

Australian/New Zealand Standard™

Electric flexible cords



AS/NZS 3191:2008

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 11 January 2008 and on behalf of the Council of Standards New Zealand on 21 December 2007.
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The following are represented on Committee EL-003:

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Australian Electrical and Electronic Manufacturers Association
Australian Industry Group
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Australian/New Zealand Standard™

Electric flexible cords

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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 3191:2003.

The objective of the Standard is to specify construction, dimensions and tests for flexible cords insulated with thermoplastic or cross-linked PVC, cross-linked elastomers or cross-linked polyolefin which, dependent on cord type, are designed for working voltages up to and including 250/250 V, 250/440 V or 0.6/1 kV.

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

Where the equivalent cords exist in IEC Standards, the dimensions for insulation and sheath thicknesses have been adopted in this Standard. This is the case for thermoplastic PVC and cross-linked elastomer insulated flexible cords, where these dimensions are identical with the values for the corresponding cords in IEC 60227, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V* and IEC 60245, *Rubber insulated cables—Rated voltages up to and including 450/750 V* respectively. The temperature ratings and hence properties of insulation and sheath materials for these dimensionally equivalent cords, however, are quite different.

There are no current equivalent IEC Standards for flexible cords insulated with cross-linked PVC or cross-linked polyolefin.

This Standard differs from the 2003 edition as follows:

- (a) Glass fibre insulated flexible cords have been deleted as they are now included in AS/NZS 3158.
- (b) Thermoplastic elastomer insulated flexible cords have been deleted.
- (c) Both duty rating and voltage designation have been provided for all constructions.
- (d) The Tables of insulation and sheathing thicknesses for the various flexible cord types have been removed from the construction Clauses and consolidated into four Tables.
- (e) The recommended neutral core colour has been changed from 'blue' to 'light blue' to align with IEC Standards.
- (f) Superfluous wording has been deleted from the Clauses covering construction requirements.
- (g) The Clauses on marking have been revised.
- (h) Cross-linked polyolefin insulation materials have been added.

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

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Australian/New Zealand Standard

Electric flexible cords

SECTION 1 SCOPE AND APPLICATION

1.1 SCOPE

This Standard specifies construction, dimensions and tests for flexible cords insulated with thermoplastic or cross-linked PVC, cross-linked elastomers, or cross-linked polyolefin which, dependent on cord type, are designed for working voltages up to and including 250/250 V, 250/440 V or 0.6/1 kV. Compliance with this Standard does not necessarily imply suitability for end use. End applications need to be considered to ensure appropriate cord selection.

NOTES:

- 1 This Standard is intended to apply only to flexible cords of the types and sizes which are included. It is not intended, however, that other types or sizes of flexible cord should be precluded from use, and regulatory authorities will consider the issue of a Certificate of Suitability for connection to the supply mains under the non-declared scheme for other types and sizes as they are developed. Any application for such certification should be accompanied by a description of the flexible cord.
- 2 Purchasing guidelines are contained in Appendix A.
- 3 The AS/NZS 3350 and AS/NZS 60335 series of appliance Standards, nominate flexible cords to IEC 60227 and IEC 60245. Appendix B will facilitate the selection of cords to this Standard, which should replace the designated IEC cords.
- 4 AS/NZS 3008.1 should be referenced to ensure correct flexible cord selection for the intended application in respect of current ratings.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS ISO

- | | |
|------|---|
| 1302 | Geometrical product specifications (GPS)—Indication of surface texture in technical product documentation |
|------|---|

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 |
| 1660.4 | Method 4: Complete cable and flexible cord |

- 1660.5.6 Method 5.6: Fire tests—Test for vertical flame propagation for a single insulated wire or cable
- 3008 Electrical installations—Selection of cables
- 3008.1 Cables for alternating voltages up to and including 0.6/1 kV (all Parts)
- 3350 Safety of household and similar electrical appliances (all Parts)
- 3808 Insulating and sheathing materials for electric cables
- 60227 Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
- 60227.5 Part 5: Flexible cables (cords)
- 60245 Rubber insulated cables—Rated voltages up to and including 450/750 V
- 60245.4 Part 4: Cords and flexible cables
- 60335 Household and similar electrical appliances (all Parts)
- IEC
- 60227 Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
- 60227-5 Part 5: Flexible cables (cords)
- 60245 Rubber insulated cables—Rated voltages up to and including 450/750 V
- 60245-4 Part 4: Cords and flexible cables
- 60332 Tests on electric and optical fibre cables under fire conditions
- 60332-1 Part 1: Test for vertical flame propagation for single vertical insulated wire or cable

1.3 DEFINITIONS

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

1.3.1 Approximate value

A value which is neither guaranteed nor checked.

1.3.2 Core

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

1.3.3 Direction of lay

The slope of the helically laid-up cores or screen wires when the cable is held vertically.

It is right hand when the slope is in the direction of the central part of the letter Z, and left hand when the slope is in the direction of the central part of the letter S.

1.3.4 Flexible cord

A flexible cable, of which no wire exceeds 0.31 mm diameter and no conductor exceeds a 4 mm² cross-sectional area, and having not more than five cores.

1.3.5 Multicore cord

A cord comprising two or more cores.

1.3.6 Pitch circle diameter

The diameter of a circle which passes through the midpoints of the laid-up cores.

1.3.7 Routine tests

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

1.3.8 Sample tests

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

1.3.9 Type tests

Tests made before supplying on a general commercial basis a type of cord covered by this Standard, to demonstrate satisfactory characteristics that meet the intended application. These tests are of such a nature that after they have been made, they need not be repeated unless changes are made in the cord materials or design which might change the performance characteristics.

1.3.10 Voltage designation

For flexible cords for a.c. systems, the rated voltages U_0 and U expressed in the form U_0/U ; or for d.c. systems, the rated voltage U_0 ,

where

- U_0 is the r.m.s. power frequency voltage to earth of the supply system or the d.c. voltage of the supply system for which the flexible cord is designed
- U is the r.m.s. power frequency voltage between phases of the supply system for which the flexible cord is designed.

1.4 VOLTAGE DESIGNATION AND DUTY RATING

The voltage designation U_0/U recognized for the purpose of this Standard is shown in the construction clause for each type of cord.

The duty rating is a guide to the physical suitability of the cords in various applications.

In this Standard the construction clauses indicate the duty rating and voltage designation as indicated below.

Duty rating	Voltage designation U_0/U
light	250/250 V
ordinary	250/440 V
heavy	0.6/1 kV

SECTION 2 CONSTRUCTION

2.1 CONDUCTORS

Conductors shall be of the type specified in the appropriate construction Clause (see Clauses 2.10.2 to 2.10.12) and shall comply with the appropriate requirements for Class 5 or Class 6 flexible conductors in AS/NZS 1125.

Except for R-S-200 insulated, the wires of the conductors shall be plain or tinned copper, but any tinned wire taken from the completed cord need not comply with the continuity test for tin plating in AS/NZS 1125.

For R-S-200 insulated, the wires of the conductor shall be tinned, silver-plated or nickel-coated copper and, when taken from the completed cord, the wires shall comply with the plating or coating test in AS/NZS 1125, as appropriate.

2.2 INSULATION

2.2.1 Material

Insulation shall comply with the requirements of one of the following materials, in accordance with AS/NZS 3808:

Material groups	Designation
Cross-linked elastomeric	R-EP-90, R-CSP-90, R-CPE-90, R-S-150, R-S-200
PVC— Thermoplastic PVC Cross-linked PVC	V-75, V-90, V-90HT XV-75, XV-90
Cross-linked polyolefin	X-90, X-90UV

NOTES:

- 1 Thermoplastic PVC insulation is subject to deformation at temperatures above 90°C. Cords insulated with V-90HT and intended to operate at temperatures above 90°C should therefore only be used with additional protection and where wiring is not exposed to mechanical stress.
Where it is possible to guard against plastic flow and where reduced insulation resistance can be tolerated, V-90HT can be operated at a temperature of 105°C for an average of 500 hours per annum.
- 2 R-EP-90, R-S-150 and R-S-200 insulated constructions are not considered to be flame retardant or oil resistant.

2.2.2 Application

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

2.2.3 Thickness

The average thickness of the insulation, determined by the method specified in AS/NZS 1660.2.1, shall be not less than the thickness (t_i) specified in Tables 2.1, 2.2, 2.3 and 2.4 and the minimum thickness at any point shall not fall below the specified thickness by more than 10% of the specified thickness plus 0.10 mm, i.e.

$$\text{minimum thickness} = (0.90t_i - 0.10 \text{ mm}).$$

TABLE 2.1
INSULATION AND SHEATH THICKNESS OF 250/250 V RATED LIGHT DUTY FLEXIBLE CORDS

1	2	3	4	5	6	7	8
Insulation thickness (t_i) mm							
Nominal conductor cross-sectional area or type mm ²	Unsheathed		Textile braided		Glass fibre braided	Sheathed	2-core flat and multicore circular light duty Cross-linked or thermoplastic PVC materials
	Single-core	2-core flat	Cross-linked elastomeric materials	Cross-linked PVC materials	R-S-150	2-core flat and multicore circular light duty Cross-linked or thermoplastic PVC materials	
	Cross-linked elastomeric materials	Thermoplastic PVC materials					
0.5	0.8	0.8	—	—	0.8	0.5	0.6
0.75	0.8	0.8	0.8	0.6	0.8	0.5	0.6
1.0	0.8	0.8	0.8	0.6	0.8	—	—
1.5	0.8	0.8	0.8	0.7	0.8	—	—
2.5	0.9	0.9	0.9	—	0.9	—	—
4	1.0	1.0	—	—	1.0	—	—
Tinsel	—	0.8	—	—	—	0.5	0.6

TABLE 2.2
INSULATION AND SHEATH THICKNESSES OF 250/440 V RATED ORDINARY DUTY UNSCREENED FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal conductor cross-sectional area mm ²	Insulation thickness (<i>t_i</i>) mm				Sheath thickness (<i>t_s</i>) Thermoplastic or cross-linked PVC materials mm					Sheath thickness (<i>t_s</i>) Cross-linked elastomeric materials mm				
	Single-core unsheathed	2-core flat sheathed	Multicore circular sheathed		2-core flat	Circular				2-core flat	Circular			
			Thermo- plastic or cross-linked PVC materials	Cross-linked elastomeric materials		2-core	3-core	4-core	5-core		2-core	3-core	4-core	5-core
0.5	0.6	0.6	—	—	0.8	—	—	—	—	0.8	—	—	—	—
0.75	0.6	0.6	0.6	0.6	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.9	1.0
1.0	0.6	—	0.6	0.6	—	0.8	0.8	0.9	0.9	—	0.9	0.9	0.9	1.0
1.5	0.7	—	0.7	0.8	—	0.8	0.9	1.0	1.1	—	1.0	1.0	1.1	1.1
2.5	0.8	—	0.8	0.9	—	1.0	1.1	1.1	1.2	—	1.1	1.1	1.2	1.3
4	0.8	—	0.8	1.0	—	1.0	1.1	1.1	1.3	—	1.2	1.2	1.3	1.4

TABLE 2.3
INSULATION AND SHEATH THICKNESSES OF 250/440 V RATED ORDINARY DUTY SCREENED FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal conductor cross-sectional area mm ²	Insulation thickness (t _i) mm	Multicore circular sheathed	Inner sheath thickness (t _s) mm						Outer sheath thickness (t _s) mm					
			Thermoplastic and cross-linked PVC materials			Cross-linked elastomeric materials			Thermoplastic and cross-linked PVC materials			Cross-linked elastomeric materials		
			2-core	3-core	4-core	2-core	3-core	4-core	2-core	3-core	4-core	2-core	3-core	4-core
			Cross-linked elastomeric materials			Thermoplastic or cross-linked PVC materials			Cross-linked elastomeric materials			Thermoplastic or cross-linked PVC materials		
0.75	0.6	0.6	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1
1.0	0.6	0.6	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2
1.5	0.7	0.8	0.8	0.9	1.0	1.0	1.0	1.1	1.0	1.1	1.1	1.2	1.2	1.2
2.5	0.8	0.9	1.0	1.1	1.1	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.2	1.3
4	0.8	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.2	1.2	1.2	1.3	1.3	1.4

TABLE 2.4
INSULATION AND SHEATH THICKNESS OF 0.6/1 kV RATED HEAVY DUTY
FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9
Nominal conductor cross-sectional area mm ²	Insulation thickness (t_i) mm			Sheath thickness (t_s) mm				
	Single-core unsheathed	Sheathed		Single-core	2-core	3-core	4-core	5-core
	Thermo- plastic PVC materials	Cross- linked polyolefin materials	Thermo- plastic PVC and Cross- linked elastomeric materials					
0.5	0.8	—	—	—	—	—	—	—
0.75	0.8	0.7	0.8	1.3	1.3	1.4	1.5	1.6
1.0	0.8	0.7	0.8	1.3	1.3	1.4	1.5	1.6
1.5	0.8	0.7	0.8	1.4	1.5	1.6	1.7	1.8
2.5	0.9	0.7	0.9	1.4	1.7	1.8	1.9	2.0
4	1.0	0.7	1.0	1.5	1.8	1.9	2.0	2.2

2.2.4 Core identification

Except as specified below for R-S-150 or R-S-200 insulation, cores intended to be used as earth conductors shall be durably coloured with a combination of green and yellow, applied so that in any 15 mm length of core, one of these colours covers not less than 30% and not more than 70% of the surface of the core, the other colour covering 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 at the surface only.

Cores insulated with R-S-150 or R-S-200 which are intended to be used as earth conductors may be durably coloured green.

For other than earth conductors and the unprotected parallel-webbed 2-core flat cords, the following colour scheme is recommended:

- (a) *Active cores* brown, black, white or grey, orange.
- (b) *Neutral core* light blue.

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

2.3 LAY-UP OF CORES

The cores of multicore cords, other than flat cords, shall be laid up in a helical or helical 'SZ' configuration.

The core sequence of the laid-up cores should be in the order specified in Clause 2.2.4, the neutral, if any, following the required number of active cores. The earth core, if any, shall always be last, following the active cores, and the neutral, if any.

2.4 FILLERS AND BINDERS

When used, fillers and binders shall be compatible with the other materials of the flexible cord with which they are in contact.

2.5 SCREENS

Screens shall comprise annealed copper wires of not less than 0.15 mm diameter applied in the form of a braid.

The electrical resistance of the screen shall not be greater than that permitted for an active conductor of the completed cord.

The number of spindles and wires per spindle shall be sufficient to ensure that the filling factor is not less than 0.45 when calculated from the following equation:

$$\text{Filling factor} = \frac{mnd_w}{2\pi D} \left(1 + \frac{\pi^2 D^2}{L^2} \right)^{1/2} \quad \dots 2.5(1)$$

where

- m = total number of spindles
- n = number of wires per spindle
- d_w = diameter of braid wire, in millimetres
- D = mean diameter of braid, in millimetres
- L = axial length or the pitch of one complete turn of a spindle of wires, in millimetres

2.6 SHEATH

2.6.1 Material

To operate the conductor at the maximum temperature appropriate for the insulation, the temperature rating of the outer and/or inner sheath may be less than that of the insulation by not more than 5°C. For cables with R-S-150 and R-S-200 insulation the maximum conductor temperature shall be limited to be not higher than 5°C above the maximum permitted for the selected sheath material.

Sheath shall comply with the requirements of one of the following materials, in accordance with AS/NZS 3808:

Material groups	Designation
Cross-linked elastomeric	GP-85-PCP, HD-85-PCP, GP-90-CSP, HD-90-CSP, GP-90-CPE, HD-90-CPE, GP-150-S
PVC—	
Thermoplastic PVC	4V-75, 5V-90, V-90HT*
Cross-linked PVC	XVS-75, XVS-90

* When used as sheath, the electrical characteristics tests and criteria do not apply.

2.6.2 Application

The sheath shall be applied over, but not adhere to the core assembly or screen, if any.

2.6.3 Thickness

The average thickness of the sheath, determined by the method specified in AS/NZS 1660.2.1, shall be not less than the thickness (t_s) specified in Tables 2.1, 2.2, 2.3 and 2.4, and the minimum thickness at any point shall not fall below the specified thickness by more than 15% of the specified thickness plus 0.10 mm, i.e.

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

2.6.4 Colour

Colouring may be within the mass or at the surface of the sheath.

2.7 NON-METALLIC BRAID

Non-metallic braid shall comprise one of the following materials, as specified in the appropriate construction clause:

- (a) For cords insulated with cross-linked elastomeric or cross-linked PVC materials, a textile yarn of cellulosic (non-melting) fibre.
- (b) For R-S-150 and R-S-200 insulated cords, a continuous filament glass fibre yarn.

Glass fibre braid shall be impregnated with a suitable varnish.

The approximate thickness of any non-metallic braid (in the case of glass fibre braided cords inclusive of the varnish coating), should be 0.2 mm.

2.8 MARKING

2.8.1 Information to be marked

Flexible cords shall be marked with the following information:

- (a) A registered name or registered mark which enables the manufacturer or supplier of the cord to be identified.
- (b) Approval mark where required by a regulatory authority.
- (c) Designation of insulation.
- (d) Designation of voltage, e.g. 250/440 V.
- (e) Designation of duty rating for multi-core sheathed cables, e.g. ORDINARY DUTY.

2.8.2 Means of marking

Means of marking shall be as follows:

- (a) Marking on outer surface

The marking shall consist of printing, reproduction in relief (embossing) or stamping (indenting). The distance between the end of one block of marking and the beginning of the next shall not exceed 550 mm.

- (b) Alternative means of marking

For cords for which the outer surface does not facilitate marking, the marking shall consist of printing on a tape which is included throughout the length of the cord or printing, reproduction in relief (embossing) or stamping (indenting) on the surface of an active core. The distance between the end of one block of marking and the beginning of the next shall not exceed 275 mm.

2.8.3 Marking of packaging

Every packaging unit shall have the following information identified 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) The rated operating voltage expressed in the form U_0/U and duty rating.
- (c) The number of cores and the size of conductors and, in the case of R-S-200 insulated cords, whether the conductor is tinned, silver-plated or nickel-coated.
- (d) Designation of insulation and sheath or other protective covering(s), if any.
- (e) The catalogue number, type number, name or other marking to distinguish the cord.
- (f) Length of cord.

2.9 TESTS

Flexible cords shall comply with Table 2.5.

TABLE 2.5

TESTS ON FLEXIBLE CORDS—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 the continuity test for plating, on conductors taken from the cord	As specified in AS/NZS 1125		
2	All tests on insulation taken from or measured on the completed cord (see Note 1)	As specified in AS/NZS 3808 for the relevant insulation designation		
3	All tests on sheath taken from or measured on the completed cord	As specified in AS/NZS 3808 for the relevant sheath designation		
4	Continuity test for plating (R-S-200 insulated cords only)	As specified in AS/NZS 1125	Sample	AS/NZS 1660.1
5	Metallic screen resistance	Compliance with Clause 2.5	Sample	AS/NZS 1660.1
6	Measurement of insulation thickness	The average and minimum thicknesses shall comply with the requirements of Clause 2.2.3	Sample	AS/NZS 1660.2.1
7	Measurement of sheath thickness	The average and minimum thicknesses shall comply with the requirements of Clause 2.6.3	Sample	AS/NZS 1660.2.1
8	Voltage test— (a) test on complete cords; (b) test on cores	No breakdown	Type	AS/NZS 1660.3
9	High voltage test for 5 min and spark test— (a) high voltage test for 5 min; (b) spark test on cores	No breakdown	Sample Routine	AS/NZS 1660.3

(continued)

TABLE 2.5 (continued)

1	2	3	4	5
Test number	Test	Pass criteria	Category of test	Reference for test method
10	Flexing test (multicore only, except cords with tinsel conductors, glass fibre braided or screened cords)	There shall be no interruption to current flow during the flexing (i.e. no broken conductors), nor shall breakdown of insulation occur during the voltage test	Type	AS/NZS 1660.4
11	Bending test (cords with tinsel conductors only)	There shall be no interruption to current flow during the bending (i.e. no broken conductors), nor shall breakdown of insulation occur during the voltage test	Type	AS/NZS 1660.4
12	Combustion propagation test (see Notes 2 and 3). Not applicable to non-metallic braided cords or R-EP-90, R-S-150 and R-S-200 insulated, unsheathed or GP-150-S sheathed cords	The cord shall be self-extinguishing. After all burning has ceased, the surface of the sample shall be wiped clean, and the charred or affected portion shall not extend to within 50 mm of the lower edge of the clamp fitted at the top. During the test, any falling particles shall not ignite the tissue paper underlay	Type	AS/NZS 1660.5.6
13	Resistance to heat of textile braid	The braid shall not show any melting or charring	Type	Appendix C
14	Compatibility test after ageing in an air oven for insulation, inner sheath (if any) and sheath Duration—240 h Temperature— For rated insulation temperature of— (a) 75°C, test at $85 \pm 2^\circ\text{C}$; or (b) 90°C, test at $100 \pm 2^\circ\text{C}$. 1) Tensile strength, minimum, for each material (percentage of value found in the unaged specimen) 2) Elongation at rupture, minimum for each material (percentage of value found in the unaged specimen)	 75 65	Type	AS/NZS 1660.2.2 or AS/NZS 1660.2.3 as appropriate

NOTES:

- 1 For the 250/250 V PVC insulated, unsheathed, parallel-webbed 2-core flat flexible cords with tinsel conductors, the insulation resistance constant (k_i) shall be not less than 10 GΩ.m at 20°C and 0.005 GΩ.m at 75°C.
- 2 *Application to assessment of fire hazard* The test provides direct data on 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 its behaviour, when 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 possible fire conditions. There must be a constant awareness of these interrelated factors and 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.
- 3 *Cautionary note* When reporting the results, the following cautionary note should 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 as envisaged by the reference specification, e.g. individual fire tests to prove an overall acceptable fire hazard level.

2.10 CONSTRUCTION

2.10.1 General

The construction of flexible cords covered by this Standard shall be as specified in Clauses 2.10.2 to 2.10.13.

The compatibility test shall be carried out only for flexible cords constructed with materials from different material groups (see Tables in Clause 2.2.1 and Clause 2.6.1).

2.10.2 Construction of 250/250 V light duty, cross-linked elastomer insulated, unsheathed single-core flexible cords

Insulation thickness shall be in accordance with Table 2.1.

NOTE: Suitable for installations only where further protected.

2.10.3 Construction of 250/250 V light duty, thermoplastic PVC insulated, unsheathed, parallel-webbed 2-core flat flexible cords

The construction requirements are as follows:

- (a) The two conductors shall be laid parallel in the same plane and insulated simultaneously, so that the cores are joined by a web which facilitates separation of the cores without damage to the insulation of either core.
- (b) Insulation thickness in accordance with Table 2.1.

2.10.4 Construction of 250/250 V light duty, cross-linked or thermoplastic PVC insulated and sheathed, 2-core flat, and 2-, 3-, 4- or 5-core circular flexible cords

The construction requirements are as follows:

- (a) Core configuration—
 - (i) 2-core flat: cores laid parallel in the same plane with the interstices optionally filled by the sheath; or
 - (ii) circular: cores laid up, and either separately filled or filled by the sheath.
- (b) Insulation and sheath thicknesses in accordance with Table 2.1.

2.10.5 Construction of 250/250 V light duty, cross-linked elastomer or cross-linked PVC insulated, textile braided 2- and 3-core flexible cords

The construction requirements are as follows:

- (a) Insulation thicknesses in accordance with Table 2.1.
- (b) Cores laid up with a length of lay not exceeding 10 times the pitch circle diameter, with the outer interstices filled with textile material.
- (c) Textile braid of cellulosic (non-melting) fibre yarn.

NOTE: These constructions are not considered to be flame retardant.

2.10.6 Construction of 250/250 V light duty, R-S-150 cross-linked elastomer insulated, glass fibre braided, single-, 2- and 3-core flexible cords

The construction requirements are as follows:

- (a) R-S-150 insulation with thickness in accordance with Table 2.1.
- (b) Cores of multicore cords, laid up with glass fibre yarn fillers.
- (c) Glass fibre yarn braid.

NOTES:

- 1 As the glass fibre yarn braided cord is more prone to mechanical damage than the textile braided cords of Clause 2.10.5, it is designed for the special high temperature applications within apparatus or fittings, where not subject to abrasion.
- 2 These constructions are not considered to be oil resistant.

2.10.7 Construction of 250/440 V ordinary duty, thermoplastic PVC insulated, unsheathed single-core flexible cords

Insulation thickness shall be in accordance with Table 2.2.

NOTE: Suitable for installations only where further protected.

2.10.8 Construction of 250/440 V ordinary duty, thermoplastic or cross-linked PVC insulated and sheathed, 2-core flat flexible cords

The construction requirements are as follows:

- (a) Cores laid parallel in the same plane with the interstices optionally filled by the sheath.
- (b) Insulation and sheath thicknesses in accordance with Table 2.2.

2.10.9 Construction of 250/440 V ordinary duty, thermoplastic or cross-linked PVC and cross-linked elastomer insulated and sheathed 2-, 3-, 4- and 5-core unscreened circular flexible cords

The construction requirements are as follows:

- (a) Cores laid up, with or without a centre filler and either separately filled or filled by the sheath.
- (b) Insulation and sheath thicknesses in accordance with Table 2.2.

2.10.10 Construction of 250/440 V ordinary duty, R-S-150 cross-linked elastomer insulated and GP-150-S sheathed 2- and 3-core circular flexible cords

Construction requirements are as follows:

- (a) Cores laid up and filled by the sheath.
- (b) Insulation and sheath thicknesses in accordance with Table 2.2.

NOTE: As the GP-150-S sheathed cord is more prone to mechanical damage than the conventional ordinary duty cords of Clause 2.10.9, it is primarily designed for the special high temperature applications not subject to mechanical damage.

2.10.11 Construction of 250/440 V ordinary duty, thermoplastic or cross-linked PVC or cross-linked elastomer insulated, sheathed, screened and overall sheathed 2-, 3- and 4-core circular flexible cords

The construction requirements are as follows:

- (a) Cores laid up, with or without a centre filler, and either separately filled or filled by the inner sheath.
- (b) Inner sheath.
- (c) Copper braided screen.
- (d) Outer sheath.
- (e) Insulation and sheath thicknesses in accordance with Table 2.3.

2.10.12 Construction of 0.6/1 kV heavy duty, thermoplastic PVC insulated, unsheathed single-core flexible cords

Insulation thickness shall be in accordance with Table 2.4.

NOTE: Suitable for installations only where further protected.

2.10.13 Construction of 0.6/1 kV heavy duty, thermoplastic PVC, cross-linked polyolefin or cross-linked elastomer insulated and sheathed, single-, 2-, 3-, 4- and 5-core circular flexible cords

The construction requirements are as follows:

- (a) For multicore constructions: cores laid up, with or without a centre filler, and either separately filled or filled by the sheath.
- (b) Insulation and sheath thicknesses in accordance with Table 2.4.

APPENDIX A
PURCHASING GUIDELINES

(Informative)

The following information should be supplied at the time of enquiry or order for flexible cords:

- (a) The number of this Australian/New Zealand Standard, i.e. AS/NZS 3191.
- (b) Length required.
- (c) Type of insulation and protective covering (if any) required.
- (d) The cross-sectional area of conductors, or whether tinsel conductors, as appropriate.
- (e) The number of cores.
- (f) The cord construction and type, e.g. whether unprotected, light duty, ordinary duty, heavy duty, flat or circular, or screened (see appropriate construction clause in Section 2).
- (g) The colour of the cores.

APPENDIX B

AS/NZS 3191 REPLACEMENT CORDS FOR IEC CORDS

(Informative)

Table B1 details the replacement flexible cords in this Standard for those covered by IEC 60227-5 and IEC 60245-4, specified in the AS/NZS 3350 or AS/NZS 60335 series of Standards for electrical appliances.

NOTE: IEC 60227-5 and IEC 60245-4 have now been adopted as AS/NZS 60227.5 and AS/NZS 60245.4 respectively.

TABLE B1
REPLACEMENT CORDS FOR IEC CORDS

IEC code designation	IEC description	AS/NZS 3191 replacement cord (See Note 1)	
		Clause	Description
60227 IEC 41 (See Note 2)	Flat tinsel cord	2.10.3	Light duty, thermoplastic PVC insulated, unsheathed, parallel-webbed, 2-core flat flexible cords, with tinsel conductors
60227 IEC 52 (See Note 3)	Light polyvinyl chloride sheathed cord	2.10.4	Light duty, thermoplastic PVC insulated and sheathed, 2-core flat, and 2- or 3-core circular flexible cords
60227 IEC 56 (See Notes 4 and 5)	Heat resistant light PVC-sheathed cord		
60227 IEC 53 (See Note 3)	Ordinary polyvinyl chloride sheathed cord	2.10.9	Ordinary duty, thermoplastic PVC insulated and sheathed, 2-, 3-, 4- and 5-core unscreened circular flexible cords
60227 IEC 57 (See Notes 4 and 5)	Heat resistant ordinary PVC-sheathed cord		
	(a) Circular types	2.10.9	Ordinary duty, thermoplastic PVC insulated and sheathed, 2-, 3-, 4- and 5-core unscreened circular flexible cords
	(b) Flat types	2.10.8	Ordinary duty, thermoplastic PVC insulated and sheathed, 2-core flat flexible cords
60245 IEC 53 (See Notes 6 & 7)	Ordinary tough rubber sheathed cord	2.10.9	Ordinary duty, cross-linked elastomer insulated and sheathed, 2-, 3-, 4- and 5-core unscreened circular flexible cords
60245 IEC 57 (See Notes 6 & 7)	Ordinary polychloroprene or other equivalent synthetic elastomer sheathed cord	2.10.9	Ordinary duty, cross-linked elastomer insulated and sheathed, 2-, 3-, 4- and 5-core unscreened circular flexible cords
60245 IEC 66 (See Notes 6 & 7)	Heavy polychloroprene or other equivalent synthetic elastomer sheathed flexible cable	2.10.13	Heavy duty, cross-linked elastomer insulated and sheathed, 2-, 3-, 4- and 5-core circular flexible cords

NOTES:

- 1 AS/NZS 3191 replacement cords are not required to be subjected to a cold bend test or cold impact test.
- 2 IEC cords are rated 70°C. AS/NZS 3191 replacement cords are rated 75°C.
- 3 IEC cords are rated 70°C. AS/NZS 3191 replacement cords are rated 75 or 90°C.
- 4 IEC cords are rated 90°C. AS/NZS 3191 replacement cords are rated 75 or 90°C.
- 5 IEC cords are required to comply with a thermal stability test.
- 6 IEC cords are rated 70°C. AS/NZS 3191 replacement cords are rated 90°C.
- 7 IEC 60245-4 cords have no defined requirements for resistance to combustion propagation. Replacement cords to AS/NZS 3191 are required to comply with AS/NZS 1660.5.6, which is equivalent to IEC 60332-1.

APPENDIX C

TEST FOR RESISTANCE TO HEAT OF TEXTILE BRAIDS

(Normative)

C1 GENERAL

The test is designed to show that the textile braid has adequate resistance to heat.

C2 APPARATUS

The following apparatus shall be used:

- (a) Electrically heated cabinet with natural airflow.
- (b) A block, made of aluminium according to Figure C1, with smooth, flat surfaces. Surface finish in accordance with AS ISO 1302; roughness class Ra 50; mass of test piece is $1000 \text{ g} \pm 50 \text{ g}$.
- (c) Steel base plate and upright, with guide rods, according to Figure C1, so designed that the aluminium block can slide between the guide rods without impediment and that any lateral tilting is avoided.
- (d) Timer; for example, stopwatch.

C3 SAMPLE

The test sample shall be a length of complete cord, approximately 300 mm long.

C4 PREPARATION

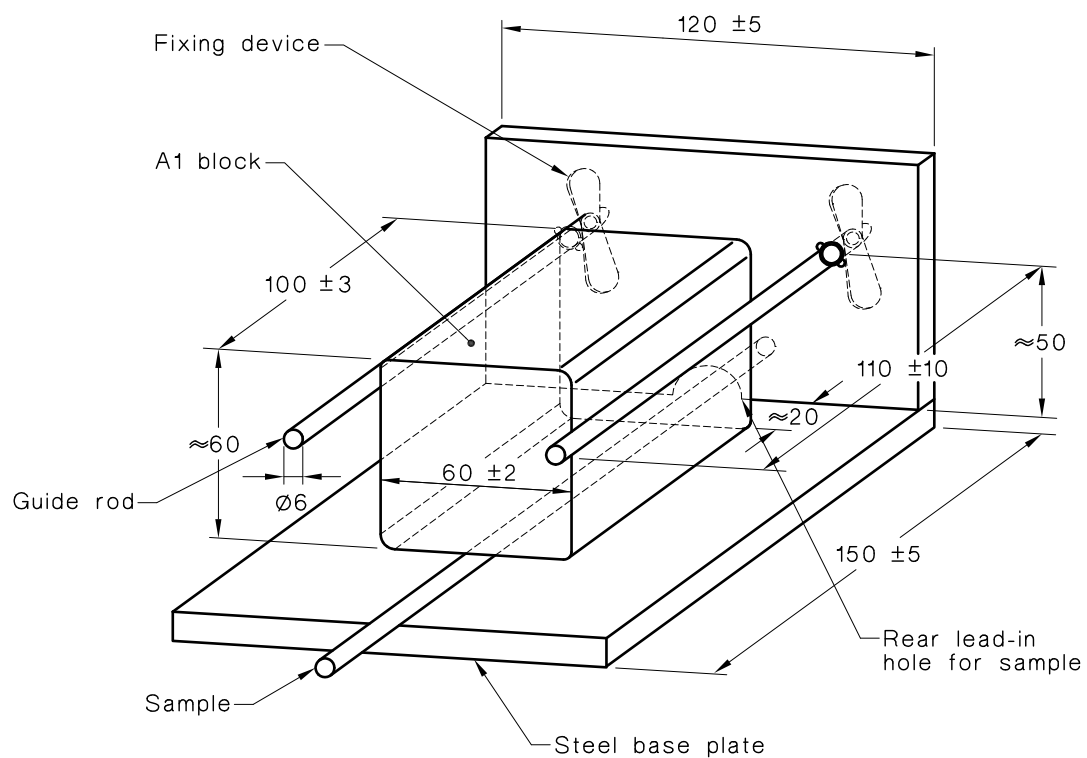
The test sample shall be straightened and arranged in the middle of the aluminium block and as closely as possible to the mean longitudinal axis of the steel base plate as shown in Figure C1, so that one end of the sample protrudes approximately 100 mm from the rear lead-in hole. The aluminium block, in accordance with C2(b), shall then be kept in the heating chamber described in Paragraph C2(a), at a temperature of $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for at least 4 h.

C5 TEST PROCEDURE

Take the aluminium block out of the cabinet and immediately place it on the sample for (60^{+3}_{-0}) s. Subsequently, the aluminium block shall be removed from the sample.

C6 CRITERIA

Criteria are given in Table 2.5.



DIMENSIONS IN MILLIMETRES

FIGURE C1 ASSEMBLED TEST APPARATUS

NOTES

NOTES

Standards Australia

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.

Standards New Zealand

The first national Standards organization was created in New Zealand in 1932. The Standards Council of New Zealand is the national authority responsible for the production of Standards. Standards New Zealand is the trading arm of the Standards Council established under the Standards Act 1988.

Australian/New Zealand Standards

Under a Memorandum of Understanding between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other 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/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

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