

## TECHNICAL INFORMATION

## CABLE TYPE DEFINITION

## Cable Type Definition According to AS/NZS 1802

Type	Description	Voltage Designation kV
<b>Cable Type Definition According to AS/NZS 1802</b>		
209	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core	from 1,1/1,1 to 11/11
210	Composite copper braid screened three-core cable with a central extensible pilot core for hand-held boring machines. Electrically symmetrical	1,1/1,1
240	Composite copper braid screened three-core cable with three interstitial pilot cores for general use in a mine such as a feeder cable or supply to a longwall face. Electrically symmetrical	from 1,1/1,1 to 11/11
241	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core, a very popular cable for general use in a mine such as pumps and power supply to a range of equipment. Electrically symmetrical	from 1,1/1,1 to 11/11
245	Semi-conductive screened three-core cable with three interstitial earth cores and three central pilot cores designed specifically for use in longwall mining systems powering shearers. Electrically symmetrical	from 1,1/1,1 to 3,3/3,3
260	Composite copper braid screened three-core cable with three interstitial pilot cores and pliable wire armour protection giving maximum mechanical strength and protection in feeder cable applications. Electrically symmetrical	from 1,1/1,1 to 11/11
275	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core, a very popular cable for use as the power supply to shuttle cars and similar reeling applications. Electrically symmetrical	1,1/1,1

## Cable Type Definition According to AS/NZS 2802

Cable Class	Type	Description	Voltage Designation kV
<b>Cable Type Definition According to AS/NZS 2802</b>			
Class 1	441	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core, popular for both trailing and reeling applications such as supply cable to draglines, drills and face shovels. Electrically symmetrical	from 3,3/3,3 to 22/22
	450	Composite copper braid screened three-core cable with two interstitial earth cores and one interstitial pilot core for use as a supply cable to mobile equipment including slow reeling applications. Electrically un-symmetrical	from 3,3/3,3 to 33/33
	451	Composite copper braid screened three-core cable with two interstitial earth cores and one reduced interstitial pilot core for use as a supply cable to large mobile equipment including slow reeling applications. Electrically un-symmetrical	
	455	Semi-conductive screened three-core cable with two interstitial earth cores and a one interstitial pilot core smaller in diameter and lighter than a Type 451 cable. Electrical un-symmetrical	from 3,3/3,3 to 11/11
Class 2	409	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core, a popular cable for use as a flexible feeder cable to mobile equipment such as draglines, drills and face shovels. Electrically symmetrical	from 1,1/1,1 to 22/22
	412	Unscreened pliable wire armoured three-core cable with three interstitial earth cores (no pilot) giving maximum mechanical strength and protection in feeder cable applications. Electrically symmetrical	1,1/1,1 only
	440	Composite copper braid screened three-core cable with three interstitial pilot cores, suitable for use with pumps or other large items of mobile equipment. Electrically symmetrical	from 1,1/1,1 to 22/22
	441	Semi-conductive screened three-core cable with three interstitial earth cores and a central extensible pilot core, popular for both trailing and reeling applications such as supply cable to small draglines, drills and face shovels. Electrically symmetrical	1,1/1,1 only

# TECHNICAL INFORMATION

## REELING & TRAILING CABLE ELECTRICAL CHARACTERISTICS

### 1. Power Core Conductor Characteristic

Nominal Cross Sectional Area	Nominal Conductor Diameter	Max. DC Resistance at 20°	Max. AC Resistance at 90°*	Nominal 3-Phase Voltage Drop*	Nominal Reactance*
mm <sup>2</sup>	mm	Ω/km	Ω/km	mV/A.m	Ω/km
1,5	1,6	14,0	17,4	30,1	0,17
2,5	2,0	8,37	10,5	18,2	0,15
6	3,5	3,39	4,33	7,5	0,14
10	4,6	2,02	2,58	4,5	0,13
16	5,7	1,24	1,57	2,7	0,12
25	7,6	0,746	0,936	1,6	0,11
35	8,8	0,547	0,675	1,2	0,10
50	10,1	0,410	0,523	0,92	0,10
70	12,1	0,271	0,346	0,62	0,097
70	12,4	0,271	0,346	0,62	0,096
95	13,3	0,212	0,270	0,50	0,095
95	14,5	0,208	0,266	0,49	0,093
120	15,4	0,164	0,209	0,40	0,092
120	16,2	0,162	0,208	0,39	0,091
150	17,2	0,129	0,166	0,33	0,091
150	18,1	0,127	0,163	0,32	0,089
185	19,3	0,106	0,137	0,28	0,089
240	23,0	0,0818	0,107	0,24	0,087
300	24,5	0,0644	0,0847	0,21	0,086

\*The AC characteristics are valid for up to 1.1/1.1kV operating voltage and can be used as a guide for higher operating voltages.

Power conductors of less than 6 sqmm nominal cross-sectional area are Class 5 flexible bunched, sizes of nominal cross-sectional area 6 sqmm or larger are multiple-stranded circular flexible (rope lay).

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### REELING & TRAILING CABLE ELECTRICAL CHARACTERISTICS

#### 1. Continuous Current Carrying Capacity

Power Conductor Nominal Area	Cable Voltage Rating			
	Protected From Sun		Exposed To Sun	
	1.1/1.1kV	3.3/3.3kV–33/33kV	1.1/1.1kV	3.3/3.3–33/33kV
mm <sup>2</sup>	A	A	A	A
1,5	23	–	18	–
2,5	30	–	23	–
6	49	–	38	–
10	66	–	51	–
16	88	89	67	66
25	120	120	90	89
35	145	145	110	105
50	170	170	125	125
70	220	220	160	155
95	250	250	185	180
120	295	295	210	220
150	340	340	245	240
185	385	385	270	265
240	455	450	315	310
300	515	510	355	350

#### 2. Current Rating Factor

Where the cable is wound on cylindrical or radial drum, the heat dispersion factor must be taken into consideration; therefore the current carrying capacity must be reduced by the derating factor:

Cylindrical Drum		Radial Drum	Ventilated	Unventilated
Number of layer on drum	Factor	Factor		
1	0,85		0,85	0,75
2	0,65			
3	0,45			
4	0,35			

Variations in ambient temperature for cable installed in air or in underground:

Ambient Temperature	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C	75°C	80°C	85°C
Conductor Temperature is 90°C	1,26	1,20	1,15	1,10	1,05	1,0	0,94	0,88	0,81	0,73	0,65	0,57	0,47	0,34	0,19

Continues Current Rating above is calculated based on the IEC60287 Standard and Australian typical environment: 40 °C air ambient temperature, 0.8 solar radian absorption coefficients and 1000W/m<sup>2</sup> and the value is for guidance only.

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## REELING & TRAILING CABLE MECHANICAL & THERMAL CHARACTERISTICS

### 1. Cable Minimum Bending Radius

Installation condition	1.1/1.1kV	3.3/3.3~33/33kV
For dispatch drum barrel	6D	8D
For fixed bend	4D	6D
For free flexing	6D	10D
For permanently repeating reeling	10D	12D
For passing over sheaves	10D	20D

For XLPE and Paper insulated HV cables, bending radii is 18D (during installation) / 12D (installed).

### 2. Cable Maximum Pulling Tension

For trailing the cable	20N/mm <sup>2</sup> of the total cross-sectional area of phase conductor
For dragging the cable	calculated by $T = L * W * f * 10$ , where T is the pulling tension, L is the length of cable to be pulled (m), W is the weight of the cable (kg/m), f is the friction coefficient (usually take as 0.5)

### 3. Temperature

Maximum continuous conductor temperature: +90°C

Minimum Ambient Temperature: -25°C

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### REELING & TRAILING CABLE MATERIAL CHARACTERISTICS

#### 1. Conductor Screen

All cables with a voltage rating of 3.3/3.3 kV and above have a cross-linked semiconductive elastomeric material extruded directly over the power core conductor through a triple extrusion process. Textile-reinforced Semiconductive tape or water barrier (water-proof) tape can be applied on special request or particular purposes.

#### 2. Insulation Screen

Semiconductive elastomer screen: The material used for insulation screen is a cross-linked semiconductive elastomeric compound which directly applied over the insulation of each power core . The maximum volume resistivity of this compound is 1 Ωm at 23 °C. Textile reinforced semiconductive tape screen: As an alternative to an elastomer screen, the textilereinforced semiconductive tape screen may be applied over the insulation of power cores of 3.3/3.3kV Type 450 & 451 (Class 1) and 3.3/3.3kV up to and including 11/11kV Type 409 & 440 (Class 2). The semiconductive tape comprises a textile fabric, coated with a semiconductive elastomer and having a continuous print on one side identifying it as being semiconductive.

#### 3. Cradle separators / Earth Covering / Screen for Core Assembly

Semiconductive elastomer used in cradle separators, the interstitial earth conductor covering (other than for Type 412) and the screen for core assembly (Types 241, 245, 275 and 441 only) is a compound based on polychloroprene (PCP) which complies with the table below.

Test (per AS/NZS1802 / AS/NZS 2802)		Specified Value
A	Mechanical tests without ageing	-
1	Tensile strength (MPa)	≥8,5
2	Elongation at rupture (percent)	≥200
3	Permanent set (percent)	≤20
B	Mechanical tests after ageing in air oven	-
1	Tensile strength (MPa)	≥6,2
2	Elongation at rupture (percent)	≥50
C	Volume resistivity at 23°C (Ω.m)	≤1,0

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### REELING & TRAILING CABLE MATERIAL CHARACTERISTICS

#### 4. Power / Pilot Core Insulation

	AS /NZS 1802 reeling and trailing cable	AS /NZS 2802 reeling and trailing cable
Power Core Insulation	R-EP-90	XR-EP-90 (for class 1 cables) R-EP-90 (for class 2 cables)
Pilot Core Insulation	R-EP-90	XR-EP-90/R-EP-90

R-EP-90: a flexible cross-linked compound based on ethylene propylene copolymer, terpolymer or a blend of the two, suitable for up to 90 °C maximum continuous operating temperature. Class 2 cables have a greater insulation radial thickness which provides a more robust cable.

XR-EP-90: a pliable cross-linked compound based on ethylene propylene copolymer (EPM), or ethylene propylene terpolymer (EPDM or EPT), having enhanced properties compares with R-EP-90, suitable for up to 90°C maximum continuous operating temperature. Class 1 cables are insulated with a high grade ethylene propylene rubber (XR-EP-90) which permits a reduced radial thickness for the insulation compared with equivalent rated

Test (per AS/NZS 1802/AS/NZS 2802)		R-EP-90		XR-EP-90
<b>A</b>	<b>Mechanical tests without ageing</b>	-		-
1	Tensile strength (MPa)	≥4,2		≥8,5
2	Elongation at rupture (percent)	≥200		≥200
<b>B</b>	<b>Mechanical tests after ageing in air oven</b>	-		-
1	Tensile strength (percentage of values found in unaged specimens)	≥70		≥75
2	Elongation at rupture (percentage of values found in unaged specimens)	≥70		≥75
<b>C</b>	<b>Hot set test</b>	-		-
1	Elongation under load (percent)	≤175		≤175
2	Residual elongation after cooling (percent)	≤15		≤15
<b>D</b>	<b>Electrical characteristics</b>	≤1,1/1,1kV	≥3,3/3,3kV	-
1	Insulation resistance constant (ki) at room temperature (GΩ.m)	≥1500	≥4000	≥4000
2	Insulation resistance constant (ki) at 90 °C (GΩ.m)	≥1,5	≥4,0	≥4,0

#### 5. Metallic Composite Screen

Composite screen for Type 409 and 440 consists of tinned annealed copper strands interwoven with polyester yarn each strand consists of seven copper wires with nominal diameter between 0.25 and 0.50 mm. Composite screens for Type 450 and 451 consists of a flat ribbon of tinned annealed copper wires laid flat and parallel interwoven with polyester yarn, each group of wires having a nominal diameter between 0.25 and 0.50 mm.

#### 6. Pliable Steel Strand Armour

Pliable armour comprises galvanized low carbon (mild) steel strands, each strand consist of seven wires applied helically over the inner sheath to provide close cover and enhanced mechanical protection. The wires comply with the requirements of AS/NZS 3863.

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### REELING & TRAILING CABLE MATERIAL CHARACTERISTICS

#### 7. Sheath

Inner sheath (Type 206 and 412 only): GP-85-PCP (Standard), GP-90-CSP or GP-90-CPE to AS/NZS 3803.

Outer sheath:

AS1802 reeling and trailing cable	HD-85-CSP, HD-90-PCP or HD-90-CPE to AS/NZS 3808
AS2802 reeling and trailing cable	HD-85-CSP, HD-90-PCP or HD-90-CPE to AS/NZS 3808 (for class 2 cable); XHD-85-CSP, XHD-90-PCP or XHD-90-CPE to AS/NZS 3808 (for class 1 cable)

GP-85-PCP: General purpose cross-linked compound based on Polychloroprene, suitable for up to 85°C maximum continuous operating temperature.

GP-90-CSP: General purpose cross-linked compound based on chlorinated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

GP-90-CPE: General purpose cross-linked compound based on Chlorosulphonated polyethylene, suitable for up to 90°C maximum continuous operating temperature.

HD-85-PCP, HD-90-CSP or HD-90-CPE is the heavy duty version of GP-85-PCP, GP-90-CSP or GP-90-CPE, and XHD is the extra-heavy duty version, the characteristic of which are as follows:

Test (except for D and E, per AS/NZS 1802/AS/NZS 2802)		GP-85-PCP	HD-85-PCP	XHD-85-PCP
<b>A</b>	<b>Mechanical tests without ageing</b>	-	-	-
1	Tensile strength (MPa)	≥8,5	≥11	≥12,5
2	Elongation at rupture (percent)	≥250	≥250	≥300
3	Tear resistance (N/mm)	-	≥5	≥7
<b>B</b>	<b>Mechanical tests after ageing in air oven</b>	-	-	-
1	Tensile strength (MPa)	≥6,2	≥8,5	≥8,5
2	Elongation at rupture (percent)	≥125	≥125	≥150
<b>C</b>	<b>Oil immersion test</b>	-	-	-
1	Tensile strength (percentage of values found in unaged specimens)	≥60	≥60	≥60
2	Elongation at rupture (percentage of values found in unaged specimens)	≥60	≥60	≥60
<b>D</b>	<b>Hot set test at 200±3 °C, 200kPa for 15mins</b>	-	-	-
1	Elongation under load, maximum (percent)	≤175	≤175	≤175
2	Elongation after cooling, maximum (percent)	≤20	≤20	≤20