

**ANSI/AHRI Standard 110**

**2012 Standard for  
Air-Conditioning, Heating  
and Refrigerating Equipment  
Nameplate Voltages**



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## **IMPORTANT**

### ***SAFETY RECOMMENDATIONS***

It is strongly recommended that the product be designed, constructed, assembled and installed in accordance with nationally recognized safety requirements appropriate for products covered by this standard.

AHRI, as a manufacturers' trade association, uses its best efforts to develop standards employing state-of-the-art and accepted industry practices. However, AHRI does not certify or guarantee safety of any products, components or systems designed, tested, rated, installed or operated in accordance with these standards or that any tests conducted under its standards will be non-hazardous or free from risk.

Note:

This standard supersedes AHRI Standard 110-2002.

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# AIR-CONDITIONING, HEATING AND REFRIGERATING EQUIPMENT NAMEPLATE VOLTAGES

## Section 1. Purpose

**1.1 Purpose.** The purpose of this standard is to establish, for air-conditioning, heating and refrigerating equipment: definitions; voltage rating requirements; equipment performance requirements; and conformance conditions.

**1.1.1 Intent.** This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

**1.1.2 Review and Amendment.** This standard is subject to review and amendment as technology advances.

**1.2** The provisions herein are recommendations intended for implementation only through reference by other authoritative documents.

## Section 2. Scope

**2.1 Scope.** This standard applies to 50 Hz and 60 Hz electrical voltage ratings and operating limits as applied to air-conditioning, heating and refrigerating equipment, heat pumps, and electric furnaces as well as components.

**2.1.1 Exclusions.** Voltages less than 100V AC are not included in this standard.

## Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

**3.1 "Shall" or "Should."** "Shall" or "should" shall be interpreted as follows:

**3.1.1 Shall.** Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

**3.1.2 Should.** "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

**3.2 Voltages.**

**3.2.1 Equipment Nameplate Voltage Rating.** The nominal Utilization Voltage marked on the equipment nameplate by the manufacturer (Tables 1 and 2).

**3.2.2 Low Voltage.** The Nominal System Voltage with the range between 100V and 1kV AC according to ANSI C84.1.

**3.2.3 Medium Voltage.** The Nominal System Voltage with the range between 1kV and 35kV AC according to IEEE 1585.

Note: For the purposes of this standard, 1kV is included under Medium Voltage.

**3.2.4 Nominal System Voltage.** A nominal value assigned to the electric power supply system for the purpose of conveniently designating its voltage class.

**3.2.5 Service Voltage.** The voltage at the point where the electric systems of the supplier and the user are connected.

- 3.3      **3.2.6 Utilization Voltage.** The voltage at the line terminals of the utilization equipment.  
Y. The transformer coil configuration.

## Section 4. Voltage Rating Requirements

**4.1**      *Standard System Voltage Relationships.* Tables 1 and 2 present the basic relationships between standard Nominal System Voltages and Utilization Voltages for air-conditioning, heating and refrigeration equipment and components. (Data derived from ANSI C84.1).

**4.2**      *Application of Voltage Ranges.* (See ANSI C84.1).

**4.2.1 Range A-Service Voltage.** Electric supply systems are designed and operated so that most Service Voltages are within the limits specified for this range. The occurrence of Service Voltages outside of these limits should be infrequent and should be handled as a special occurrence.

**4.2.2 Range A-Utilization Voltage.** User systems are to be designed and thus must operate acceptably between the minimum and maximum Utilization Voltage Range A.

Utilization equipment shall be designed and rated to give acceptable performance throughout this range, per the applicable AHRI Standard.

**4.2.3 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 are typically limited in extent, frequency and duration. When they occur, corrective measures are typically undertaken within a reasonable time to improve voltages to meet Range A requirements.

Insofar as practical, utilization equipment shall be designed to give acceptable performance in the extremes of this range of Utilization Voltage, although not necessarily equal performance as in Range A.

**4.2.3.1 Exception.** For 208V systems only, motor driven equipment shall be designed to start and operate satisfactorily under rated load conditions at the extremes of Range B, but not necessarily under maximum load conditions. For rated and maximum load conditions, see the industry standards for the product concerned.

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 the location and nature of load or circuits involved, and the magnitude and duration of the deviation beyond Range B limits.

**Table 1. Standard Nominal System Voltages for 60 Hz Systems in the U.S.A.**

Voltage Class	Nominal System Voltage	Nameplate Voltage Marking	Voltage Range A <sup>2</sup>			Voltage Range B <sup>2</sup>		
			Maximum	Minimum		Maximum	Minimum	
			Utilization and Service Voltage	Service Voltage	Utilization Voltage	Utilization and Service Voltage	Service Voltage	Utilization Voltage
Low Voltage <sup>1,2,4</sup>	Single Phase							
	120	115	126	114	108	127	110	104
	208 or 240	208/230 (200/230)	252	197	187	254	191	180
	208	208 (200)	228	197	187	228	191	180
	240	230	252	228	216	254	220	208
	277	265	291	263	249	293	254	240
	Three Phase <sup>5</sup>							
	208 or 240	208/230 (200/230)	252	197	187	254	191	180
	208	208 (200)	228	197	187	228	191	180
	240	230	252	228	216	254	220	208
	480	460	504	456	432	508	440	416
	600	575	630	570	540	635	550	520
Medium Voltage <sup>5</sup>	Nominal System Voltage does not apply for the medium voltage range.	2340	2520	2340	2160 <sup>3</sup>	2540	2280	2080 <sup>3</sup>
		4050/2340	4370Y/2520	4050Y/2340	3740Y/2160 <sup>3</sup>	4400Y/2540	3950Y/2280	3600Y/2080 <sup>3</sup>
		4050	4370	4050	3740 <sup>3</sup>	4400	3950	3600 <sup>3</sup>
		4680	5040	4680	4320 <sup>3</sup>	5080	4560	4160 <sup>3</sup>
		6730	7240	6730	6210 <sup>3</sup>	7260	6560	5940 <sup>3</sup>
		8110/4680	8730Y/5040	8110Y/4680		8800Y/5080	7900Y/4560	
		11700/6760	12600Y/7270	11700Y/6760		12700Y/7330	11400Y/6580	
		12160/7020	1309Y/7560	12160Y/7020		13200Y/7620	11850Y/6840	
		12870/7430	13860Y/8000	12870Y/7430		13970Y/8070	12504Y/7240	
		13460/7770	14490Y/8370	13460Y/7770		14520Y/8380	13110Y/7570	
		13460	14490	13460	12420 <sup>3</sup>	14520	13110	11880 <sup>3</sup>
		20260/11700	21820Y/12600	20260Y/11700		22000Y/12700	19740Y/11400	
		22290/12870		22290Y/12870			21720Y/12540	
		22430		22430			21850	
							23690Y/13680	

Notes for Table 1:

1) Minimum Utilization Voltages for 120 thru 600 volt combination lighting and power circuits servicing cord - plug connected equipment are:

Nominal System Voltage, V	Range A, V	Range B, V
120	110	106
208	191	184
240	220	212
277	254	245
480	440	424
600	550	530

2) It is recognized that there are in existence, power systems whose operating characteristics deviate from the voltage range limits of this table. It shall not be construed that nameplate voltage rated equipment, suitable for application to such systems and deviating from the values appearing in this table, may not be produced.

3) 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.

4) Motors are usually guaranteed to operate satisfactorily and to deliver their full power at the rated frequency and at a voltage 10% above or below their rating, or at the rated voltage. Some U.S. single-phase HVAC components that are dual-voltage rated (e.g., 208/230-1-60) may carry a minus 5% voltage allowance from the lower voltage rating of 208 volts.

Equipment having more than one marked rated voltage, which is permitted to be connected to these voltages without individual adjustment, should have the voltages separated by a hyphen. Example: 208-230V; The equipment may be operated at these utilization voltages or at voltages between these values without individually adjusting for the difference between them.

Equipment having more than one marked rated voltage, which requires rewiring or other adjustments made by the installer to the equipment to permit connection to these voltages, should have the voltages separated by an oblique stroke.

Example: 208/230V; The equipment may be operated at these utilization voltages only if the installer makes the proper wiring or adjustment to the equipment for each voltage as specified by the manufacturer.

5) For Medium Voltages.

A) Three-phase three-wire systems are systems in which only the three-phase conductors are carried out from the source of the connection of loads. The source may be derived from any type of three-phase transformer connection, grounded or ungrounded.

B) 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, which defines the transformer coil configuration, a slant line, and the phase-to-neutral voltage.

**4.3** *Nominal System Voltages for 50Hz and 60Hz Non U.S.A. Systems Only.* For the standard Nominal System Voltages for 50Hz and 60Hz units for non U.S.A. systems only, see Table 2.

<b>Table 2. Standard Nominal System Voltages for 50Hz and 60Hz Systems (For non U.S.A. systems only)</b>						
Systems	Nominal Frequency (Hz)	Voltage				
		Highest Supply or Utilization Voltage	Nominal Voltage	Lowest Supply Voltage	Lowest Utilization Voltage	Nameplate Voltage Marking <sup>5</sup>
Three-phase Four-wire or Three-wire Systems	50	253	230	207	198	230
		253/440	230/400 <sup>1</sup>	207/360	198/344	400/230
		440/759	400/690 <sup>2</sup>	360/621	344/593	690/400
		1100	1000	900	860	1000
	60	132/229	120/208	108/187	103/179	208/120
		264	240 <sup>3</sup>	216	206	240
		253/440	230/400 <sup>1</sup>	207/360	198/344	400/230
		305/528	277/480	249/432	238/413	480/277
		528	480	432	413	480
		382/660	347/600	312/540	298/516	600/347
		660	600	540	516	600
Single-phase Three-wire Systems	60	132/264	120/240 <sup>4</sup>	108/216	103/206	240/120
<b>Notes:</b> There are many power systems throughout the world and this table lists the most common.  1) The value of 230/400 V is the result of the evolution of 220/380V and 240/415V systems which has been completed in Europe and many other countries. However, 220/380V and 240/415V systems still exist. 2) The value of 400/690 V is the result of the evolution of 380/660V systems which has been completed in Europe and many other countries. However, 380/660V systems still exist. 3) The value of 200V or 220V is also used in some countries. 4) The values of 100/200V are also used in some countries on 50 Hz or 60 Hz systems. 5) The first number is phase to neutral voltage and the second number is phase to phase voltage.						



**4.4** *AC Three Phase Systems with Nominal Voltage Above 1kV and Not Exceeding 35kV at 50Hz and 60Hz (For non-U.S.A. systems only).* For AC three phase systems with nominal voltage above 1kV and not exceeding 35kV at 50Hz and 60Hz in the U.S.A. only, see Table 3, which was derived from IEC Standard 60038.

<b>Table 3. AC Three Phase Systems With Nominal Voltage Above 1kV and not Exceeding 35kV at 50Hz and 60Hz (For non-U.S.A. systems only)<sup>1,2</sup></b>		
Highest Voltage Equipment (kV)	Nominal System Voltage (kV)	Nameplate Voltage Marking (kV)
3.6 <sup>3</sup>	3.3 <sup>3</sup> 3 <sup>3</sup>	3.3
7.2 <sup>3</sup>	6.6 <sup>3</sup> 6 <sup>3</sup>	6.6
12	11 10	11
17.5	- 15	15
24	22 20	22
36 <sup>4</sup>	33 <sup>4</sup> 30 <sup>4</sup>	33
40.5 <sup>4</sup>	- 35 <sup>4</sup>	35
Notes: 1) It is recommended that in any one country, the ratio between two adjacent nominal voltages should be not less than two. 2) In a normal system, the highest voltage and the lowest voltage do not differ by more than approximately $\pm 10\%$ from the nominal voltage of the system. 3) These values should not be used for new public distribution systems. 4) The unification of these values is under consideration.		

## Section 5. Equipment Performance Requirements

**5.1** *Equipment Standard Rating Requirements.* Equipment standard rating tests, in accordance with equipment rating standards, shall be conducted at the Equipment Nameplate Voltage Rating. For all dual nameplate voltage equipment covered by this standard, any Standard Rating tests shall be performed at both voltages or at the lower of the two voltages if only a single Standard Rating is to be published.

## Section 6. Conformance Conditions

**6.1** *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard shall not reference, state, or acknowledge the standard in any written, oral, or electronic communication.

## APPENDIX A. REFERENCES - NORMATIVE

**A1** Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standards. All references in this appendix are considered as part of the standard.

**A1.1** ANSI C84.1-2006, *Electrical Power Systems and Equipment - Voltage Ratings (60 Hz)*, 2006, American National Standards Institute, 25 West 43<sup>rd</sup> Street, 4<sup>th</sup> Floor, New York, NY 10036, U.S.A.

**A1.2** ASHRAE *Terminology of Heating, Ventilation, Air Conditioning & Refrigeration*, Second Edition, 1991, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

**A1.3** IEC Standard 60038, *IEC Standard Voltages*, 2009, International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, 1211 Geneva 20, Switzerland.

**A1.4** IEEE 1585, *Guide for the Functional Specification of Medium Voltages (1-35kV) Electronic Series Devices for Compensation of Voltage Fluctuations*, 2002, Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17<sup>th</sup> Floor New York, NY 10016.

## APPENDIX B. REFERENCES - INFORMATIVE

**B1** Listed here are all standards, handbooks, and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

**B1.1** IEC Standard Publication 60038, *IEC Standard Voltages*, 1983, International Electrotechnical Commission, 3 rue de Varembe, P.O. Box 131, 1211 Geneva 20, Switzerland.

**B1.2** ASHRAE *Handbook—HVAC Systems and Equipment*, 2008, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.