AS 3191—1994

Australian Standard®

Approval and test specification— Electric flexible cords

STANDARDS AUSTRALIA

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Approval and test specification—Electric flexible cords

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL/3 on Electric Wires and Cables to supersede AS 3191—1991, *Approval and test specification—Electric flexible cords*.

It specifies construction and test criteria for flexible cords insulated with PVC, crosslinked elastomers, glass fibre or thermoplastic fluoropolymers 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.

This Standard is one of a series of approval and test specifications issued by Standards Australia. The specifications are accompanied by a general specification, AS 3100, containing definitions and general requirements for electric materials and equipment. The purpose of these specifications is to outline the conditions which must be met to secure approval for the sale and use of electrical equipment in Australia. Only safety matters and conditions closely allied thereto are covered. For guidelines on purchasing flexible cords, see Appendix A.

This Standard differs from the 1991 edition as follows:

(a) The V-105 insulation in Table 1.1, while having retained the criteria, has now been redesignated as V-90 HT (i.e. a higher temperature endurance version of V-90) insulation and permits conductor operating temperature up to a maximum of 105°C for limited periods (see Note 1 to Table 1.1).

Accordingly, the V-105 insulated cables in Table 2.2 and Clause 2.10.8 have been similarly redesignated as V-90 HT insulated.

(b) Marking Clauses 2.8.1(c) and 2.8.3(e) have been extended for R-S-150 insulated and GP-90-CSP or GP-90-CPE sheathed cords. Marking for V-90 HT has been added.

(c) V-105 insulation has been deleted from Clause 2.10.10.

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.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies construction, dimensions and tests for flexible cords insulated with PVC, crosslinked elastomers, glass fibre or thermoplastic fluoropolymers 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.

NOTE: 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.

1.2 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS

1125 Conductors in insulated electric cables and flexible cords

1660 Methods of test for electric cables, cords and conductors

3000 SAA Wiring Rules

SAA

MP49 Register of colours of manufacturers' identification threads for electric cables and flexible cords

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 Flexible cord—a flexible cable, of which no wire exceeds 0.31 mm diameter and no conductor exceeds a 4 mm^2 cross-sectional area, and having not more than five cores.

1.3.4 Maximum continuous conductor temperature—the maximum temperature at which the conductor of the cord may be operated continuously, and is the temperature resulting from the combined effect of the ambient temperature and the current loading on the conductor.

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 all completed cord to demonstrate its integrity.

1.3.8 Sample tests—tests made on samples of completed cord, or components taken from completed cord, to verify that the finished product meets the design specification.

1.3.9 Special tests—tests made by the manufacturer on samples of completed cord, or components taken from a completed cord, at a specified frequency, to verify that the finished product meets the design specifications.

1.3.10 Type tests—tests required to be made by a manufacturer before supplying on a general commercial basis a type of cord covered by this Standard, to demonstrate satisfactory characteristics to 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 materials or design which might change the characteristics.

1.3.11 Voltage designation—for flexible cords for a.c. systems, the rated voltages U_o and U expressed in the form U_o/U; or for d.c systems, the rated voltage U_o,

where

U_o = 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 = the r.m.s power frequency voltage between phases of the supply system for which the flexible cord is designed.

1.4 MAXIMUM CONTINUOUS CONDUCTOR TEMPERATURE The maximum continuous conductor temperature of flexible cords shall be as specified in Table 1.1.

TABLE 1.1

MAXIMUM CONTINUOUS CONDUCTOR TEMPERATURE

Cord type	Temperature
Cords insulated with V-75	75°C
Cords insulated with R-EP-90 Cords insulated with R-CSP-90 Cords insulated with R-CPE-90 Cords insulated with V-90	90°C
Cords insulated with V-90HT	90°C (see Note 1)
Cords insulated with R-S-150 Cords insulated with glass fibre and having tinned copper conductors Cords insulated with thermoplastic fluoropolymer and having tinned copper conductors	Except where otherwise specified in Note 2 to this Table, 150°C
Cords insulated with glass fibre and having silver-plated or nickel-coated copper conductors Cords insulated with R-S-200 and having silver-plated or nickel-coated copper conductors Cords insulated with thermoplastic fluoropolymer and having silver-plated or nickel-coated copper conductors	200°C

NOTES:

1 Where it is possible to guard against plastic flow and where reduced insulation resistance can be tolerated, the V-90HT insulated, unprotected cords (see Clause 2.10.8) can be operated at temperatures above 90°C up to 105°C for an average of 500 h per annum during the cord service life.

2 The R-S-150 insulated and GP-90-CSP or GP-90-CPE sheathed cords (see Clause 2.10.3) are designed for applications where only the conductor terminations are subject to the high operating temperature necessitating the high temperature rated insulation (e.g. cords attached to some stage lighting equipment).

Cords with this combination of insulation and sheath are restricted to a maximum 90°C operation appropriate for the sheath, except that, at terminations, the conductors may operate at the higher maximum temperature specified in Table 1.1.

1.5 VOLTAGE DESIGNATION The rated voltage U_o/U recognized for the purpose of this Standard is shown in the construction clause for each type of cord.

SECTION 2 PVC OR CROSSLINKED ELASTOMER INSULATED FLEXIBLE CORDS

2.1 CONDUCTORS Conductors shall be of the type specified in the appropriate construction Clause (see Clauses 2.10.2 to 2.10.18) and shall comply with the appropriate requirements in AS 1125.

The wires of the conductors shall be—

(a) *for V-75, V-90 or V-90HT insulated*—either plain or tinned, but any tinned wire taken from the completed cord need not comply with the tinning test in AS 1125;

(b) *for R-EP-90, R-CSP-90 or R-CPE-90 insulated*—tinned but, when taken from the completed cord, the wires need not comply with the tinning test in AS 1125;

(c) *for R-S-150 insulated*—tinned and, when taken from the completed cord, the wires shall comply with the tinning test in AS 1125; and

(d) *for R-S-200 insulated*—silver-plated or nickel-coated and, when taken from the completed cord, the wires shall comply with the plating or coating test in AS 1125, as appropriate.

Tinsel conductors shall comply with the appropriate requirements in AS 1125.

2.2 INSULATION

2.2.1 Material

2.2.1.1 *Types of crosslinked elastomer insulation* Insulation shall be one of the following crosslinked materials:

R-EP-90 A compound based on ethylene propylene copolymer, terpolymer or a blend of the two, suitable for up to 90°C maximum continuous operating temperature.

R-CSP-90 A compound based on chlorosulphonated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

R-CPE-90 A compound based on chlorinated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

R-S-150 A compound based on polyorganosiloxane, suitable for up to 150°C maximum continuous operating temperature.

R-S-200 A higher temperature version of type R-S-150, suitable for up to 200°C maximum continuous operating temperature.

NOTE: Compounds other than those listed above may be given consideration, provided that the requirements for a given insulation in Table 2.1 they are designed to replace are satisfied. No thermoplastic elastomer may be considered as equivalent to any crosslinked elastomer.

2.2.1.2 *Types of PVC insulation* Insulation shall be one of the following materials:

V-75 A combination of materials, of which the characteristic constituent is the plastomer polyvinyl chloride. The same term also designates compounds containing both polyvinyl chloride and certain of its copolymers. It is suitable for up to 75°C maximum continuous operating temperature.

V-90 or V-90HT Higher temperature versions of type V-75, suitable for up to 90°C maximum continuous operating temperature (see Note 1 to Table 1.1).

2.2.2 Application The insulation shall be homogeneous, applied with a close fit, but shall not adhere to the conductor.

2.2.3 **Thickness** The average thickness of the insulation, determined by the method specified in AS 1660, shall be not less than the thickness specified in the tables of dimensions, and the minimum thickness at any point shall not fall below the specified thickness by more than 10% of the specified thickness (t_i) plus 0.1 mm:

$$0.1(t_i) + 0.1 \text{ mm}$$

TABLE 2.1

TESTS AND CRITERIA FOR CROSSLINKED ELASTOMER INSULATION

	1	2	3	4	5	6	7
	Test	**Criteria**				**Category of test**	**Reference for test method**
		R-EP-90	**R-CSP-90 R-CPE-90**	**R-S-150**	**R-S-200**		
A	Mechanical tests without ageing:					Type	AS 1660
	1 Tensile strength, min. (MPa)	4.2	7.0	5.0	5.0		
	2 Elongation at rupture, min. (%)	200	250	150	150		
B	Mechanical tests after ageing in an air oven:					Type	AS 1660
	Duration (hours)	168	240	240	240		
	Temperature (°C)	135 ±3	120 ±3	200 ±3	250 ±3		
	1 Tensile strength, min.						
	a) (% of values found in unaged specimens)	70	50	—	—		
	b) actual (MPa)	—	—	4.0	4.0		
	2 Elongation at rupture, min.						
	a) (% of values found in unaged specimens)	70	50	—	—		
	b) actual (%)	—	—	120	120		
C	Oil immersion test:					Type	AS 1660
	Duration (hours)	—	18	—	—		
	Temperature (°C)	—	120 ±3	—	—		
	1 Tensile strength, min. (% of values found in unaged specimens)	—	60	—	—		
	2 Elongation, at rupture, min. (% of values found in unaged specimens)	—	60	—	—		
D	Hot set test:					Type	AS 1660
	Duration (minutes)	15	15	15	15		
	Temperature (°C)	250 ±3	200 ±3	200 ±3	200 ±3		
	Load (kPa)	200	200	200	200		
	1 Elongation under load, max. (%)	175	175	175	175		
	2 Residual elongation after cooling, max. (%)	15	20	25	25		
E	Electrical characteristics:					Type	AS 1660
	1 Insulation resistance constant (k_i) at 20°C, min. (GΩ.m)	1 500	1	400	400		
	2 Insulation resistance constant (k_i) at 90°C, min. (GΩ.m)	1.5	0.001	0.4	0.4		

2.2.4 **Tests** All tests shall be made as given in Table 2.1 for crosslinked elastomer insulation, or in Table 2.2 for PVC insulation, as appropriate. The category of each test shall be as specified in the appropriate table. For approvals purposes all tests are applicable.

2.2.5 **Criteria** The insulation taken from, or measured on, the completed cord when subjected to the tests given in the appropriate table, shall comply with the criteria specified therein.

2.2.6 Core identification Cores intended to be used as earth conductors shall be durably coloured with a combination of green and yellow, applied such 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 a surface layer 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 schemes are recommended—

(a) when used as fixed wiring—
active cores red, white and blue
neutral core black; or

(b) when used as a supply flexible cord—
active cores brown, black, white, orange
neutral core blue.*

TABLE 2.2

TESTS AND CRITERIA FOR PVC INSULATION

1	2	3	4	5	6
Test	Criteria			Category of test	Reference for test method
	V-75	V-90	V-90HT		
A Mechanical tests without ageing:				Type	AS 1660
1 Tensile strength, min. (MPa)	12.5	12.5	12.5		
2 Elongation at rupture, min. (%)	150	150	150		
B Mechanical tests after ageing in an air oven:				Type	AS 1660
Duration (hours)	504	504	504		
Temperature (°C)	100 ±2	115 ±2	120 ±2		
1 Tensile strength, min. (% of values found in unaged specimens)	75	75	75		
2 Elongation at rupture, min. (% of values found in unaged specimens)	65	65	65		
C Loss of mass, max.: (Median loss in mg/cm² of exposed surface area of specimens)	2.0	2.0	2.0	Type	AS 1660
D Pressure test at high temperature:				Type	AS 1660
Temperature (°C)	75 ±2	90 ±2	90 ±2		
Indentation, max. (%)	50	50	50		
E Heat shock test:	No cracks			Special	AS 1660
F Electrical characteristics:				Type	AS 1660
1 Insulation resistance constant (k_i) at 20°C, min. (GΩ.m)	40†	40	40		
2 Insulation resistance constant (k_i) at elevated temperature, min. (GΩ.m)	0.02† at 75°C	0.002 at 90°C	0.002 at 90°C		

† For the 250/250 V PVC insulated, unprotected, parallel-webbed 2-core flat flexible cord 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.

* Where there is no neutral conductor, the colour blue may serve to identify any conductor other than that used for earthing.

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 configuration.

The core sequence of the laid-up cores shall be in the order specified in Clause 2.2.6, 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 Where used, fillers and binders shall be suitable non-metallic materials that are compatible with the other materials of the cord with which they are in contact, and shall be capable of maintaining their function continuously at the maximum permissible continuous conductor temperature.

2.5 SCREENS

2.5.1 Composite braid screen Composite braid screen shall comprise annealed copper wires of not less than 0.18 mm diameter, helically applied in one direction, interwoven in the opposite direction with polyethylene terephthalate or polyamide yarn, thus forming a braid.

The screen wires of the crosslinked elastomer sheathed cord shall be tinned, but any tinned wire taken from the completed cord need not comply with the tinning test in AS 1125.

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

The coverage by the copper wires shall be not less than 70% when calculated from the following equation:

$$\text{Percentage covering} = \frac{W}{m} \times 100$$

where

W = number of wires × diameter of a single wire, in millimetres

$$m = \frac{L\pi d}{\sqrt{[(\pi d)^2 - L^2]}}$$

L = axial length or pitch of one complete turn of a screen wire, in millimetres

d = pitch diameter of screen, in millimetres, taken as the nominal diameter over the underlying component plus the diameter of one wire together with an allowance for increased thickness due to opposite weave yarn.

2.5.2 All copper braid screen All copper braid screen shall comprise annealed copper wires of not less than 0.18 mm diameter applied in the form of a braid.

The screen wires of crosslinked elastomer sheathed cords shall be tinned, but any tinned wire taken from the completed cord need not comply with the tinning test in AS 1125.

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:

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

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 of the pitch of one complete turn of a spindle of wires, in millimetres

2.6 SHEATH

2.6.1 Material

2.6.1.1 *Types of crosslinked elastomer sheath* Sheath shall be one of the following crosslinked materials:

GP-90-CSP A general purpose compound based on chlorosulphonated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

HD-90-CSP A heavy duty version of the above GP-90-CSP.

GP-90-CPE A general purpose compound based on chlorinated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

HD-90-CPE A heavy duty version of the above GP-90-CPE.

GP-150-S A general purpose compound based on polyorganosiloxane, suitable for up to 150°C maximum continuous operating temperature.

NOTE: Compounds other than those listed above may be given consideration, provided that they satisfy the requirements for the sheath that they are designed to replace. No thermoplastic elastomer may be considered as equivalent to any crosslinked elastomer.

2.6.1.2 *Types of PVC sheath* Sheath shall be one of the following materials:

4V-75 A combination of materials, of which the characteristic constituent is the plastomer polyvinyl chloride. The same term also designates compounds containing both polyvinyl chloride and certain of its copolymers. It is suitable for up to 75°C maximum continuous operating temperature.

5V-90 A higher temperature version of type 4V-75, suitable for up to 90°C maximum continuous operating temperature.

2.6.2 Application The sheath shall be homogeneous and shall fit closely over, but not adhere to the core assembly or screen, if any.

2.6.3 Thickness The average thickness of the sheath (t_s), determined by the method specified in AS 1660, shall be not less than the thickness specified in the tables of dimensions, and the minimum thickness at any point shall not fall below the specified thickness by more than 15% of the specified thickness (t_s) plus 0.1 mm:

$$0.15(t_s) + 0.1 \text{ mm}.$$

2.6.4 Tests All tests shall be conducted as given in Table 2.3 for crosslinked elastomer sheaths, or in Table 2.4 for PVC sheaths, as appropriate. The category of each test shall be as specified in the appropriate table. For approvals purposes all tests are applicable.

2.6.5 Criteria The sheath taken from, or measured on, the completed cord, when subjected to the tests given in the appropriate table, shall comply with the criteria specified therein.

2.6.6 Colour Recommendations on the colour of sheath are given in the construction clauses for certain types of flexible cord. Colouring may be within the mass or at the surface of the sheath.

TABLE 2.3

TESTS AND CRITERIA FOR CROSSLINKED ELASTOMER SHEATHS

1 Test	2 Criteria GP-90-CSP GP-90-CPE	3 Criteria HD-90-CSP HD-90-CPE	4 Criteria GP-150-S	5 Category of test	6 Reference for test method
A Mechanical tests without ageing:				Type	AS 1660
1 Tensile streagth, min. (MPa)	8.5	11.0	5.0		
2 Elongation at rupture, min. (%)	250	250	150		
3 Tear resistance, min. (N/mm)	—	5.0	—		
B Mechanical tests after ageing in an air oven:				Type	AS 1660
Duration (hours)	240	240	240		
Temperature (°C)	120 ±3	120 ±3	200 ±3		
1 Tensile strength, actual, min.(MPa)	6.2	8.5	4.0		
2 Elongation at rupture, actual, min. (%)	125	125	120		
C Oil immersion test:				Type	AS 1660
Duration (hours)	28	18	--		
Temperature (°C)	120 ±3	120 ±3			
1 Tensile strength, min. (% of values found in unaged specimens)	60	60	—		
2 Elongation at rupture, min. (% of values found in unaged specimens)	60	60	—		
D Hot set test:				Type	AS 1660
Duration (minutes)	15	15	15		
Temperature (°C)	200 ±3	200 ±3	200 ±3		
Load, (kPa)	200	200	200		
1 Elongation under load, max. (%)	175	175	175		
2 Residual elongation after cooling, max. (%)	20	20	20		

2.7 NON-METALLIC BRAID

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

(a) For R-EP-90, R-CSP-90 and R-CPE-90 insulated cords, 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.

(c) For PVC insulated cords, a yarn as for Item (a) above or other suitable textile yarn (e.g. polyethylene terephthalate, polyamide).

The braid shall be closely and uniformly woven, fit snugly over the core or, in the case of multicore cords, the core assembly.

Glass fibre braid shall be impregnated with a suitable varnish, applied so that it adheres to the braid and prevents ingress of moisture. Sufficient varnish shall be applied to provide protection at the maximum cord operating temperature, and under the degree of bending likely to be experienced during installation and use, to prevent fraying of braid at terminations, and in the case of single core cords, to prevent the braid slipping along the length of the cord.

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

TABLE 2.4

TESTS AND CRITERIA FOR PVC SHEATHS

1	2	3	4	5
Test	Criteria		Category of test	Reference for test method
	4V-75	5V-90		
A Mechanical tests without ageing:			Type	AS 1660
1 Tensile strength, min. (MPa)	12.5	12.5		
2 Elongation at rupture, min. (%)	150	150		
B Mechanical tests after ageing in an air oven:			Type	AS 1660
Duration (hours)	240	504		
Temperature (°C)	110 ±2	115 ±2		
1 Tensile strength, min. (% of values found in unaged specimens)	75	75		
2 Elongation at rupture, min. (% of values found in unaged specimens)	65	65		
C Loss of mass, max.: (Median loss in mg/cm² of exposed surface area of specimens)	2.0	2.0	Type	AS 1660
D Pressure test at high temperature:			Type	AS 1660
Temperature (°C)	75 ±2	90 ±2		
Indentation, max. (%)	50	50		
E Heat shock test:	No cracks		Special	AS 1660

2.8 MARKING

2.8.1 Information to be marked Flexible cords shall be marked with the following information:

(a) Manufacturer's name, registered trade name or registered mark.

(b) Approvals mark where required by a regulatory authority.

(c) The maximum permissible continuous conductor temperature, where in excess of 75°C. In the case of R-S-150 insulated and GP-90-CSP or GP-90-CPE sheathed (see Clause 2.10.3), the legend shall be '90°C/150°C at the terminals only'. In the case of V-90HT insulated, unprotected (see Clause 2.10.8), the legend shall be '90°C HT'.

In all cases the degree symbol (°) may be omitted.

2.8.2 Means of marking Marking shall be legible and durable and in accordance with Item (a) or Item (b) or, in the case of a manufacturer's identification thread, in accordance with Item (c) as follows:

(a) *Marking on insulation or sheath* The marking shall consist of printing, reproduction in relief (embossing), or stamping (indenting) on the insulation of one or more cores or on the sheath. The distance between the end of one block of marking and the beginning of the next shall not exceed—

(i) 200 mm if the marking is on the insulation; or

(ii) 500 mm if the marking is on the sheath.

(b) *Marking on a tape* The marking shall consist of printing on a tape which is included throughout the full length of the cord. The distance between the end of one block of marking and the beginning of the next shall not exceed 200 mm.

(c) *Manufacturer's identification thread* Manufacturer's identification thread shall comprise clearly discernible and permanently coloured strands (see SAA MP49), suitably incorporated throughout the full length of the cord.

2.8.3 Marking of coils or reels Every coil or reel of flexible cord shall have the following information marked by means of an attached tag or label, or marked directly on the reel:

(a) The manufacturer's name, registered trade name, registered mark or other distinguishing mark.

(b) The rated operating voltage expressed in the form U_o/U.

(c) The number of cores and the size of conductors and, in the case of R-S-200 insulated cords, whether the conductor is silver-plated or nickel-coated.

(d) Wording to identify the type of insulation and sheath or other protective covering(s), if any.

(e) The maximum continuous conductor temperature.

In the case of R-S-150 insulated and GP-90-CSP or GP-90-CPE sheathed (see Clause 2.10.3), the marking shall include the legend '90°C/150°C at the terminals only'.

In the case of V-90HT insulated, unprotected (see Clause 2.10.8), the marking shall include the legend '90°C HT'.

(f) The catalogue number, type number, name or other marking to distinguish the cord.

(g) Length of cord.

NOTE: Manufacturers making a statement of compliance with this Australian Standard on a product, packaging or promotional material related to that product, are advised to ensure that such compliance is capable of being verified.

2.9 TESTS Flexible cords shall comply with the tests specified in Table 2.5.

For approvals purposes all tests are applicable.

2.10 CONSTRUCTION AND DIMENSIONS

2.10.1 General The construction and dimension requirements for PVC and crosslinked elastomer insulated cords shall be as specified in Clauses 2.10.2 to 2.10.18 and Tables 2.6 to 2.22 respectively.

The approximate overall dimensions do not form a mandatory part of this Standard.

NOTE: Notes on the calculation of approximate dimensions are given in Appendix B.

TABLE 2.5
TESTS ON PVC OR CROSSLINKED ELASTOMER INSULATED CORD—CRITERIA, CATEGORY AND REFERENCE

1	2	3	4	5
Test number	Test	Criteria	Category of test	Reference for test method
1	All appropriate tests, with the exception of resistance, on conductors taken from the cord	As specified in AS 1125 for the appropriate conductor except as modified in Clause 2.1		
2	All appropriate tests on insulation taken from the cord	As specified in Table 2.1 or 2.2 for the appropriate insulation		
3	All appropriate tests on sheath taken from the cord	As specified in Table 2.3 or 2.4 for the appropriate sheath		
4	Conductor examination and resistance	The conductor dimensions, form, material and resistance shall comply with the appropriate requirements in AS 1125	Sample	AS 1660
5	Metallic screen resistance	The screen resistance shall comply with the appropriate requirements of Clause 2.5	Sample	AS 1660
6	Measurement of insulation thickness	The average and minimum thicknesses shall comply with the requirements of Clause 2.2.3	Special	AS 1660
7	Measurement of sheath thickness	The average and minimum thicknesses shall comply with the requirements of Clause 2.6.3	Special	AS 1660
8	Voltage test— (a) test on complete cords; (b) test on cores	No breakdown of the insulation shall occur	Type	AS 1660
9	High voltage test for 5 min and spark test— (a) high voltage test for 5 min; (b) spark test on cores	No breakdown of the insulation shall occur	Sample Routine	AS 1660
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 1660
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 1660
12	Combustion propagating test (see Notes 1 and 2). Not applicable to non-metallic braided cords or R-S-150 and R-S-200 insulated (unprotected) 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 1660

NOTES TO TABLE 2.5:

1 *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.

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

Individual items of this test report shall 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.

2.10.2 Construction of 250/250 V crosslinked elastomer insulated, textile braided 2 and 3 core flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-EP-90, R-CSP-90 or R-CPE-90 insulation.

(c) 2 or 3 cores laid up with a length of lay not exceeding 10 times the pitch circle diameter, with the outer interstices optionally filled.

(d) Textile braid of cellulosic (non-melting) fibre yarn.

(e) Dimensions in accordance with Table 2.6.

TABLE 2.6

DIMENSIONS OF 250/250 V CROSSLINKED ELASTOMER INSULATED, TEXTILE BRAIDED 2 AND 3 CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t)	Approximate overall diameter*	
		2 core	3 core
mm^2	mm	mm	mm
0.75	0.8	6.6	7.1
1.0	0.8	6.9	7.4
1.5	0.8	7.5	8.0
2.5	0.9	8.9	9.6

* The approximate overall diameters are given for user information only and do not constitute a mandatory part of this Standard.

2.10.3 Construction of 250/440 V crosslinked elastomer insulated and sheathed ordinary duty 2, 3, 4 and 5 core circular flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-EP-90 or R-S-150 crosslinked elastomer insulation.

(c) 2, 3, 4 or 5 cores laid up, with or without a centre filler, and either separately filled or filled by the sheath.

(d) Sheath of GP-90-CSP or GP-90-CPE.

(e) Dimensions in accordance with Table 2.7.

NOTES:

1 The recommended colour of the sheath is black.

2 See Note 2 to Table 1.1.

3 For ordinary duty cords suitable for temperatures in excess of 90°C, see Clause 2.10.6.

TABLE 2.7

DIMENSIONS OF 250/440 V CROSSLINKED ELASTOMER INSULATED AND SHEATHED ORDINARY DUTY 2, 3, 4 AND 5 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10
Nominal area of conductor mm²	Average thickness of insulation (t_i) mm	Average thickness of sheath (t_s)				Approximate overall diameter*			
0.75	0.6	0.8	0.9	0.9	1.0	7.0	7.6	8.2	9.1
1.0	0.6	0.9	0.9	0.9	1.0	7.4	7.8	8.5	9.4
1.5	0.8	1.0	1.0	1.1	1.1	9.0	9.6	10.6	11.6
2.5	0.9	1.1	1.1	1.2	1.3	10.7	11.3	12.6	14.0
4.0	1.0	1.2	1.2	1.3	1.4	12.4	13.2	14.6	15.9

* See footnote to Table 2.6.

2.10.4 Construction of 250/250 V crosslinked elastomer insulated, unprotected single core flexible cords The construction requirements are as follows:

(a) (i) For other than R-S-200 insulated—
bunched, tinned, annealed copper conductor; or

(ii) For R-S-200 insulated—
bunched, silver-plated or nickel-coated, annealed copper conductor.

(b) R-EP-90, R-CSP-90, R-CPE-90, R-S-150 or R-S-200 insulation.

(c) Dimensions in accordance with Table 2.8.

NOTE: Suitable for installations only where further protected.

TABLE 2.8

DIMENSIONS OF 250/250 V CROSSLINKED ELASTOMER INSULATED, UNPROTECTED SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (*t*)	Approximate overall diameter*
mm²	mm	mm
0.5	0.8	2.9
0.75	0.8	3.2
1.0	0.8	3.3
1.5	0.8	3.6
2.5	0.9	4.4
4.0	1.0	5.1

* See footnote to Table 2.6.

2.10.5 Construction of 250/440 V crosslinked elastomer insulated, sheathed, screened and overall sheathed 2, 3 and 4 core circular flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-EP-90 insulation.

(c) 2, 3 or 4 cores laid up, with or without a centre filler and either separately filled or filled by the sheath.

(d) Sheath of GP-90-CSP or GP-90-CPE.

(e) Composite or all copper braided screen.

(f) Overall sheath of HD-90-CSP or HD-90-CPE.

(g) Dimensions in accordance with Table 2.9.

NOTE: The recommended colour of overall sheath is black.

TABLE 2.9

DIMENSIONS OF 250/440 V CROSSLINKED ELASTOMER INSULATED, SHEATHED, SCREENED AND OVERALL SHEATHED 2, 3 AND 4 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal area of conductor	Average thickness of insulation (t_i)	Average thickness of inner sheath (t_2)			Average thickness of outer sheath (t_o)			Approximate overall diameter*					
								All copper screen			Composite screen		
mm²	mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm
0.75	0.6	0.8	0.9	0.9	1.1	1.1	1.1	10.3	10.9	11.5	9.9	10.5	11.1
1.0	0.6	0.9	0.9	0.9	1.1	1.1	1.2	10.7	11.1	12.1	10.3	10.7	11.6
1.5	0.8	1.0	1.0	1.1	1.2	1.2	1.2	12.6	13.1	14.1	12.2	12.7	13.7
2.5	0.9	1.1	1.1	1.2	1.2	1.3	1.3	14.2	15.1	16.3	13.9	14.8	16.0
4.0	1.0	1.2	1.2	1.3	1.3	1.3	1.4	16.1	16.8	18.5	15.9	16.6	18.3

* See footnote to Table 2.6.

2.10.6 Construction of 250/440 V R-S-150 crosslinked elastomer insulated and GP-150-S sheathed ordinary duty 2 and 3 core circular flexible cords Construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-S-150 insulation.

(c) 2 or 3 cores laid up and either separately filled or filled by the sheath.

(d) Sheath of GP-150-S.

(e) Dimensions in accordance with Table 2.10.

NOTES:

1 The recommended colour of the sheath is white.

2 As the GP-150-S sheathed cord is more prone to mechanical damage than the conventional ordinary duty cords of Clause 2.10.3, its use is primarily designed for the special high temperature applications not subject to mechanical damage (see also AS 3000).

TABLE 2.10

DIMENSIONS OF 250/440 V R-S-150 CROSSLINKED ELASTOMER INSULATED AND GP-150-S SHEATHED ORDINARY DUTY 2 AND 3 CORE CIRCULAR FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)		Approximate overall diameter*	
		2 core	3 core	2 core	3 core
mm²	mm	mm	mm	mm	mm
0.75	0.6	0.8	0.8	7.0	7.6
1.0	0.6	0.9	0.9	7.4	7.8
1.5	0.8	1.0	1.0	9.0	9.6
2.5	0.9	1.1	1.1	10.7	11.3

* See footnote to Table 2.6.

2.10.7 Construction of 250/250 V R-S-150 crosslinked elastomer insulated, glass fibre braided, single, 2 and 3 core flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-S-150 insulation.

(c) In the case of multicore cords—
2 or 3 cores laid up with glass fibre yarn fillers.

(d) Glass fibre yarn braid.

(e) Dimensions in accordance with Table 2.11.

NOTE: As the glass fibre yarn braided cord is more prone to mechanical damage than the textile braided cords of Clause 2.10.2, its use is designed for the special high temperature applications within apparatus or fittings, where not subject to abrasion.

TABLE 2.11

DIMENSIONS OF 250/250 V R-S-150 CROSSLINKED ELASTOMER INSULATED, GLASS FIBRE BRAIDED, SINGLE, 2 AND 3 CORE FLEXIBLE CORDS

Nominal area of conductor mm²	Average thickness of insulation (r) mm	Approximate overall diameter*		
		Single core mm	2 core mm	3 core mm
0.5	0.8	3.4	6.0	—
0.75	0.8	3.7	6.6	7.1
1.0	0.8	3.8	6.9	7.4
1.5	0.8	4.1	7.5	8.0
2.5	0.9	4.9	8.9	9.6
4.0	1.0	5.6	10.4	11.1

* See footnote to Table 2.6.

2.10.8 Construction of 250/440 V ordinary duty or 0.6/1 kV heavy duty PVC insulated, unprotected single core flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75, V-90 or V-90HT insulation.*

(c) Dimensions in accordance with Table 2.12.1 or 2.12.2, as appropriate.

NOTE: Suitable for installations only where further protected.

TABLE 2.12.1

DIMENSIONS OF 250/440 V ORDINARY DUTY PVC INSULATED, UNPROTECTED SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t_i)	Approximate overall diameter†
mm²	mm	mm
0.5	0.6	2.5
0.75	0.6	2.8
1.0	0.6	2.9
1.5	0.7	3.4
2.5	0.8	4.2
4.0	0.8	4.7

† See footnote to Table 2.6.

TABLE 2.12.2

DIMENSIONS OF 0.6/1 kV HEAVY DUTY PVC INSULATED, UNPROTECTED SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t_i)	Approximate overall diameter†
mm²	mm	mm
0.5	0.8	2.9
0.75	0.8	3.2
1.0	0.8	3.3
1.5	0.8	3.6
2.5	0.9	4.4
4.0	1.0	5.1

† See footnote to Table 2.6.

* PVC insulation is subject to thermal 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 for wiring not exposed to mechanical stress. See Note 1 to Table 1.1.

2.10.9 Construction of 250/250 V PVC insulated, unprotected, parallel-webbed 2 core flat flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper or tinsel conductor, as appropriate.

(b) Insulation—

(i) for cords with conductors other than tinsel: V-75 or V-90; or

(ii) for cords with tinsel conductors: V-75.

(c) Dimensions in accordance with Table 2.13.

In either of Items (i) or (ii) 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.

TABLE 2.13

DIMENSIONS OF 250/250 V PVC INSULATED, UNPROTECTED, PARALLEL-WEBBED 2 CORE FLAT FLEXIBLE CORDS

Nominal area or type of conductor mm²	Average thickness of insulation (t_i) mm	Approximate overall dimensions* mm
0.5	0.8	3.0 × 5.7
0.75	0.8	3.3 × 6.3
1.0	0.8	3.4 × 6.5
1.5	0.8	3.8 × 7.2
2.5	0.9	4.5 × 8.6
4.0	1.0	5.3 × 10.1
Tinsel	0.8	3.2 × 6.1

* The approximate overall dimensions are given for user information only, and do not constitute a mandatory part of this Standard.

2.10.10 Construction of 250/440 V PVC insulated and sheathed, ordinary duty 2, 3, 4 and 5 core circular flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 or V-90 insulation.

(c) 2, 3, 4 or 5 cores laid up, with or without a centre filler and either separately filled or filled by the sheath.

(d) Sheath of—

(i) 4V-75 for V-75 insulation; or

(ii) 5V-90 for V-90 insulation.

(e) Dimensions in accordance with Table 2.14.

NOTE: The recommended colour of the sheath is grey.

TABLE 2.14

DIMENSIONS OF 250/440 V PVC INSULATED AND SHEATHED, ORDINARY DUTY 2, 3, 4 AND 5 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10
Nomiual area of conductor core	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)				Approximate overall diameter*			
mm²	mm	2 core mm	3 core mm	4 core mm	5 core mm	2 core mm	3 core mm	4 core mm	5 core mm
0.75	0.6	0.8	0.8	0.8	0.9	7.0	7.4	8.0	8.9
1.0	0.6	0.8	0.8	0.9	0.9	7.2	7.6	8.5	9.2
1.5	0.7	0.8	0.9	1.0	1.1	8.2	8.9	10.0	11.0
2.5	0.8	1.0	1.1	1.1	1.2	10.1	10.9	11.9	13.2
4.0	0.8	1.0	1.1	1.1	1.3	11.1	12.1	13.2	14.5

* See footnote to Table 2.6.

2.10.11 Construction of 250/440 V PVC insulated and sheathed, ordinary duty 2 core flat flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 insulation.

(c) 2 cores laid parallel in the same plane, touching, the interstices optionally filled by the sheath in Item (d) below.

(d) 4V-75 sheath.

(e) Dimensions in accordance with Table 2.15.

NOTE: The recommended colour of the sheath is grey.

TABLE 2.15

DIMENSIONS OF 250/440 V PVC INSULATED AND SHEATHED, ORDINARY DUTY 2 CORE FLAT FLEXIBLE CORDS

Nominal area of conductor mm²	Average thickness of insulation (t_i) mm	Average thickness of sheath (t_s) mm	Approximately overall dimensions* mm
0.5	0.6	0.8	4.2 × 6.3
0.75	0.6	0.8	4.6 × 7.0

* See footnote to Table 2.13.

2.10.12 Construction of 250/250 V PVC insulated and sheathed, light duty 2 core flat, and 2 or 3 core circular flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper or tinsel conductor, as appropriate.

(b) V-75 insulation

(c) Core configuration—

(i) 2 core flat: 2 cores laid parallel in the same plane, touching, the interstices optionally filled by the sheath in Item (d); or

(ii) 2 or 3 core circular: 2 or 3 cores laid up, and either separately filled or filled by the sheath.

(d) 4V-75 sheath.

(e) Dimensions in accordance with Table 2.16.

NOTE: The recommended colour of the sheath is grey.

TABLE 2.16

DIMENSIONS OF 250/250 V PVC INSULATED AND SHEATHED, LIGHT DUTY 2 CORE FLAT, AND 2 OR 3 CORE CIRCULAR FLEXIBLE CORDS

Nominal area or type of conductor	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)	Approximate overall dimensions*	
mm²	mm	mm	mm	
0.5	0.5	0.6	2 core circular	5.5
			2 core flat	3.6 × 5.5
0.75	0.5	0.6	2 core circular	6.1
			3 core circular	6.5
			2 core flat	3.9 × 6.1
Tinsel	0.5	0.6	2 core flat	3.8 × 5.9

* See footnotes to Tables 2.6 and 2.13, for circular and flat cords respectively.

2.10.13 Construction of 250/250 V PVC insulated, textile braided 2 and 3 cor flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 or V-90 insulation.

(c) 2 or 3 cores laid up, with the outer interstices optionally filled.

(d) Textile braid of fibre yarn (not glass).

(e) Dimensions in accordance with Table 2.17.

TABLE 2.17

DIMENSIONS OF 250/250 V PVC INSULATED, TEXTILE BRAIDED 2 AND 3 CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (*t*)	Approximate overall diameter*	
		2 core	3 core
mm^2	mm	mm	mm
0.75	0.6	5.8	6.2
1.0	0.6	6.0	6.4
1.5	0.7	7.1	7.6

* See footnote to Table 2.6.

2.10.14 Construction of 250/440 V PVC insulated, sheathed, screened and overall sheathed 2, 3 and 4 core circular flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 or V-90 insulation.

(c) 2, 3 or 4 cores laid up, with or without a centre filler and either separately filled or filled by the sheath.

(d) Sheath of—

(i) 4V-75 for V-75 insulation; or

(ii) 5V-90 for V-90 insulation.

(e) Composite or all copper braided screen.

(f) Overall sheath of—

(i) 4V-75 for V-75 insulation; or

(ii) 5V-90 for V-90 insulation.

(g) Dimensions in accordance with Table 2.18.

NOTE: The recommended colour of the overall sheath is black.

TABLE 2.18

DIMENSIONS OF 250/440 V PVC INSULATED, SHEATHED, SCREENED AND OVERALL SHEATHED 2, 3 AND 4 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal area of conductor	Average thickness of insulation (t_i)	Average thickness of inner sheath (t_s)			Average thickness of outer sheath (t_s)			Approximate overall diameter*					
								All copper screen			Composite screen		
mm²	mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm	2 core mm	3 core mm	4 core mm
0.75	0.6	0.8	0.8	0.8	1.0	1.0	1.0	10.1	10.5	11.1	9.7	10.1	10.7
1.0	0.6	0.8	0.8	0.9	1.0	1.0	1.1	10.3	10.7	11.8	9.9	10.3	11.4
1.5	0.7	0.8	0.9	1.0	1.0	1.1	1.1	11.3	12.3	13.3	10.9	11.8	12.9
2.5	0.8	1.0	1.1	1.1	1.1	1.1	1.2	13.4	14.2	15.5	13.1	13.9	15.2
4.0	0.8	1.0	1.1	1.1	1.2	1.2	1.2	14.7	15.6	16.7	14.4	15.4	16.5

* See footnote to Table 2.6.

2.10.15 Construction of 0.6/1 kV crosslinked elastomer insulated and sheathed, heavy duty single core flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-EP-90, R-CSP-90 or R-CPE-90 insulation.

(c) Sheath of HD-90-CSP or HD-90-CPE.

(d) Dimensions in accordance with Table 2.19.

NOTE: The recommended colour of the sheath is black.

TABLE 2.19

DIMENSIONS OF 0.6/1 kV CROSSLINKED ELASTOMER INSULATED AND SHEATHED, HEAVY DUTY SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)	Approximate overall diameter*
mm²	mm	mm	mm
0.75	0.8	1.3	5.9
1.0	0.8	1.3	6.0
1.5	0.8	1.4	6.5
2.5	0.9	1.4	7.3
4.0	1.0	1.5	8.2

* See footnote to Table 2.6.

2.10.16 Construction of 0.6/1 kV PVC insulated and sheathed, heavy duty single core flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 or V-90 insulation.

(c) Sheath of--

(i) 4V-75 for V-75 insulation; or

(ii) 5V-90 for V-90 insulation.

(d) Dimensions in accordance with Table 2.20.

NOTE: The recommended colour of the sheath is grey or black.

TABLE 2.20

DIMENSIONS OF 0.6/1 kV PVC INSULATED AND SHEATHED, HEAVY DUTY SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation(t_i)	Average thickness of sheath(t_s)	Approximate overall diameter*
mm^2	mm	mm	mm
0.75	0.8	1.3	5.9
1.0	0.8	1.3	6.0
1.5	0.8	1.4	6.5
2.5	0.9	1.4	7.3
4.0	1.0	1.5	8.2

* See footnote to Table 2.6.

2.10.17 Construction of 0.6/1 kV crosslinked elastomer insulated and sheathed, heavy duty 2, 3, 4 and 5 core circular flexible cords The construction requirements are as follows:

(a) Bunched, tinned, annealed copper conductor.

(b) R-EP-90, R-CSP-90 or R-CPE-90 insulation.

(c) 2, 3, 4 or 5 cores laid up, with or without a centre filler and either separately filled or filled by the sheath.

(d) Sheath of HD-90-CSP or HD-90-CPE.

(e) Dimensions in accordance with Table 2.21.

NOTE: The recommended colour of the sheath is black.

TABLE 2.21

DIMENSIONS OF 0.6/1 kV CROSSLINKED ELASTOMER INSULATED AND SHEATHED, HEAVY DUTY 2, 3, 4 AND 5 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10
Nominal area of conductor core	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)				Approximate overall diameter*			
mm²	mm	2 core mm	3 core mm	4 core mm	5 core mm	2 core mm	3 core mm	4 core mm	5 core mm
0.75	0.8	1.3	1.4	1.5	1.6	8.8	9.5	10.5	11.5
1.0	0.8	1.3	1.4	1.5	1.6	9.0	9.8	10.7	11.7
1.5	0.8	1.5	1.6	1.7	1.8	10.1	10.8	11.8	13.0
2.5	0.9	1.7	1.8	1.9	2.0	12.9	13.8	14.0	15.4
4.0	1.0	1.8	1.9	2.0	2.2	13.6	14.5	16.0	17.8

* See footnote to Table 2.6.

2.10.18 Construction of 0.6/1 kV PVC insulated and sheathed, heavy duty 2, 3, 4 and 5 core circular flexible cords The construction requirements are as follows:

(a) Bunched, plain or tinned, annealed copper conductor.

(b) V-75 or V-90 insulation.

(c) 2, 3, 4 or 5 cores laid up, with or without a centre filler, and either separately filled or filled by the sheath.

(d) Sheath of—

(i) 4V-75 for V-75 insulation; or

(ii) 5V-90 for V-90 insulation.

(e) Dimensions in accordance with Table 2.22.

NOTE: The recommended colour of the sheath is grey or black.

TABLE 2.22

DIMENSIONS OF 0.6/1 kV PVC INSULATED AND SHEATHED, HEAVY DUTY 2, 3, 4 AND 5 CORE CIRCULAR FLEXIBLE CORDS

1	2	3	4	5	6	7	8	9	10
Nominal area of conductor core	Average thickness of insulation (t_i)	Average thickness of sheath (t_s)				Approximate overall diameter*			
mm²	mm	2 core mm	3 core mm	4 core mm	5 core mm	2 core mm	3 core mm	4 core mm	5 core mm
0.75	0.6	1.3	1.4	1.5	1.6	8.8	9.5	10.5	11.5
1.0	0.8	1.3	1.4	1.5	1.6	9.0	9.8	10.7	11.7
1.5	0.8	1.5	1.6	1.7	1.8	10.1	10.9	11.8	13.0
2.5	0.9	1.7	1.8	1.9	2.0	11.9	12.8	14.0	15.4
4.0	1.0	1.8	1.9	2.0	2.2	13.6	14.5	16.0	17.8

* See footnote to Table 2.6.

SECTION 3 GLASS FIBRE INSULATED FLEXIBLE CORDS

3.1 CONDUCTORS Conductors shall be annealed copper, complying with the appropriate requirements in AS 1125. The wires of the conductors shall be as follows:

(a) For cords with a maximum operating temperature of 150°C—tinned and, when taken from the completed cord, shall comply with the tinning test in AS 1125.

(b) For cords with a maximum operating temperature of 200°C silver-plated or nickel-coated and, when taken from the completed cord, shall comply with the plating or coating test in AS 1125.

3.2 INSULATION

3.2.1 Material Insulation shall comprise continuous filament glass fibre yarn, of quality suitable for electrical use, or tape made from such yarn.

The glass insulation shall be thoroughly impregnated* with a suitable varnish (e.g. silicone).

3.2.2 Application The insulation shall be applied in the form of a closely and uniformly woven braid, helical lapping or taping, or a combination of any of these provided that, in the case of single-core unprotected or multicore cords, the outermost layer is a braid. If applied in the form of braid only, it shall comprise at least two braid layers.

The insulation shall fit closely on, but shall be capable of being easily stripped from the conductor without damage to any plating on the wires.

3.2.3 Thickness The average thickness of insulation (t_i), determined by the method specified in AS 1660, shall be not less than the thickness specified in the tables of dimensions, and the minimum thickness at any point shall not fall below the specified thickness by more than 10 percent.

3.2.4 Core identification

3.2.4.1 *Method* Cores of cords shall be clearly and durably identified by colours in accordance with Clause 3.2.4.2.

3.2.4.2 *Colours* Cores intended to be used as earth conductors shall be durably coloured green. For cores other than those intended to be used as earth conductors, the following colour scheme is recommended:

active cores	red, white, blue
neutral cores	black

3.3 LAY-UP OF CORES Cores of multicore cords shall be laid up in a helical configuration. The core sequence of the laid-up cores shall be in the order specified in Clause 3.2.4.2, the neutral (if any) following the active cores. The earth core (if any) shall always be last, following the active cores and neutral (if any).

3.4 FILLERS The outer interstices of multicore cords shall be filled with glass fibre yarn or equivalent material and shall be capable of operating continuously at the maximum permissible continuous conductor temperature.

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* A material is considered to be thoroughly impregnated when the varnish penetrates the interstices between the fibrous components sufficiently to bond the yarn and prevent fraying at terminations, and provides a surface film which adequately excludes moisture, dirt and other contaminants.

3.5 GLASS FIBRE PROTECTIVE BRAID The braid shall comprise a continuous filament glass fibre yarn. It shall be closely and uniformly woven and fit snugly over the core or, in the case of multicore cords, the core assembly.

The braid shall be impregnated with a suitable varnish, applied so that it adheres to the braid and prevents ingress of moisture. Sufficient varnish shall be applied to provide protection at the maximum cord operating temperature, and under the degree of bending likely to be experienced during installation and use, to prevent fraying of braid at terminations, and in the case of single-core cords, to prevent the braid slipping along the length of the cord.

The approximate thickness of the braid, inclusive of the varnish coating, shall be 0.2 mm.

3.6 MARKING

3.6.1 Information to be marked Flexible cords shall be marked with the manufacturer's name, registered trade name, registered mark or an identification thread.

3.6.2 Means of marking Marking shall be legible and durable and in accordance with items (a) or (b) below as appropriate:

(a) *Marking on a tape* The marking shall consist of printing on a tape which is suitably incorporated throughout the full length of the cord. The distance between the end of one block of marking and the beginning of the next shall not exceed 200 mm.

(b) *Manufacturer's identification thread* Manufacturer's identification threads shall comprise clearly and durably coloured threads (see SAA MP49), suitably incorporated throughout the full length of the cord.

3.6.3 Marking of coils or reels Every coil or reel of glass fibre insulated flexible cord shall have the following information marked by means of an attached tag or label, or marked directly on the reel as follows:

(a) The manufacturer's name, registered trade name, registered mark, or other distinguishing mark.

(b) The rated operating voltage, expressed in the form U_c/U.

(c) The number of cores and the size of conductors and, in the case of 200°C rated cords, whether the conductor is silver-plated or nickel-coated.

(d) Wording to identify the type of insulation and protective covering, if any.

(e) The maximum continuous conductor temperature.

(f) The catalogue number, type number, name or other marking to distinguish the cord.

(g) Length of cord.

3.7 TESTS Flexible cords shall comply with the tests specified in Table 3.1. For approvals purposes all tests are applicable.

3.8 CONSTRUCTION AND DIMENSIONS

3.8.1 General The construction and dimensions of glass fibre insulated flexible cords shall be as specified in Clauses 3.8.2 and 3.8.3, and Tables 3.2 and 3.3 respectively.

NOTE: Notes on the calculation of approximate diameter are given in Appendix B.

TABLE 3.1

TESTS ON GLASS FIBRE INSULATED CORD—CRITERIA, CATEGORY AND REFERENCE

1	2	3		4	5
Test number	Test	Criteria		Category of test	Reference for test method
1	All appropriate tests on conductors taken from the cord	As specified in AS 1125 for the appropriate conductor			
2	Measurement of insulation thickness	The average and minimum thickness of insulation shall comply with Clause 3.2.3		Special	AS 1660
3	Surface leakage test No. 1	The leakage resistance shall correspond to a surface resistivity not less not 1 500 MΩ/m²		Type	AS 1660
4	High voltage test No. 1	No breakdown of the insulation shall occur		Special	AS 1660
5	Insulation resistance test No. 1	The insulation resistance shall not be less than 10 MΩ.m		Special	AS 1660
6	Heat ageing test Duration of ageing	100 h		Type	AS 1660
	Temperature of ageing	Max. continuous conductor temperature, °C	Temperature of ageing, °C		
		150	165 ±3		
		200	220 ±4		
	A Dripping of varnish (1 h after commencement of ageing)	The varnish shall not drip			
	B Flexibility (at completion of ageing)	The insulation or protective braid shall not crack			
7	Surface leakage test No. 2	The leakage resistance shall correspond to a surface resistivity of not less not 1 500 MΩ/m²		Type	AS 1660
8	High voltage test No. 2	No breakdown of the insulation shall occur		Type	AS 1660
9	Insulation resistance test No. 2	The insulation resistance shall not be less than 10 MΩ.m		Type	AS 1660
10	Abrasion resistance	No breakdown when high voltage tested after the abrasion test		Type	AS 1660
11	Combustion propagation test See Notes 1 and 2 to Table 2.5	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 1660

3.8.2 Construction of 0.6/1 kV glass fibre insulated and glass braid protected single, 2 and 3 core flexible cords The construction requirements are as follows:

(a) Conductor as specified in Clause 3.1.

(b) Glass fibre insulation as specified in Clause 3.2.

(c) Core configuration—

(i) single core: glass fibre protective braid; or

(ii) multicore: 2 or 3 cores laid up with glass fibre yarn fillers, glass fibre protective braid.

(d) Dimensions in accordance with Table 3.2.

NOTE: Glass fibre insulated and protected flexible cords are suitable for installation in dry locations only, where they are not subject to continuous flexing, abrasion or other mechanical damage.

TABLE 3.2

DIMENSIONS OF 0.6/1 kV GLASS FIBRE INSULATED AND GLASS BRAID PROTECTED SINGLE, 2 AND 3 CORE FLEXIBLE CORDS

Nominal area of conductor	Average thickness of insulation (t)	Approximate overall diameter*		
		Single core	2 core	3 core
mm²	mm	mm	mm	mm
0.5	0.9	3.6	6.4	—
0.75	0.9	3.9	7.1	7.6
1.0	0.9	4.0	7.3	7.8
1.5	0.9	4.4	7.9	8.4
2.5	0.9	4.9	8.9	9.6
4.0	1.0	5.6	10.4	11.1

* See footnote to Table 2.6.

3.8.3 Construction of 0.6/1 kV glass fibre insulated, unprotected, single core flexible cords The construction requirements are as follows:

(a) Conductor as specified in Clause 3.1.

(b) Glass fibre insulation as specified in Clause 3.2.

(c) Dimensions in accordance with Table 3.3.

NOTE: Suitable for installation in dry locations only, where further protected, and where not subject to continuous flexing and abrasion.

TABLE 3.3

DIMENSIONS OF 0.6/1 kV GLASS FIBRE INSULATED, UNPROTECTED, SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor mm^2	Average thickness of insulation (t_i) mm	Approximate overall diameter* mm
0.5	0.9	3.1
0.75	0.9	3.4
1.0	0.9	3.5
1.5	0.9	3.8
2.5	0.9	4.4
4.0	1.0	5.1

* See footnote to Table 2.6.

SECTION 4 THERMOPLASTIC FLUOROPOLYMER INSULATED FLEXIBLE CORDS

4.1 CONDUCTORS Conductors shall be annealed copper, complying with the appropriate requirements in AS 1125. The wires of the conductors shall be:

(a) For cords with a maximum operating temperature of 150°C—tinned, and when taken from the completed cord, shall comply with the tinning test in AS 1125.

(b) For cords with a maximum operating temperature of 200°C—silver-plated or nickel-coated, and when taken from the completed cord, shall comply with the plating or coating test in AS 1125.

4.2 INSULATION

4.2.1 Material The insulation shall consist of a thermoplastic fluoropolymer to comply with the requirements of Table 4.1. Suitable materials include, but are not restricted to, PTFE, ETFE, FEP and ECTFE.

4.2.2 Application The insulation shall be homogeneous, applied with a close fit, but shall not adhere to the conductor.

4.2.3 Thickness The average thickness of insulation (t_i), determined by the method specified in AS 1660, shall be not less than the thickness specified in Table 4.2 and the minimum thickness at any point shall not fall below 0.13 mm.

4.2.4 Core identification Cores intended to be used as earth conductors shall be durably coloured green.

4.3 MARKING OF COILS OR REELS Every coil or reel of flexible cord shall have the following information marked by means of an attached tag or label, or marked directly on the reel:

(a) The manufacturer's name, registered trade name, registered mark or other distinguishing mark.

(b) The rated operating voltage expressed in the form U_o/U.

(c) The size of conductor and, in the case of 200°C rated cords, whether the conductor is silver-plated or nickel-coated.

(d) Wording to identify the type of insulation.

(e) The maximum continuous conductor temperature.

(f) The catalogue number, type number, name or other marking to distinguish the cord.

(g) Length of cord.

4.4 TESTS All flexible cords shall comply with the tests specified in Table 4.1. For approvals purposes, all tests are applicable.

TABLE 4.1

TESTS ON THERMOPLASTIC FLUOROPOLYMER INSULATED CORD—CRITERIA, CATEGORY AND REFERENCE

1	2	3		4	5
Test number	**Test**	**Criteria**		**Category of test**	**Reference for test method**
1	All appropriate tests on conductors taken from the cord	As specified in AS 1125 for the appropriate conductor			
2	Measurement of insulation thickness	The average and minimum thickness of insulation shall comply with Clause 4.2.3		Special	AS 1660
3	High voltage test No. 1	No breakdown of the insulation shall occur		Special	AS 1660
4	Heat ageing test Duration of ageing	100 h		Type	AS 1660 (as specified for fibrous insulation)
	A Temperature of ageing	Max. continuous conductor temperature, °C	Temperature of ageing, °C		
		150	165 ±3		
		200	220 ±4		
	B Flexibility (at completion of ageing)	The insulation shall not crack			
5	High voltage test No. 2	No breakdown of the insulation shall occur		Type	AS 1660
6	Abrasion resistance	No breakdown when high voltage tested after the abrasion test		Type	AS 1660 (as specified for fibrous insulation)
7	Combustion propagation test See Notes 1 and 2 to Table 2.5	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 1660

4.5 CONSTRUCTION AND DIMENSIONS

4.5.1 Construction of 250/250 V thermoplastic fluoropolymer insulated, unprotected single core flexible cords The construction requirements are as follows:

(a) Conductor as specified in Clause 4.1.

(b) Thermoplastic fluoropolymer insulation as specified in Clause 4.2.

(c) Dimensions in accordance with Table 4.2.

NOTE: Suitable for installation only where further protected.

TABLE 4.2

DIMENSIONS OF 250/250 V THERMOPLASTIC FLUOROPOLYMER INSULATED, UNPROTECTED, SINGLE CORE FLEXIBLE CORDS

Nominal area of conductor mm²	Average thickness of insulation (t_i) mm	Approximate overall diameter* mm
0.5	0.15	1.5
0.75	0.15	1.9
1.0	0.15	2.0
1.5	0.15	2.3
2.5	0.15	2.8
4.0	0.15	3.3

* See footnote to Table 2.6.

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 Standard, i.e. AS 3191.

(b) Length of flexible cord 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) Maximum continuous conductor temperature of cord (see Table 1.1).

(g) The cord construction and type, e.g. whether unprotected, ordinary duty, heavy duty, flat or circular (see appropriate construction clause in Section 2, 3 or 4).

(h) The colour of the cores.

(i) In the case of screened cords, whether composite braid screen or all copper braid screen is required.

APPENDIX B

NOTES ON CALCULATION OF DIMENSIONS OF FLEXIBLE CORDS

(Informative)

B1 APPROXIMATE OVERALL DIMENSIONS The approximate overall dimensions have been calculated by adding the following:

(a) The diameter of the core or core assembly (as appropriate) calculated from the diameter of the conductor, plus twice the specified thickness of insulation and, in the case of multicore cords, the total being multiplied by the appropriate lay-up factor.

(b) Twice the specified thickness of each of the protective coverings (see also Paragraph B3).

(c) The tolerance on the calculated overall diameter or dimensions of the cord, established in accordance with Paragraph B2.

B2 TOLERANCE The tolerance which has been adopted for the approximate overall dimensions was established by taking 4 percent of the sum of Items (a) and (b) of Paragraph B1 and adding 0.3 mm, rounded to one decimal place. In the case of flat cords, the tolerance on both the major and minor axes is the same as for a circular cord having a diameter equal to the major axis dimension of the flat cord.

B3 DIMENSIONAL ALLOWANCE Where tables of dimensions do not specify the thickness of a protective covering (e.g. textile braid) the following dimensional allowances have been used:

(a) For non-metallic (including varnished glass fibre yarn) braid protective covering the increase in diameter due to the covering being 0.5 mm.

(b) For all copper braid screen the increase in diameter due to the braid being 1.0 mm.

(c) For composite braid screen the increase in diameter due to the braid being 1.4 mm.

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