AS/NZS 5000.2:2006
Reconfirmed 2017

Australian/New Zealand Standard™

Electric cables—Polymeric insulated

Part 2: For working voltages up to and including 450/750 V

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-003, Electric Wires And Cables. It was approved on behalf of the Council of Standards Australia on 30 June 2006 and on behalf of the Council of Standards New Zealand on 23 June 2006.
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The following are represented on Committee EL-003:

Australasian Railway Association
Australian Electrical and Electronic Manufacturers Association
Australian Industry Group
Canterbury Manufacturers Association New Zealand
Department of Primary Industries, Mine Safety (NSW)
Electrical Contractors Association of New Zealand
Electrical Regulatory Authorities Council
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This Standard was issued in draft form for comment as DR 05495.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

RECONFIRMATION

OF
AS/NZS 5000.2:2006
Electric cables—Polymeric insulated
Part 2: For working voltages up to and including 450/750 V

RECONFIRMATION NOTICE

Technical Committee EL-003 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 10 October 2016.

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The following are represented on Technical Committee EL-003:

Australian Cable Makers' Association
Australian Industry Group
Electrical Compliance Testing Association
Electrical Regulatory Authorities Council
National Electrical and Communications Association
Queensland University of Technology

NOTES

Australian/New Zealand Standard™

Electric cables—Polymeric insulated

Part 2: For working voltages up to and including 450/750 V

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-003, Electric Wires and Cables, to supersede AS/NZS 5000.2: 1999.

The objective of this Standard is to provide construction, dimensions and tests for single-core and multicore polymeric insulated and oversheathed cables up to and including 16 mm^2 conductor size intended for use in power and lighting circuits in installations at working voltages up to and including 450/750 V.

In preparation of this Standard consideration was given to IEC 60227-4, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V,* Part 4: *Sheathed cables for fixed wiring* and acknowledgment is made of the assistance received from that source.

The nominal cross-sectional areas of the conductors specified in this Standard are based on the values recommended in IEC 60228, *Conductors of insulated cables*.

This Standard differs from the 1999 edition in the following significant ways:

(a) Class 1 conductors are not permitted for 1.5 mm^2 sizes and above.

(b) The calculated value of the oversheath thickness for circular multicore cables has been subjected to a minimum value of 1.2 mm.

(c) The option of armoured cables has been deleted.

(d) The 25 mm^2 conductor size in Tables 1 and 2 has been deleted.

(e) A requirement has been included for legibility of the cable marking.

(f) Requirements for qualification testing have been included.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

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1 SCOPE

This Standard specifies construction, dimensions and tests for single-core and up to 4-core and earth multicore polymeric insulated and oversheathed cables up to and including 16 mm^2 conductor size intended for fixed applications in power and lighting circuits in installations at working voltages up to and including 450/750 V.

Insulated unsheathed cables are not included in this Standard (refer to AS/NZS 5000.1).

This Standard does not apply to specialized polymeric insulated cables for which there are separate Australian/New Zealand Standards, e.g. flexible cords.

NOTE: Purchasing guidelines are contained in Appendix A.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS/NZS	
1125	Conductors in insulated electric cables and flexible cords
1660	Test methods for electric cables, cords and conductors
1660.1	Method 1: Conductors and metallic components
1660.2.1	Method 2.1: Insulation, extruded semi-conductive screens and non-metallic sheaths—Methods for general application
1660.2.2	Method 2.2: Insulation, extruded semi-conductive screens and non-metallic sheaths—Methods specific to elastomeric, XLPE and XLPVC materials
1660.2.3	Method 2.3: Insulation, extruded semi-conductive screens and non-metallic sheaths—Methods specific to PVC and halogen free thermoplastic materials
1660.3	Method 3: Electrical tests
1660.5.6	Method 5.6: Fire tests—Test for vertical flame propagation for a single insulated wire or cable
3000	Electrical installations
3808	Insulating and sheathing materials for electric cables
5000	Electric cables—Polymeric insulated
5000.1	Part 1: For working voltages up to and including 0.6/1 (1.2) kV

3 DEFINITIONS

For the purposes of this Standard, definitions given in the referenced Standards and those below apply.

3.1 Core (of a cable)

The conductor with its insulation but not including any protective covering.

3.2 Fixed cable

A cable which is designed to be fixed or supported in position.

3.3 Multicore cable

A cable comprising two or more cores.

3.4 Nominal value

Value by which a quantity is designated and which is often used in tables.

3.5 Qualification test report

A report of results obtained from all routine, sample and type tests.

3.6 Routine tests

Tests made by the manufacturer on each manufactured length of cable to check that each length meets the specified requirements.

3.7 Sample tests

Tests made by the manufacturer on samples of completed cable, or components taken from completed cable, adequate to verify that the finished product meets the design specification.

3.8 Shall

Indicates that a statement is mandatory.

3.9 Should

Indicates a recommendation.

3.10 Type tests

Tests made before supplying on a general commercial basis a type of cable covered by this Standard, to demonstrate satisfactory performance characteristics that meet the intended application.

3.11 Voltage designation

For cables for a.c. systems, the rated voltages U_0 and U expressed in the form of U_0/U or for cables for d.c. systems, the rated voltage U_0—

where

U_0 = the r.m.s. power frequency voltage to earth of the supply system or d.c. voltage of the supply system for which the cable is designed.

U = the r.m.s. power frequency voltage between phases of the supply system and for which the cable is designed.

4 VOLTAGE DESIGNATION

The rated voltage, U_0/U recognized for the purposes of this Standard is 450/750 V.

5 CONDUCTORS

Conductors shall consist of plain or tinned annealed copper, complying with the relevant requirements of AS/NZS 1125 including uniaxial conductors. Class 1 conductors shall not be used for sizes of 1.5 mm^2 and above. Where tinning is provided, any wires taken from the completed cable need not comply with the continuity test for tin plating specified in AS/NZS 1660.1.

Cables having solid phase conductors of 1.0 mm^2 may use solid earth conductors of the same size.

6 INSULATION

6.1 Materials

Insulation shall be V-90, V-90HT, XV-90, HFI-90-TP, X-90, X-HF-90 or X-HF-110 and shall comply with the requirements of AS/NZS 3808.

6.2 Application

The insulation shall be applied over, but shall not adhere to, the conductor.

6.3 Thickness

The average thickness of insulation for phase and neutral cores shall not be less than the nominal thickness (t_i) specified in Table 1 for V-90, V-90HT, XV-90 or HFI-90-TP or Table 2 for X-90, X-HF-90 or X-HF-110. The minimum thickness at any point for phase, neutral and earth cores shall not fall below the values specified in Tables 1 or 2, as appropriate.

6.4 Core identification

The colours green and yellow, either alone or in combination with any other colour, shall not be used except for earth cores described below.

Earth cores shall be durably coloured and meet the requirements of AS/NZS 3000. Where a combination of green and yellow is used it shall be applied such that in any 15 mm length of core one of these colours covers at least 30 % and not more than 70 % of the surface of the core, and the other colour covers the remainder of the surface. The mass of the insulation shall be either green or yellow; the other colour may be part of the mass or a surface layer only.

For other than earth cores, the colouring for identification may be within the mass or at the surface of the core insulation.

The recommended core colours are as follows:

(a) Phase cores: red, white (or uncoloured) and blue.

(b) Neutral core: black.

(c) Earth core: green/yellow.

7 CONSTRUCTION OF CABLES

7.1 General

All cables shall be oversheathed in accordance with Clause 8.

7.2 Flat cables

For multicore cables the cores shall be laid parallel in the same plane and touching.

NOTE: The position of any active or earth core is not specified in this Standard. However, normal practice in Australia is for the earth to occupy an inner position and for New Zealand an outer position. Any neutral core shall occupy an outer position.

7.3 Circular cables

7.3.1 *Lay-up of cores*

Cores, other than any centre core in circular cables, shall be laid up in helical, helical ‘SZ’, or waveform configuration.

7.3.2 *Fillers, barrier tapes and binders*

When used, fillers, barrier/binder tapes and other binders shall be compatible with the other materials of the cable with which they are in contact.

8 OVERSHEATH

8.1 Material

The oversheath material shall comply with Clause 8.1.1 or Clause 8.1.2.

8.1.1 *Single-core and flat cables*

For single-core and flat cables the oversheath shall be 3V-90, 5V-90, XVS-90, HFS-90-TP or HFS-110-TP and shall comply with the requirements of AS/NZS 3808.

8.1.2 *Multicore circular cables*

For multicore circular cables, as above in Clause 8.1.1, with the exclusion of 3V-90.

8.2 Application

The oversheath shall be applied closely over but not adhere to the underlying core or cores.

8.3 Thickness

8.3.1 *Single-core and flat cables*

The average thickness of oversheath shall be not less than the nominal thickness (t_s) specified in Table 1 or Table 2. The minimum thickness at any point shall not fall below the values specified in Table 1 or Table 2, as appropriate.

8.3.2 *Circular multicore cables*

The nominal thickness of oversheath (t_s) shall be calculated from the following equation:

$$t_s = 0.035D_p + 1.000 \text{ mm}$$

where

D_p = the fictitious diameter under the oversheath, in mm (see AS/NZS 5000.1, except that the values for insulation nominal thickness, t_i, shall be as specified in Tables 1 or 2, as applicable, within this Standard)

The calculated value of t_s shall be rounded off to one decimal place and shall be not less than 1.2 mm.

The minimum thickness at any point shall not fall below the nominal thickness (t_s) by more than 15 % of the nominal thickness plus 0.10 mm, i.e.

$$\text{minimum thickness} = (0.85t_s - 0.10 \text{ mm}).$$

TABLE 1

DIMENSIONS OF CABLES INSULATED WITH V-90, V-90HT, XV-90 OR HFI-90-TP

1	2	3	4	5	6	7	8	9
Phase and neutral cores			**Earth core**		**Oversheath**			
					Multicore flat		**Single-core**	
Nominal conductor cross-sectional area	**Nominal insulation thickness (t_i)**	**Minimum insulation thickness at any point**	**Nominal conductor cross-sectional area**	**Minimum insulation thickness at any point**	**Nominal thickness (t_s)**	**Minimum thickness at any point**	**Nominal thickness (t_s)**	**Minimum thickness at any point**
mm^2	**mm**	**mm**	**mm^2**	**mm**	**mm**	**mm**	**mm**	**mm**
1.0	0.6	0.44	1.0	0.44	0.9	0.67	0.8	0.58
1.5	0.6	0.44	1.5	0.44	0.9	0.67	0.8	0.58
2.5	0.7	0.53	2.5	0.53	1.0	0.75	0.8	0.58
4	0.8	0.62	2.5	0.53	1.1	0.84	0.9	0.67
6	0.8	0.62	2.5	0.53	1.1	0.84	0.9	0.67
10	1.0	0.80	4	0.62	1.2	0.92	0.9	0.67
16	1.0	0.80	6	0.62	1.3	1.01	1.0	0.75

NOTE: For oversheath thickness of multicore circular cables, refer to Clause 8.3.2.

TABLE 2

DIMENSIONS OF CABLES INSULATED WITH X-90, X-HF-90 OR X-HF-110

1	2	3	4	5	6	7	8	9
Phase and neutral cores			Earth core		Oversheath			
					Multicore flat		Single-core	
Nominal conductor cross-sectional area mm^2	Nominal insulation thickness (t_i) mm	Minimum insulation thickness at any point mm	Nominal conductor cross-sectional area mm^2	Minimum insulation thickness at any point mm	Nominal thickness (t_s) mm	Minimum thickness at any point mm	Nominal thickness (t_s) mm	Minimum thickness at any point mm
1.0	0.6	0.44	1.0	0.44	0.9	0.67	0.8	0.58
1.5	0.6	0.44	1.5	0.44	0.9	0.67	0.8	0.58
2.5	0.6	0.44	2.5	0.44	1.0	0.75	0.8	0.58
4	0.7	0.53	2.5	0.44	1.1	0.84	0.9	0.67
6	0.7	0.53	2.5	0.44	1.1	0.84	0.9	0.67
10	0.7	0.53	4	0.53	1.2	0.92	0.9	0.67
16	0.7	0.53	6	0.53	1.3	1.01	1.0	0.75

NOTE: For oversheath thickness of multicore circular cables, refer to Clause 8.3.2.

9 MARKING

9.1 Information to be marked

Cables shall be durably and legibly marked with the following information on the outermost surface:

(a) A registered name or registered mark, which enables the manufacturer or supplier of the cable to be identified.

(b) Year of manufacture.

(c) Designation of insulation (see Clause 6.1).

(d) 'ELECTRIC CABLE' followed by voltage rating e.g. 450/750 V.

The distance between the end of one block of marking and the beginning of the next shall not exceed 550 mm.

9.2 Legibility of marking on outer surface

The legibility of the marking shall be assessed with normal or corrected vision at an illuminance of 400-600 lux at a distance of 0.3 m.

9.3 Marking of packaging

Every packaging unit shall have the following information indicated by means of an attached tag or label or by marking directly on the unit:

(a) A registered name or registered mark, which enables the manufacturer or supplier of the cable to be identified.

(b) Voltage rating e.g. 450/750 V.

(c) The number of cores and size of the conductor(s).

(d) Designation of insulation and oversheath (see Clauses 6.1 and 8.1).

(e) The catalogue number or type number or name or other marking to distinguish the cable.

(f) Length of cable.

(g) Standard number including Part number, i.e. AS/NZS 5000.2.

10 TESTS

10.1 General

Cables shall comply with the tests specified in Table 3.

Type tests are of such a nature that, after they have been made, they need not be repeated unless changes are made in the cable materials or design which might change the performance characteristics.

10.2 Qualification test report

To supply cable on a commercial basis, the supplier shall, on request, make available a Qualification Test Report (QTR) showing compliance with all requirements of the Standard, including the tests in Table 3.

A QTR need not be prepared or submitted for each conductor size.

To qualify all cables in this Standard, qualification testing shall be conducted on the 2-core and earth construction.

A QTR covering a cable with an earth core will qualify a cable without the earth core.

A separate QTR is required for the following:

(a) Different insulation designation.

(b) Different oversheath designation.

TABLE 3

TESTS ON CABLE – PASS CRITERIA, CATEGORY AND REFERENCE

1	2	3	4	5
Test number	**Test**	**Pass criteria**	**Category of test**	**Reference for test method**
1	All tests, with the exception of conductor resistance and continuity for tin plating, on conductors taken from a completed cable	As specified in AS/NZS 1125 for the relevant conductor		
2	Conductor resistance on completed cable	As specified in AS/NZS 1125 for the relevant conductor	Sample	AS/NZS 1660.3
3	All tests on insulation taken from a completed cable	As specified in AS/NZS 3808 for the relevant insulation designation		
4	All tests on oversheath taken from a completed cable	As specified in AS/NZS 3808 for the relevant material		
5	Measurement of insulation thickness	The average, where appropriate, and minimum thicknesses shall comply with the requirements of Clause 6.3.	Sample*	AS/NZS 1660.2.1
6	Measurement of oversheath thickness	For single-core and flat cables, the average and minimum thicknesses shall comply with the requirements of Clause 8.3.1. For circular multicore cables, the minimum thickness shall comply with the requirements of Clause 8.3.2.	Sample*	AS/NZS 1660.2.1
7	High voltage a.c. test for 4 h	No breakdown	Type	AS/NZS 1660.3
8	Spark test on cores during production	No breakdown	Routine	AS/NZS 1660.3
9	High voltage test for 5 min: (a) Single-core cables		Not required	
	(b) Multicore cables	No breakdown	Sample	AS/NZS 1660.3
10	Vertical flame propagation (see Notes 1 and 2)	The distance between the lower edge of the top support and the onset of charring shall be greater than 50 mm. The charring shall not extend downwards to a point greater than 540 mm from the lower edge of the top support. During the test, any falling particles shall not ignite the filter paper underlay.	Type	AS/NZS 1660.5.6

(*continued*)

TABLE 3 (*continued*)

1	2	3	4	5
Test number	**Test**	**Pass criteria**	**Category of test**	**Reference for test method**
10	Compatibility test after ageing in an air oven for dissimilar materials which are in direct contact only Duration — 240 h Temperature — For rated insulation temperature of— (a) 90°C, test at 100 ±2°C; or (b) 110°C, test at 120 ±2°C.		Type	AS/NZS 1660.2.2 or AS/NZS 1660.2.3 as appropriate
	(1) Tensile strength, minimum, for each dissimilar material (percentage of value found in the unaged specimen)	75		
	(2) Elongation at rupture, minimum for each dissimilar material (percentage of value found in the unaged specimen)	65		

* These tests may be conducted during production or on completed cable.

NOTES:

1 *Application to assessment of fire hazard* The test provides direct data as to the likelihood of a single electric cable igniting and transmitting fire when exposed to a specified external ignition source. Fire, however, is a complex phenomenon, and fire associated with a cable run is a function of the characteristics of the cable materials, the method of installation and the environment in which it is used.

Consequently, no single test can give a full assessment of the fire hazard under all conditions of fire that may apply. There shall be a constant awareness of these interrelated factors and the effects of important variables in using this test to assess the fire hazard in any particular situation (e.g. in high vertical runs of bunches of cables). Special installation precautions may have to be taken as it cannot be assumed that a bunch of cables will behave in the same way as a single cable.

2 *Cautionary note* When reporting the results, the following cautionary note shall be added:

Individual items of this test report should not be quoted in isolation as proof of product acceptability nor applied to directly assess performance under conditions other than those envisaged by the reference specification, e.g. individual fire tests to prove an overall acceptable fire hazard level.

APPENDIX A

PURCHASING GUIDELINES

(Informative)

A1 GENERAL

Australian/New Zealand Standards are intended to include the technical requirements for relevant products, but do not purport to comprise all the necessary provisions of a contract. This Appendix contains recommendations on the information to be supplied by the purchaser at the time of enquiry or order.

A2 INFORMATION TO BE SUPPLIED BY THE PURCHASER

The purchaser should supply the following information at the time of enquiry and order:

(a) Number of this Standard, i.e. AS/NZS 5000.2.

(b) Length of cable and individual drum lengths required.

(c) Number of cores and required identification.

(d) Conductor—size, material and configuration.

(e) Insulation designation, e.g. V-90, HFI-90-TP.

(f) Type of construction, e.g. flat or circular.

(g) Oversheath designation and colour.

(h) Whether metre marking is required.

NOTES

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Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

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