers 20 N. Wacker Drive Chicago, Illinois 60606
AMCA	Air Moving and Conditioning Association 205 W. Toughy Avenue Park Ridge, Illinois 60068
ANSI	American National Standards Institute, Inc 1430 Broadway New York, N.Y. 10018
ARI	Air Conditioning and Refrigeration Institute 1815 N. Ft. Myer Drive Arlington, Virginia 22209
CS	Commercial Standards Office of Commodity Standards National Bureau of Standards, U.S. Department of Commerce Washington, D.C. 20234
IBR	Institute of Boiler and Radiator Manufacturers 393 Seventh Avenue New York, N.Y. 10001
IEEE	The Institute of Electrical and Electronics Engineers, Inc 345 East 47th Street New York, N.Y. 10017
IPCEA	Insulated Power Cable Engineers Association 283 Valley Road Montclair, New Jersey 07042
NEMA	National Electrical Manufacturers Association 155 East 44th Street New York, N.Y. 10017

ANSI C84.1a-1973
Supplement to C84.1-1970

American National Standard

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supplement to voltage ratings for electric power systems and equipment (60 Hz)

Approved March 26, 1973

Secretariat: Edison Electric Institute
National Electrical Manufacturers Association

Replace pages 9 and 12 with the following revised pages which include voltage limits established for the 600 volt nominal system voltage.

On page 18, replace the address of IPCEA with the following:

Insulated Power Cable Engineers Association
192 Washington Street
Belmont, Massachusetts 02178

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NOMINAL SYSTEM VOLTAGE (Note a)			VOLTAGE RANGE A (Note b)			VOLTAGE RANGE B (Note b)		
			Minimum		Maximum	Minimum		Maximum
Two-wire	Three-wire	Four-wire	Utilization Voltage (Note c)	Service Voltage	Utilization and Service Voltage (Note e)	Utilization Voltage (Note c)	Service Voltage	Utilization and Service Voltage
Single-Phase Systems								
120			110	114	126	106	110	127
	120/240		110/220	114/228	126/252	106/212	110/220	127/254
Three-Phase Systems								
		208Y/120	191Y/110	197Y/114	218Y/126	184Y/106 (Note d)	191Y/110 (Note d)	220Y/127
		240/120	220/110	228/114	252/126	212/106	220/110	254/127
	240		220	228	252	212	220	254
		480Y/277	440Y/254	456Y/263	504Y/291	424Y/245	440Y/254	508Y/293
	480		440	456	504	424	440	508
	600 (Note f)		550	570	630 (Note f)	530	550	635 (Note f)
	2400		2160	2340	2520	2080	2280	2540
		4160Y/2400	3740Y/2160	4050Y/2340	4370Y/2520	3600Y/2080	3950Y/2280	4400Y/2540
	4160		3740	4050	4370	3600	3950	4400
	4800		4320	4680	5040	4160	4560	5080
	6900		6210	6730	7240	5940	6560	7260
		8320Y/4800	(Note g)	8110Y/4680	8730Y/5040	(Note g)	7900Y/4560	8800Y/5080
		12000Y/6930		11700Y/6760	12600Y/7270		11400Y/6580	12700Y/7330
		12470Y/7200		12160Y/7020	13090Y/7560		11850Y/6840	13200Y/7620
		13200Y/7620		12870Y/7430	13860Y/8000		12540Y/7240	13970Y/8070
		13800Y/7970		13460Y/7770	14490Y/8370		13110Y/7570	14520Y/8380
	13800		12420	13460	14490	11880	13110	14520
		20780Y/12000	(Note g)	20260Y/11700	21820Y/12600	(Note g)	19740Y/11400	22000Y/12700
		22860Y/13200		22290Y/12870	24000Y/13860		21720Y/12540	24200Y/13970
	23000			22430	24150		21850	24340
		24940Y/14400		24320Y/14040	26190Y/15120		23690Y/13680	26400Y/15240
		34500Y/19920		33640Y/19420	36230Y/20920		32780Y/18930	36510Y/21080
	34500			33640	36230		32780	36510

Higher Voltage Three-Phase Systems in kV

Nominal System Voltage	Maximum Voltage
46	48.3
69	72.5
115	121
138	145
161	169
230	242

For these systems Range A and Range B limits are not shown because, where they are used as service voltages, the operating voltage level on the user's system is normally adjusted by means of voltage regulation to suit his requirements.

NOTES.

[illegible]

(except for the 240/120 volt delta system), a start line, and the phase to neutral voltage. Single phase services and loads may be supplied from either single phase or three phase systems. The principal Band three connections that are used to supply single phase and three phase services are discussed in Appendix A.

(b) The voltage ranges on this table are [illegible] in Appendix B.

(c) Maximum allowable voltage drop for [illegible] only all circuits not supplied [illegible] conditions as follows:

Nominal System Voltage	Range A	Range B
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]

(d) [illegible] systems voltages [illegible] Maximum allowable [illegible] Range B [illegible] systems [illegible] 600 volts.

(e) [illegible]

(f) [illegible]

(g) [illegible]

* Information from American National Standard C92.2-1967

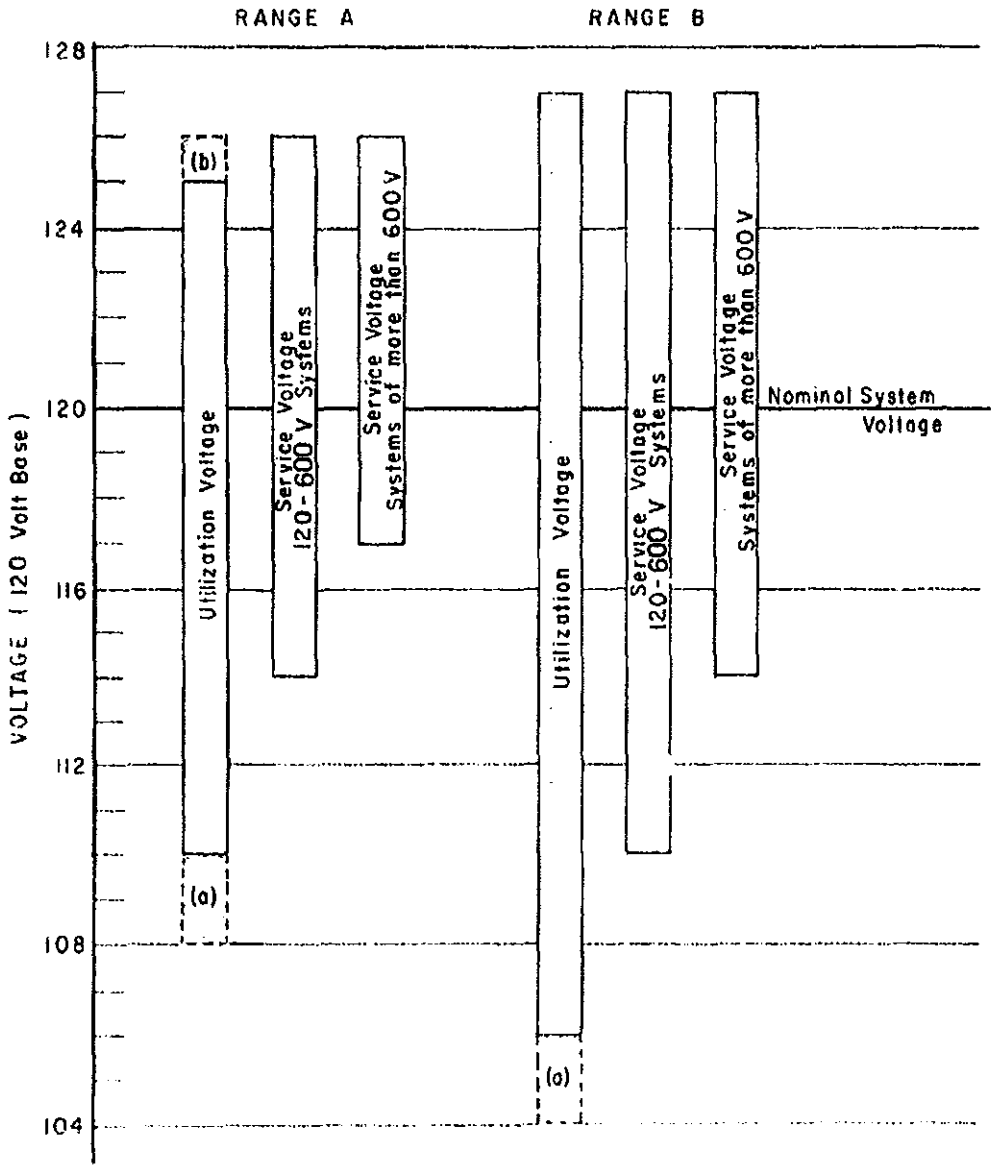
Extra High Voltage Three-Phase Systems in kV

Preferred Nominal System Voltage	Preferred Maximum Voltage
345	362
500	550
700	765

Appendix B

Illustration of Voltage Ranges of Table 1

This chart shows the basis of the Range A and Range B limits of Table 1. The limits in Table 1 were determined by multiplying the limits shown in this chart by the ratio of each nominal system voltage to the 120-volt base. [For exceptions see Note (d).]



NOTES

(a) These shaded portions of the ranges do not apply to circuits supplying lighting loads. See Note (c) to Table 1.

(b) This shaded portion of the range does not apply to 120-600 V systems. See Note (e) to Table 1.

(c) The difference between minimum service and minimum utilization voltages is intended to allow for voltage drop in the customer's wiring system. This difference is greater for service of more than 600 V to allow for additional voltage drop in transformations between service voltage and utilization equipment.

(d) The Range B utilization voltage limits in Table 1 for 6900 V and 13 800 V systems [illegible]