

Australian Standard™

Standard voltages

[Modified and including the full text of IEC 60038:1983]

This Australian Standard was prepared by Committee EL/40, Standard Voltages, Current Ratings and Frequencies. It was approved on behalf of the Council of Standards Australia on 17 December 1999 and published on 23 February 2000.

The following interests are represented on Committee EL/40:

Australian Electrical and Electronic Manufacturers Association
Consumer Electronics Suppliers Association
Electricity Supply Association of Australia
Institution of Engineers, Australia
Ministry of Commerce, New Zealand

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL/40, Standard Voltages, Current Ratings and Frequencies, to supersede AS 2926—1987, *Standard voltages—Alternating (50 Hz) and direct*.

This Standard is the result of a consensus among representatives on the Joint Committee to produce it as an Australian Standard.

This Standard is based on and contains the full text of, but is not equivalent to, IEC 60038:1983, *IEC standard voltages*, incorporating its Amendment 1:1994 and Amendment 2:1997.

Variations to IEC 60038:1983, as amended, are indicated at the appropriate places throughout this Standard. Strikethrough (*example*) identifies IEC tables and passages of text which, for the purposes of this Australian Standard, are deleted. Where Australian tables or passages of text are added, each is set in its proper place and identified by shading (*example*). A summary of these variations is given in Appendix ZZ.

In January 1997, the IEC commenced numbering its Standards from 60000 by adding 60000 to the number of each existing Standard. This coordinates IEC numbering with ISO numbering. During the transition period an IEC Standard might be identified by its new number or its old number (for example, IEC 60050 or IEC 50).

The term 'normative' has been used in this Standard to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

As this Standard is reproduced from an International Standard, the following applies:

- (a) The AS number is shown only on the cover and title page.
- (b) In the source text, 'this publication' should read 'this Australian Standard'.

References to International Standards should be replaced by equivalent Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian or Australian/New Zealand Standard</i>	
IEC		AS	
60071	Insulation co-ordination	1824	Insulation co-ordination
60071-1	Part 1: Definitions, principles and rules	1824.1	Part 1: Definitions, principles, and rules
		AS/NZS	
60335	Safety of household and similar electrical appliances	3350	Safety of household and similar electrical appliances
60335-1	Part 1: General requirements	3350.1	Part 1: General requirements

The following Australian/New Zealand Standard is referenced in this document.

AS/NZS

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

CONTENTS

	<i>Page</i>
Scope	1
SECTION ONE - DEFINITIONS	
1 Nominal system voltage.....	1
2 Highest and lowest voltages of a system (excluding transient or abnormal conditions) ..	1
3 Supply terminals Point of supply.....	2
4 Supply voltage.....	2
5 Supply voltage range	2
6 Utilization voltage	2
7 Utilization voltage range	2
8 Rated voltage (of equipment)	2
9 Highest voltage for equipment.....	2
SECTION TWO - TABLES OF STANDARD VOLTAGES	
Table I.....	3
Table II.....	4
Table III.....	5
Table IIIA.....	5
Table IV.....	6
Table V.....	6
Table VI.....	7
Appendix ZZ Variations to IEC 60038:1983, Amendment 1:1994 and Amendment 2:1997 for application in Australia	8

NOTES

STANDARDS AUSTRALIA

Australian Standard
Standard Voltages

Any IEC table, figure or passage of text that is struck-through is not part of this Standard. Any Australian table, figure or passage of text that is added (and identified by shading) is part of this Standard.

Scope

This publication applies to:

- a.c. transmission, distribution and utilization systems and equipment for use in such systems with standard frequencies 50 Hz and ~~60 Hz~~ having a nominal voltage above 100 V;
- a.c. and d.c. traction systems;
- a.c. and d.c. equipment having rated voltages below 120 V a.c. or below 750 V d.c., the a.c. voltages being intended (but not exclusively) for 50 Hz and ~~60 Hz~~ applications; such equipment covers batteries (from primary or secondary cells), other power supply devices (a.c. or d.c.), electrical equipment (including industrial and communication), and appliances.

This publication shall not apply to voltages representing or transmitting signals or measured values.

This publication shall not apply to standard voltages of components and parts used within electrical devices or items of equipment.

SECTION ONE—DEFINITIONS

For alternating voltages, the voltages stated below are r.m.s. values.

1 Nominal system voltage

Voltage by which a system is designated.

2 Highest and lowest voltages of a system (excluding transient or abnormal conditions)**2.1 Highest voltage of a system**

The highest value of voltage which occurs under normal operating conditions at any time and at any point on the system.

It excludes voltage transients, such as those due to system switching, and temporary voltage variations.

2.2 Lowest voltage of a system

The lowest value of voltage which occurs under normal operating conditions at any time and at any point on the system.

It excludes voltage transients, such as those due to system switching, and temporary voltage variations.

3 ~~Supply terminals~~ Point of supply

The point where the distribution system of the electricity supply authority and the electrical system of the consumer are connected.

4 Supply voltage

The phase-to-phase or phase-to-neutral voltage at the ~~supply terminals~~ point of supply.

5 Supply voltage range

The voltage range at the ~~supply terminals~~ point of supply.

6 Utilization voltage

The phase-to-phase or phase-to-neutral voltage at the outlets or at the terminals of equipment.

7 Utilization voltage range

The voltage range at the outlets or at the terminals of equipment.

8 Rated voltage (of equipment)

The voltage assigned generally by a manufacturer, for a specified operating condition of a component, device or equipment.

9 Highest voltage for equipment

Highest voltage for which the equipment is specified regarding:

- a) the insulation;
- b) other characteristics which may be referred to this highest voltage in the relevant equipment recommendations.

The highest voltage for equipment is the maximum value of the "~~highest system voltage~~" "**highest voltage of the system**" (see 2.1) for which the equipment may be used.

NOTES

- 1 The highest voltage for equipment is indicated for nominal system voltages higher than 1 000 V only. It is understood that, particularly for certain nominal system voltages, normal operation of equipment cannot be ensured up to this highest voltage for equipment, having regard to voltage-sensitive characteristics such as losses of capacitors, magnetizing current of transformers, etc.

In such cases, the relevant recommendations must specify the limit to which the normal operation of this equipment can be ensured.

- 2 It is understood that the equipment to be used in systems having nominal voltage not exceeding 1 000 V should be specified with reference to the nominal system voltage only, both for operation and for insulation.
- 3 Attention is drawn to the fact that in some equipment standards (for example, IEC 60335-1 and IEC 60071-1) the term "voltage range" has a different meaning.

SECTION TWO—TABLES OF STANDARD VOLTAGES

Table I- A.C. systems having a nominal system voltage between 100 V and 1 000 V inclusive and related equipment

In the following table, the three-phase four-wire systems and single-phase three-wire systems include single-phase circuits (extensions, services, etc.) connected to these systems.

The lower values in the first and second columns are voltages to neutral and the higher values are voltages between phases. When one value only is indicated, it refers to three-wire systems and specifies the voltage between phases. ~~The lower value in the third column is the voltage to neutral and the higher value is the voltage between lines.~~

The voltages in excess of 230/400 V are intended exclusively for heavy industrial applications and large commercial premises.

Three-phase, four-wire or three-wire systems		Single-phase three-wire systems
Nominal system voltage V		Nominal system voltage V
50 Hz	60 Hz	60 Hz
—	120/208	120/240
—	240	—
230/400 ¹⁾	277/480	—
230/460 ²⁾	—	—
400/690 ^{†)}	480	—
—	347/600	—
1 000	600	—

¹⁾ The nominal voltage of existing 220/380 V and 240/415 V systems shall evolve toward the recommended value of 230/400 V. The transition period should be as short as possible and should not exceed the year 2003. During this period, as a first step, the electricity supply authorities of countries having 220/380 V systems should bring the voltage within the range 230/400 V +6%, -10% and those of countries having 240/415 V systems should bring the voltage within the range 230/400 V +10%, -6%. At the end of the transition period, the tolerance of 230/400 V ±10% should have been achieved; after this the reduction of this range will be considered. All the above considerations apply also to the present 380/660 V value with respect to the recommended value 400/690 V.

²⁾ Single-phase three-wire systems only.

Concerning supply voltage range, under normal service conditions, it is recommended that the voltage at the ~~supply terminals~~ **point of supply** should not differ from the nominal voltage of the system by more than ~~±10%~~ **+10%, -6%**.

For the utilization voltage range, in addition to the voltage variations at the ~~supply terminals~~ **point of supply**, voltage drops may occur within the consumer's installations. For low-voltage installations, this voltage drop is limited to ~~4%~~ **5%**, in accordance with AS/NZS 3000, therefore, the utilization voltage range is ~~+10%, -14%~~ **+10%, -11%**. This utilization range should be taken into account by Product Committees.

^{†)} ~~At the end of the transition period, the reduction of this range will be considered.~~

Table II - D.C. and a.c. traction systems *

	Voltage			Rated frequency of a.c. systems (Hz)
	Lowest (V)	Nominal (V)	Highest ^{***} (V)	
D.C. systems	(400) 500 1 000 2 000	(600) 750 1 500 3 000	(720) [(840)] 900 [1 050] 1 800 [2 100] 3 600**	
A.C. single-phase systems	(4 750) 12 000 19 000	(6 250) 15 000 25 000	(6 900) 17 250 27 500 [30 000]	50 or 60 16 50 or 60

* The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. ~~In particular for a.c. single-phase systems, the nominal voltage 6 250 V should be used only when local conditions make it impossible to adopt the nominal voltage 25 000 V.~~

The values indicated in the table above are the values agreed by the International Mixed Committee on Electric Traction Equipment (C.M.T.) and by IEC Technical Committee No. 9, Electric Traction Equipment, except where varied for Australian conditions.

~~** In certain European countries, this voltage may reach 4 000 V. The electrical equipment of vehicles operating international services in these countries shall be capable of withstanding this absolute maximal voltage for brief periods of up to 5 min.~~

~~*** Highest voltages on the left are "without regeneration". Highest voltages "with regeneration" are given in square brackets on the right. The regenerative value for 25 000 V a.c. systems is intended for new systems and equipment. For existing systems, the value should be regarded as a short-time rating only, depending on existing equipment, particularly if both regenerative and non-regenerative rolling stock are in service.~~

Table III - A.C. three-phase systems having a nominal voltage above 1 kV and not exceeding 35 kV and related equipment *

Two series of Highest voltages for equipment are given below, one for 50 Hz and 60 Hz systems (Series I), the other for 60 Hz systems (Series II—North American practice). It is recommended that only one of these series should be used in any one country.

It is also recommended that only one of the two series of nominal system voltages given for Series I should be used in any one country.

Series I		Series II	
Highest voltage for equipment (kV)	Nominal 50Hz system voltage (kV)	Highest voltage for equipment (kV)	Nominal system voltage (kV)
3.6 ¹⁾	3.3 ¹⁾ 3 ¹⁺⁾	4.40 ¹⁺⁾	4.16 ¹⁺⁾
7.2 ¹⁾	6.6 ¹⁾ 6 ¹⁺⁾	—	—
12	11 10	—	—
—	— —	13.2 ²⁺⁾	12.47 ²⁺⁾
—	— —	13.97 ²⁺⁾	13.2 ²⁺⁾
—	— —	14.52 ¹⁺⁾	13.8 ¹⁺⁾
(17.5)	— (15)	—	—
24	22 20	—	—
—	— —	26.4 ²⁺⁾	24.94 ²⁺⁾
36 ³⁺⁾	33 ³⁺⁾ —	—	—
—	— —	36.5 ²⁺⁾	34.5 ²⁺⁾
40.5 ³⁺⁾	— 35 ³⁺⁾	—	—

* These systems are generally three-wire systems unless otherwise indicated. The values indicated are voltages between phases.

The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future.

Notes

1.— It is recommended that in any one country geographic area the ratio between two adjacent nominal system voltages should be not less than two.

2.— In a normal system of Series I, The highest voltage and the lowest voltage do not differ by more than approximately $\pm 10\%$ from the nominal voltage of the system. In a normal system of Series II, the highest voltage does not differ by more than $+5\%$ and the lowest voltage by more than -10% from the nominal voltage of the system.

¹⁾ These values should not be used for public distribution systems.

²⁾ These systems are generally four-wire systems.

³⁾ The unification of these value is under consideration.

Table IIIA - A.C. single wire earth return (swer) systems

Nominal system voltage (kV)
12.7 ¹⁾
19.1 ¹⁾

¹⁾ These voltages have been derived from three-phase nominal system voltages of 22 kV and 33 kV respectively. The highest voltage for equipment is not specified for swer systems as it will vary depending on the supply and earthing conditions.

Table IV- A.C. three-phase systems having a nominal voltage above 35 kV and not exceeding 230 kV and related equipment*

Two series of Nominal system voltages are given below. It is recommended that only one of the two series should be used in any one country.

It is recommended that in any one country geographic area only one value in the following groups should be used for the highest voltage for equipment:

123 kV-145 kV

245 kV-300 kV (see Table V)-362 kV (see Table V).

Highest voltage for equipment (kV)	Nominal system voltage (kV)	
(52)	(45)	—
72.5	66	69
123	110	115
145	132	138
(170)	(150)	—
245	220	230

- The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. The values are voltages between phases.

Note.— In the present table, the term "geographical area" may indicate a single country, a group of countries which agree to adopt the same voltage level, or a part of a very large country.

Table V- A.C. three-phase systems having a highest voltage for equipment exceeding 245 kV ¹⁾

It is recommended that in any one geographical area only one value in the following groups should be used for the highest voltage for equipment:

245 kV (see Table IV)-300 kV-362 kV

362 kV-420 kV

420 kV-550 kV

Highest voltage for equipment (kV)
(300)
362
420
550 ²⁾
800 ^{3), 5)}
1 050 ⁴⁾
1 200 ⁵⁾

¹⁾ The values indicated in parentheses should be considered as non-preferred values. It is recommended that these values should not be used for new systems to be constructed in future. The values are voltages between phases.

²⁾ The value 525 kV is also used.

³⁾ The value 765 kV is also used; the test values for equipment should be the same as defined by the IEC for 765 kV.

- 4) The value 1100 kV is also used.
- 5) In any one geographical area where the 1050 kV value is adopted, neither the value 800 kV nor the value 1200 kV should be used.

Note.— In the present table, the term "geographical area" may indicate a single country, a group of countries which agree to adopt the same voltage level, or a part of a very large country.

**Table VI - Equipment having a nominal voltage
below 120 V a.c. or below 750 V d.c.**

D.C.		A.C.	
Nominal values		Nominal values	
Preferred (V)	Supplementary (V)	Preferred (V)	Supplementary (V)
	2.4		
	3		
	4		
	4.5		
6	5	6	5
	7.5		
12	9	12	
	15		15
24	30	24	
			36
36			42
	40		
48		48	
60			60
72			
	80		
96			100
110		110	
220	125		
	250		
440	600		

Notes 1.— Because the voltage of primary and secondary cells is below 2.4 V, and the choice of the type of cell to be used in various applications will be based on properties other than voltage, these values are not included in the table. The relevant IEC Technical Committees may specify types of cells and related voltages for specific applications.

2.— It is recognized that for technical and economic reasons additional voltages may be required for certain specific fields of application.

Appendix ZZ

Variations to IEC 60038:1983 Amendment 1: 1994 and Amendment 2: 1997 for application in Australia

(Normative)

ZZ1 Introduction

Variations made to IEC 60038:1983 Amendment 1: 1994 and Amendment 2: 1997 have been incorporated in the body of the Standard. They are listed in this Annex for easy reference.

ZZ2 Variations

The variations are as follows:

CLAUSE	
Scope	Reference to 60 Hz systems deleted.
Section 1	
Definition 3	<i>Supply terminals</i> replaced by <i>Point of supply</i> to align with the AS/NZS 3000 definition. In AS/NZS 3000:2000 Point of Supply is defined as "The junction of the electricity distributor's conductors with the consumer's mains". In Australia, this point is located at the physical point of connection, not at the point of crossing the consumer's property boundary.
Definition 9	<i>Highest system voltage</i> replaced by <i>Highest voltage of the system in last line before Note</i> .
Section 2	
Table I	Reference to 60 Hz systems removed in text above Table and Table itself.
	Note 1 varied.
	Note 2 added.
	Supply voltage range varied from $\pm 10\%$ to $+10\%$, -6% in first paragraph below table.
	Utilization voltage drop varied from 4% to 5%, in accordance with AS/NZS 3000 and utilization voltage range varied from $+10\%$, -14% to $+10\%$, -11% in second paragraph below Table.
	Note to second paragraph below Table deleted.
Table II	Traction voltages not applicable in Australia deleted. Highest voltages with regeneration and accompanying note *** added.
Table III	Series II and non-applicable nominal system voltages in Series I, together with referring text and note deleted.
Table IIIA	Added to cover a.c. single wire earth return (SWER) systems.
Table IV	Second series of nominal system voltages and referring text deleted.
	<i>Country</i> replaced with <i>geographic area</i> and 363 kV replaced with 362 kV in second paragraph to align with Table V.
	Note added to define <i>geographic area</i>

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Australian Standards

Australian Standards are prepared by committees of experts from industry, governments, consumers and other relevant sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

Standards Australia is responsible for ensuring that the Australian viewpoint is considered in the formulation of international Standards and that the latest international experience is incorporated in national Standards. This role is vital in assisting local industry to compete in international markets. Standards Australia represents Australia at both ISO (The International Organization for Standardization) and the International Electrotechnical Commission (IEC).

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