

Australian/New Zealand Standard™

Explosive atmospheres

**Part 7: Equipment protection by
increased safety ‘e’**



AS/NZS 60079.7:2016

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-014, Equipment for Explosive Atmospheres. It was approved on behalf of the Council of Standards Australia on 1 March 2016 and on behalf of the Council of Standards New Zealand on 12 February 2016.
This Standard was published on 22 March 2016.

The following are represented on Committee EL-014:

Auckland Regional Chamber of Commerce
Australian Chamber of Commerce and Industry
Australian Industry Group
Australian Institute of Petroleum
Australian Petroleum Production and Exploration Association
Australian Pipelines and Gas Association
Aviation and Marine Engineers Association
Bureau of Steel Manufacturers of Australia
Department of Industry, Skills and Regional Development, NSW
Department of Natural Resources and Mines, Qld (SIMTARS)
Electrical Compliance Testing Association
Electrical Contractors Association of New Zealand
Electrical Regulatory Authorities Council
Engineers Australia
Institute of Electrical Inspectors
Institute of Instrumentation, Control and Automation Australia
Institution of Professional Engineers New Zealand
Mining Electrical and Mining Mechanical Engineering Society
SafeWork NSW
University of Newcastle
WorkSafe New Zealand

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS 60079.7:2015.

Australian/New Zealand Standard™

Explosive atmospheres

Part 7: Equipment protection by increased safety 'e'

Originated as AS/NZS 60079.7:2002.
Previous edition 2006.
Third edition 2016.

COPYRIGHT

© Standards Australia Limited/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, PO Box 10729, Wellington 6011.

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee, EL-014 Equipment for Explosive Atmospheres, to supersede AS/NZS 60079.7:2006.

The objective of this Standard is to specify the requirements for the design, construction, testing and marking of electrical apparatus with type of protection increased safety ‘e’ intended for use in explosive gas atmospheres. This Standard applies to electrical apparatus where the rated voltage does not exceed 15 kV r.m.s. a.c. or d.c. Additional measures are applied to ensure that the apparatus does not produce arcs, sparks, or excessive temperatures in normal operation or under specified abnormal conditions. The objective of the revision is to adopt the current edition of IEC 60079-7.

The particular requirements of this Standard supplement the general requirements specified in AS/NZS 60079.0. This Standard is intended to be read in conjunction with AS/NZS 60079.0.

This Standard is identical with, and has been reproduced from IEC 60079-7, Ed 5.0 (2015), *Explosive atmospheres, Part 7: Equipment protection by increased safety “e”*.

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

- (a) In the source text ‘this part of IEC 60079’ should read ‘this Australian/New Zealand standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

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

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS/NZS	
60079	Explosive atmospheres	60079	Explosive atmospheres
60079-0	Part 0: Equipment—General requirements	60079.0	Part 0: Equipment—General requirements
60079-11	Part 11: Equipment protection by intrinsic safety “i”	60079.11	Part 11: Equipment protection by intrinsic safety ‘i’
IEC/IEEE			
60079-30-1	Part 30-1:Electrical resistance trace heating—General and testing requirements	60079.30.1	Part 30.1: Electrical resistance trace heating—General and testing requirements
IEC			
60238	Edison screw lampholders	60238	Edison screw lampholders (IEC 60238, Ed. 8.2 (2011) MOD)
60432	Incandescent lamps—Safety specifications	60432	Incandescent lamps—Safety specifications
60432-1	Part 1: Tungsten filament lamps for domestic and similar general lighting purposes	60432.1	Part 1: Tungsten filament lamps for domestic and similar general lighting purposes
60432-2	Part 2: Tungsten halogen lamps for domestic and similar general lighting purposes	60432.2	Part 2: Tungsten-halogen lamps for domestic and similar general lighting purposes
60432-3	Part 3: Tungsten halogen lamps (non-vehicle)	60432.3	Part 3: Tungsten-halogen lamps (non-vehicle)
IEC		AS	
60529	Degrees of protection provided by enclosures (IP Code)	60529	Degrees of protection provided by enclosures (IP Code)

IEC		AS/NZS	
60947	Low-voltage switchgear and controlgear	60947	Low-voltage switchgear and controlgear
60947-1	Part 1: General rules	60947.1	Part 1: General rules
60947-7-1	Part 7-1: Ancillary equipment—Terminal blocks for copper conductors	60947.7.1	Part 7.1: Ancillary equipment—Terminal blocks for copper conductors
60947-7-2	Part 7-2: Ancillary equipment—Protective conductor terminal blocks for copper conductors	60947.7.2	Part 7.2: Ancillary equipment—Protective conductor terminal blocks for copper conductors
60947-7-4	Part 7-4: Ancillary equipment—PCB terminal blocks for copper conductors	60947.7.4	Part 7.4: Ancillary equipment—PCB terminal blocks for copper conductors
60998	Connecting devices for low-voltage circuits for household and similar purposes	60998	Connecting devices for low-voltage circuits for household and similar purposes
60998-2-4	Part 2-4: Particular requirements for twist-on connecting devices	60998.2.4	Part 2.4: Particular requirements for twist-on connecting devices
60999	Connecting devices—Electrical copper conductors—Safety requirements for screw-type and screwless-type clamping units	60999	Connecting devices—Electrical copper conductors—Safety requirements for screw-type and screwless-type clamping units
60999-1	Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm ² up to 35 mm ² (included)	60999.1	Part 1: General requirements and particular requirements for clamping units for conductors from 0.2 mm ² up to 35 mm ² (included)
60999-2	Part 2: Particular requirements for clamping units for conductors above 35 mm ² up to 300 mm ² (included)	60999.2	Part 2: Particular requirements for clamping units for conductors above 35 mm ² up to 300 mm ² (included)
61184	Bayonet lampholders	61184	Bayonet lampholders (IEC 61184, Ed. 3.1 (2011) MOD)
ISO		AS	
2859	Sampling procedures for inspection by attributes	1199	Sampling procedures for inspection by attributes
2859-1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection	1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

Only normative references that have been adopted as Australian or Australian/New Zealand Standards have been listed.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

CONTENTS

1	Scope	F€
2	Normative references	FF
3	Terms and definitions	FH
4	Constructional requirements	Fİ
4.1	Level of Protection	Fİ
4.2	Electrical connections	Fİ
4.2.1	General	Fİ
4.2.2	Field wiring connections	FÌ
4.2.3	Factory connections.....	FJ
4.2.4	External plug and socket connections for field wiring connection	GF
4.3	Clearances	GG
4.4	Creepage distances	GG
4.5	Printed wiring boards with conformal coating, Level of Protection “ec”	GÌ
4.6	Solid electrical insulating materials	GJ
4.6.1	Specification	GJ
4.6.2	Long-term thermal stability	GJ
4.7	Windings.....	H€
4.7.1	General	H€
4.7.2	Insulated conductors	H€
4.7.3	Winding impregnation	H€
4.7.4	Conductor dimensions	H€
4.7.5	Sensing elements	HF
4.8	Temperature limitations	HF
4.8.1	General	HF
4.8.2	Conductors	HF
4.8.3	Insulated windings	HG
4.9	Wiring internal to equipment	HG
4.10	Degrees of protection provided by enclosures.....	HH
4.11	Fasteners	HI
5	Supplementary requirements for specific electrical equipment	HI
5.1	General.....	HI
5.2	Electrical machines	HI
5.2.1	General	HI
5.2.2	Degrees of protection provided by electrical machines, Level of Protection “eb”.....	HÍ
5.2.3	Degrees of protection provided by electrical machines, Level of Protection “ec”.....	HÍ
5.2.4	Connection facilities for external conductors	HÍ
5.2.5	Internal fans	HÍ
5.2.6	Minimum air gap	HÍ
5.2.7	Rotating electrical machines with cage rotors	HÎ
5.2.8	Limiting temperature	HÌ
5.2.9	Machines with permanent magnet rotors.....	IF
5.2.10	Stator winding insulation system.....	IF
5.2.11	Supplemental winding requirements Level of Protection “eb”	IG

5.2.12	Bearing seals and shaft seals	I G
5.2.13	Neutral point connections	I H
5.3	Luminaires, hand lights, or caplights	I H
5.3.1	General	I H
5.3.2	Light source	I I
5.3.3	Minimum distance between lamp and protective cover	I Í
5.3.4	Electrical spacings	I Í
5.3.5	Lampholders and lamp caps	I Î
5.3.6	Auxiliaries for Luminaires in Level of Protection "ec"	I J
5.3.7	Surface temperatures	Í €
5.3.8	Limiting temperatures	Í F
5.3.9	Luminaires for tubular fluorescent bi-pin lamps	Í F
5.3.10	Tests for resistance to impact	Í G
5.4	Analog measuring instruments and instrument transformers	Í G
5.4.1	General	Í G
5.4.2	Limiting temperature	Í G
5.4.3	Short-circuit currents	Í G
5.4.4	Short time thermal current	Í H
5.4.5	Measuring instruments supplied by current transformers	Í H
5.4.6	Moving coils	Í H
5.4.7	External secondary circuits	Í H
5.5	Transformers other than instrument transformers	Í H
5.6	Supplementary requirements for equipment incorporating cells and batteries	Í I
5.6.1	Type of cells and batteries	Í I
5.6.2	Requirements for cells and batteries ≤ 25 Ah	Í Í
5.6.3	Requirements for valve-regulated or vented cells or batteries > 25 Ah	Í Ì
5.6.4	Charging of cells and batteries	Î F
5.7	General purpose connection and junction boxes	Î G
5.8	Resistance heating equipment (other than trace heating systems)	Î G
5.8.1	General	Î G
5.8.2	Heating resistors	Î G
5.8.3	Temperature coefficient	Î H
5.8.4	Insulating material	Î H
5.8.5	Cold-start current	Î H
5.8.6	Electrical safety device	Î H
5.8.7	Electrically conductive covering	Î H
5.8.8	Exclusion of explosive atmosphere	Î I
5.8.9	Conductor cross-section	Î I
5.8.10	Limiting temperature	Î I
5.8.11	Safety device	Î I
5.9	Supplementary requirements for fuses	Î Í
5.9.1	General	Î Í
5.9.2	Temperature class of equipment	Î Î
5.9.3	Fuse mounting	Î Î
5.9.4	Fuse enclosures	Î Î
5.9.5	Replacement fuse identification	Î Î
5.10	Other electrical equipment	Î Î
6	Type verifications and type tests	Î Î
6.1	Dielectric strength	Î Î

6.2	Rotating electrical machines	Ï Ï
6.2.1	Determination of starting current ratio I_A/I_N and the time t_E	Ï Ï
6.2.2	Mounting of machine for test.....	Ï Ï
6.2.3	Additional tests for machines	Ï Ï
6.2.4	Overspeed test of cemented magnets	Ï J
6.3	Luminaires	Ï J
6.3.1	Battery operated luminaires	Ï J
6.3.2	Impact and drop tests	Ï J
6.3.3	Mechanical tests for screw lampholders other than E10.....	Ï €
6.3.4	Abnormal operation of luminaires	Ï F
6.3.5	Sulphur dioxide test for Level of Protection “eb” for the connection of bi-pin lamp caps to lampholders	Ï G
6.3.6	Vibration test for Level of Protection “eb” for luminaires with bi-pin lamps	Ï H
6.3.7	Test for wiring of luminaires subject to high-voltage impulses from ignitors	Ï I
6.3.8	Tests for electronic starters for tubular fluorescent lamps and for ignitors in Level of Protection “ec” for discharge lamps	Ï I
6.3.9	Test for starter holders for luminaires in Level of Protection “ec”	Ï Í
6.4	Measuring instruments and instrument transformers	Ï Í
6.5	Transformers other than instrument transformers.....	Ï Î
6.6	Verification and tests for cells and batteries of Level of Protection “eb”	Ï Î
6.6.1	General	Ï Î
6.6.2	Insulation resistance	Ï Î
6.6.3	Mechanical shock test	Ï Î
6.6.4	Test for ventilation of Level of Protection “eb” battery container.....	Ï Î
6.7	Verification and tests for cells and batteries of Level of Protection “ec”	Ï Ï
6.7.1	General	Ï Ï
6.7.2	Insulation resistance	Ï Ï
6.7.3	Mechanical shock test	Ï Ï
6.7.4	Test for ventilation of Level of Protection “ec” battery container.....	Ï Ï
6.8	General purpose connection and junction boxes	Ï J
6.8.1	General	Ï J
6.8.2	Maximum dissipated power method	Ï J
6.8.3	Defined arrangement method.....	Ï J
6.9	Resistance heating equipment	Ï J
6.10	Terminal insulating material tests.....	Ï €
7	Routine verifications and routine tests	Ï F
7.1	Dielectric tests	Ï F
7.2	Dielectric tests for batteries	Ï G
7.3	Inter-turn overvoltage tests	Ï G
8	Ex Component certificates	Ï G
8.1	General.....	Ï G
8.2	Terminals.....	Ï G
9	Marking and instructions.....	Ï H
9.1	General marking	Ï H
9.2	Ex Component enclosures	Ï I
9.3	Instructions for use	Ï I
9.3.1	Battery operated equipment.....	Ï I

9.3.2	Terminals	ìí
9.3.3	Luminaires.....	ìí
9.3.4	Machines.....	ìí
9.4	Warning markings.....	ìí
10	Documentation	ìí
Annex A (normative) Temperature determination of electrical machines – Methods of test and of calculation.....		
A.1	General.....	ìí
A.2	Determination of maximum service temperatures	ìí
A.2.1	Rotor temperature – normal operation	ìí
A.2.2	Winding temperature – normal operation	ìí
A.3	Determination of maximum surface temperatures.....	ìí
A.3.1	General	ìí
A.3.2	Locked rotor tests	ìí
A.4	Optional calculation of maximum surface temperature	ìJ
A.4.1	General	ìJ
A.4.2	Rotor temperature	ìJ
A.4.3	Stator temperature.....	ìJ
A.5	Determination of t_E time	ìJ
A.6	Arduous starting conditions.....	J€
A.7	Motors operated with a converter	J€
Annex B (normative) Type tests for specific forms of resistance heating devices or resistance heating units (other than trace heater)		
B.1	Resistance heating devices subjected to mechanical stresses	JF
B.2	Resistance heating devices or units intended for immersion.....	JF
B.3	Resistance heating devices or units having hygroscopic insulating material.....	JF
B.4	Verification of limiting temperature of resistance heating devices (other than trace heaters)	JF
B.4.1	General	JF
B.4.2	Safety devices	JF
B.4.3	Resistance heating unit of stabilized design.....	JG
B.4.4	Heating device with temperature self-limiting characteristic	JG
Annex C (informative) Cage motors – Thermal protection in service.....		
Annex D (informative) Resistance heating devices and units – Additional electrical protection		
D.1	Objective	Jí
D.2	Method of protection	Jí
Annex E (informative) Combinations of terminals and conductors for general purpose connection and junction boxes.....		
E.1	General.....	Jí
E.2	Maximum dissipated power method.....	Jí
E.3	Defined arrangement method.....	Jí
Annex F (normative) Dimensions of copper conductors.....		
Annex G (normative) Test procedure for T5 (only 8 W), T8, T10 and T12 lamps.....		
G.1	Asymmetric pulse test.....	Jì
G.1.1	General	Jì
G.1.2	Test procedure	Jì
G.2	Asymmetric power test.....	F€€
G.2.1	General	F€€

G.2.2	Test procedure	F€F
Annex H (normative)	Alternative separation distances for Level of Protection “ec” equipment under controlled environments.....	F€I
H.1	General.....	F€I
H.2	Specific Conditions of Use	F€I
H.3	Control of pollution access	F€I
H.4	Voltage limitation	F€I
H.5	Control of overvoltages and transient protection	F€I
H.6	Alternative separation distances	F€I
Annex I (informative)	Application, installation, and testing considerations for Level of Protection “ec” asynchronous machines.....	F€I
I.1	Surface temperature	F€I
I.2	Starting.....	F€I
I.3	Rated voltage and surface discharges	108
Annex J (informative)	Luminaires incorporating LEDs	109
J.1	LEDs for EPL Gb	109
J.2	LEDs for EPL Gc.....	109
Bibliography.....		110
Figure 1 – Determination of creepage distances and clearances		28
Figure 2 – Minimum values of the time t_E (in seconds) of motors in relation to the starting current ratio I_A/I_N		39
Figure 3 – Arrangement for the luminaire vibration test.....		73
Figure A.1 – Diagram illustrating the determination of time t_E		90
Figure E.1 – Example of defined terminal/conductor arrangement table		97
Figure G.1 – Asymmetric pulse test circuit		100
Figure G.2 – Asymmetric power detection circuit.....		102
Figure G.3 – Flow Chart – Asymmetric power Test for T8, T10, T12 and T5 (8 W lamps)		103
Table 1 – Tracking resistance of insulating materials		23
Table 2 – Minimum Creepage distances, clearances and separations		24
Table 3 – Conditions for the determination of maximum surface temperature.....		31
Table 4 – Maximum temperatures for insulated windings		32
Table 5 – Potential air gap sparking risk assessment for cage rotor ignition risk factors.....		38
Table 6 – Stator insulation system tests of Level of Protection “ec” machines		42
Table 7 – Assumed voltage of neutral points.....		43
Table 8 – Minimum distance between lamp and protective cover		45
Table 9 – Creepage distances and clearances at peak values of pulse voltages greater than 1,5 kV		46
Table 10 – Creepage distances and clearances for screw lampholder and lamp cap.....		47
Table 11 – Resistance to the effect of short-circuit currents		53
Table 12 – Types and use of cells and batteries		55
Table 13 – Explosion test mixtures		68
Table 14 – Tests for resistance to impact.....		70
Table 15 – Insertion torque and minimum removal torque		70

Table 16 – Power dissipation of cathodes of lamps supplied by electronic ballasts	72
Table 17 – Value for pull-out tests	81
Table 18 – Creepage distances and clearances for screw lamp caps	85
Table 19 – Text of warning markings.....	85
Table F.1 – Standard cross-sections of copper conductors	98
Table H.1 – Alternative separation distances for equipment under controlled environments	106

AUSTRALIAN/NEW ZEALAND STANDARD

Explosive atmospheres**Part 7:
Equipment protection by increased safety ‘e’****1 Scope**

This part of IEC 60079 specifies the requirements for the design, construction, testing and marking of electrical equipment and Ex Components with type of protection increased safety “e” intended for use in explosive gas atmospheres.

Electrical equipment and Ex Components of type of protection increased safety “e” are either:

- a) Level of Protection “eb” (EPL “Mb” or “Gb”); or
- b) Level of Protection “ec” (EPL “Gc”)

Level of Protection “eb” applies to equipment or Ex Components, including their connections, conductors, windings, lamps, and batteries; but not including semiconductors or electrolytic capacitors.

NOTE 1 The use of electronic components, such as semiconductors or electrolytic capacitors, is excluded from Level of Protection “eb” as expected malfunctions could result in excessive temperatures or arcs and sparks if the internal separation distances were not applied. It is not generally practical to maintain those separation distances and maintain the function of the electronic component.

Level of Protection “ec” applies to equipment or Ex Components, including their connections, conductors, windings, lamps, and batteries; and also including semiconductors and electrolytic capacitors.

NOTE 2 The use of electronic components, such as semiconductors or electrolytic capacitors, is permitted in Level of Protection “ec” as these are evaluated under both normal conditions and regular expected occurrences, and are not likely to result in excessive temperatures or arcs and sparks. As the requirements for separation distances are not applied to the internal construction, commercially available electronic components are generally suitable if the external separation distances comply.

The requirements of this standard apply to both Levels of Protection unless otherwise stated.

For Level of Protection “eb”, this standard applies to electrical equipment where the rated voltage does not exceed 11 kV r.m.s., a.c. or d.c.

For Level of Protection “ec”, this standard applies to electrical equipment where the rated voltage does not exceed 15 kV r.m.s., a.c. or d.c.

NOTE 3 Short circuit currents flowing through increased safety connections of mains circuits are not considered to create a significant risk of ignition of an explosive gas atmosphere due to movement of connections as a result of mechanical stresses created by the short circuit current. Normal industrial standards require that the effects of short time high currents on the security of connections be considered. The presence of the explosive gas atmosphere does not adversely affect the security of the connection.

NOTE 4 Any short term thermal excursions that occur as a result of electrical current excursions above normal rated currents, such as those that occur during the starting of motors, are not considered to create a significant risk of ignition of an explosive gas atmosphere due to the relatively short duration of the event and the convection that occurs during the event.

NOTE 5 High-voltage connections and associated wiring (above 1 kV) can be susceptible to increased partial discharge activity that could be a source of ignition. Increased spacings to earthed surfaces or other connections and provision of suitable high-voltage stress relief for the terminations are typically provided.