

INTRODUCTION :

Rubber was the first insulant to be used in Electric Cable manufacture but gave way to other insulants like paper, PVC, XLPE etc.

Rubber is still considered the preferred insulation for flexible cables and cables where very small bending diameter is desired.

Copper / Aluminium Conductors are both used generally in rubber cables. Annealed tinned flexible conductor (class-5) is predominantly used in rubber cables. However Cables with class 1 and class 2 conductor with either Copper or Aluminium can be supplied on request.

Initially natural rubber was used as both insulation and sheathing material, but nowadays many synthetic materials are available for insulation and sheathing. The details are as given below :

Type Designation	Basic Rubber	Max. Cond. Temp. For Continuous Operation °C	Max Cond. Temp for Shortckt. Operation °C	Remarks
<u>Insulation</u>				
IE 1	Natural Rubber	60	200	Low Voltage
IE 2	EPDM	90	250	Low Voltage
IE 3	EPDM	90	250	High Voltage
IE 4	PCP/CSP	90	250	Oil/Fire Retardant
IE 5	Silicon	150 (180 as per VDE)	350	High Temp.
<u>Sheath</u>				
SE 1	Natural Rubber / SBR	60	200	Normal Duty
SE 2	Natural Rubber / SBR	60	200	Heavy Duty
SE 3	NBRPVC/ PCP/CSP	90	250	HR, oil /flame retardant, Normal duty.
SE 4	NBRPVC/ PCP/CSP	90	250	HR, oil /flame retardant, Heavy duty.

Specific types are indicated subsequently.



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The following cable types are covered in details:

1. Railway Cables (TROPOFLEX)

- As per RDSO specification
- As per CLW specification
- As per DLW specification

2. Ship wiring cables (TROPOFLEX & TROPOLAST)

3. Welding cables (TROPOFLEX)

4. Heat resistant Silicon Elastomeric cables (TROPOTHERM)

5. Mining Cables (TROPOFLEX)

- Coal Cutting and Drilling Cables
- Pliable Armoured Trailing Cables

6. Material Handling Cables (TROPOFLEX)

- Reeling/ Unreeling Trailing Cables & Lift Control Cables
- SShoeu Type cables

7. General Purpose Cables for industrial/domestic usage (TROPOFLEX)

8. Special Cables (TROPOFLEX)

- a) Fire survival cables
- b) Low Smoke, Zero Halogen, Low Toxic Limited Fire Survival Cable.

Railway Cables

Cable Type : R, RR
As per RDSO : E-14/01 (Part-I)

Application : These cables are used on electrical locos, diesel electric locos, diesel hydraulic locos, diesel rail cars, battery locomotives and electrical multiple units.

Construction : Covers 1,3,13,19 & 27 core copper flexible cables.

Construction of single core cable shall be :

- Tinned annealed copper conductor,
- Separator tape of coloured Polyester,
- Elastomeric covering of IE-4 type insulation.(CSP based)

In addition to this multi core cable shall have

- Binder tape of polyester (Melinex) or RPCT
- Elastomeric sheath of SE-4 type material

Specifications : RDSO : SPEC/E-14/01 (PART-I) RevII

Voltage Grade : 750 V grade

Technical data : Refer annexure I & II

Technical Data : for 750 V single core cable.

Sr. No	Nominal sectional area	Thickness of covering	Overall nominal external dia.	Tolerance on external dia.
	mm ²	Mm	mm	mm
1.	0.5	1.4	4.2	± 0.5
2.	0.75	1.4	4.4	± 0.5
3.	1.0	1.4	4.6	± 0.5
4.	1.5	1.4	4.9	± 0.5
5.	2.5	1.4	5.3	± 0.5
6.	3.0	1.4	5.5	± 0.5
7.	4.0	1.4	6.1	± 0.5
8.	6.0	1.5	7.0	± 0.7
9.	10.0	1.6	8.1	± 0.7
10.	16.0	1.8	10.0	± 0.7
11.	25.0	2.1	12.1	± 0.8
12.	35.0	2.1	13.7	± 1.0
13.	50.0	2.2	15.7	± 1.0
14.	70.0	2.3	18.0	± 1.0
15.	95.0	2.4	20.3	± 1.0
16.	120.0	2.5	22.0	± 1.0
17.	150.0	2.6	24.2	± 1.0
18.	185.0	2.8	26.6	± 1.0
19.	240.0	2.9	30.1	± 1.3
20.	300.0	3.1	33.7	± 1.5
21.	400.0	3.2	37.9	± 1.5
22.	500.0	3.5	42.1	± 1.6

Technical Data : for 750 V multicore cable.

Sr. No	No. of cores	Nominal sectional area	Thickness of Elastomeric covering	Overall nominal sheath thickness	Overall nominal external dia.	Tolerance on external dia.
		mm ²	Mm	mm	mm	mm
1.	13	2.5	1.4	1.4	25.5	± 1.5
2.	19	2.5	1.4	1.4	29.0	± 1.5
3.	27	2.5	1.4	1.4	34.5	± 1.5
4.	19	3.0	1.4	1.4	30.0	± 1.5
5.	19	4.0	1.4	1.6	32.0	± 1.5
6.	3	10.0	1.5	1.5	20.0	± 1.5
7. *	19	4.0	1.2	3.6	36.5	± 1.5
8. *	27	4.0	1.2	3.6	43.0	± 1.5

* Jumper cables for inter coach coupler connections on EMUs. These multicore cables shall have overall outer sheath in two layers with an open braid of cotton twine reinforced in between.

Railway Cables

Cable Type : RR
RDSO : SPEC/E-14/01 (Part-II)

Application : These cables are used on electrical locos, diesel electric locos, diesel hydraulic locos, diesel rail cars, battery locomotives and electrical multiple units.

Construction : Construction of single core cable 1500 V and 3000 V shall be :

- Tinned annealed copper conductor,
- Separator tape of coloured Polyester,
- Heat resisting EPR based insulation in accordance with type IE-3 of IS : 6380 –1984
- Optional proofed Tape
- Heat resisting, oil resisting and flame retardant CSP based elastomeric sheath in accordance with type SE-4 of IS : 6330 – 1984.

Specifications : RDSO : SPEC/E-14/01 (PART-II) Rev. II

Voltage Grade : 1500, 3000 V grade

Technical data : Refer Annexure III & IV

Annexure III

Technical data for :1500 V grade single core Elastomer insulated cable

Sr. No	Nominal sectional area	Insulation Thickness	Sheath thickness	External nominal diameter	Tolerance on external dia.
	mm ²	Mm	mm	Mm	mm
1.	2.5	1.8	1.2	8.7	± 0.7
2.	4.0	1.8	1.2	9.3	± 0.7
3.	6.0	1.8	1.2	10.0	± 0.7
4.	10.0	1.8	1.4	11.3	± 0.7
5.	16.0	1.8	1.4	12.8	± 0.7
6.	25.0	1.8	1.6	14.7	± 0.8
7.	35.0	1.8	1.6	16.3	± 1.0
8.	50.0	2.0	1.6	18.5	± 1.0
9.	70.0	2.0	1.6	20.6	± 1.0
10.	95.0	2.0	1.7	23.3	± 1.0
11.	120.0	2.3	1.8	25.2	± 1.0
12.	150.0	2.3	1.8	27.2	± 1.0
13.	185.0	2.6	2.0	30.3	± 1.1
14.	225.0	2.6	2.0	32.1	± 1.1
15.	240.0	2.8	2.1	34.1	± 1.3
16.	270.0	2.8	2.1	35.7	± 1.3
17.	300.0	3.0	2.2	37.9	± 1.5
18.	400.0	3.3	2.3	42.7	± 1.5
19.	500.0	3.6	2.4	47.1	± 1.6
20.	630.0	4.0	2.5	51.8	± 1.8

Annexure IV

Technical data for: 3000 V grade single core Elastomer insulated cable

Sr. No	Nominal sectional area	Insulation Thickness	Sheath thickness	External nominal diameter	Tolerance on external dia.
	mm ²	Mm	mm	Mm	mm
1.	10.0	2.6	1.5	13.1	± 0.7
2.	16.0	2.6	1.5	14.6	± 0.7
3.	25.0	2.6	1.7	16.7	± 1.0
4.	35.0	2.6	1.7	18.1	± 1.0
5.	50.0	2.8	1.7	20.3	± 1.0
6.	70.0	2.8	1.7	22.4	± 1.0
7.	95.0	3.0	1.8	25.1	± 1.0
8.	120.0	3.1	1.8	26.8	± 1.0
9.	150.0	3.1	2.0	29.3	± 1.1
10.	185.0	3.2	2.0	31.5	± 1.1
11.	225.0	3.2	2.0	33.8	± 1.1
12.	240.0	3.4	2.1	35.3	± 1.3
13.	270.0	3.4	2.1	37.1	± 1.3
14.	300.0	3.5	2.2	38.9	± 1.5
15.	400.0	3.5	2.2	42.9	± 1.5
16.	500.0	3.6	2.4	47.1	± 1.6
17.	630.0	4.0	2.5	51.8	± 1.8

Railway Cables

Cable Type : R
As per DEL/SPN/130

Application : These cables are used on diesel electric locos, diesel hydraulic locos, and diesel rail cars.

Construction : Construction of single core cable covering sizes 1 x 48/ 0.2 & 1 x 80/0.2 shall be :

- Tinned annealed, high conductivity, circular copper conductor,
- A coloured polyester separator tape applied over the bare conductor.
- Single elastomeric covering of oil resisting and flame retardant CSP based insulating material in accordance with type IE-4 of IS : 6380 –1984

Specifications : DEL/SPN/130

Voltage Grade : 300 V

Technical Data :

Item No.	Min. no. & Nom. Dia. Of wire (No./mm)	Nom. Area (Sq. mm)	Tol. On individual wire (mm)	Nom. Thickness of CSP covering. (T1) (mm)	Max. overall dia. Of cable (mm)	Max. DC resistance at 20 deg C (Ohm/km)
1.	48/0.2	1.5	± 0.01	0.75	3.58	12.7
2.	80/0.2	2.5	± 0.01	0.9	4.34	7.63

Railway Cables

Cable Type : RR
As per DEL/SPN/129

Application : These cables are used on diesel electric locos, diesel hydraulic locos, and diesel rail cars.

Construction : Construction of Single core cable shall be :

- Tinned annealed, high conductivity, multi stranded, circular copper conductor.
- A coloured polyester separator tape applied over the bare conductor.
- Conductor shall be insulated with Ethylene Propylene rubber.
- Single Elastomeric covering of oil resisting, fire retardant and abrasion resisting CSP based Elastomeric compound suitable for 90 °C continuous conductor temperature.

Sheathing shall be in accordance with type SE4, serial No.V (b) of table I of IS : 6380 – 1984.

Specifications : DEL/SPN/129

Voltage Grade : 1000 V, 1500 V

Technical Data : Refer Annexure V

Annexure V

Sr. No.	Conductor			Nominal thickness		Overall cable dia. (mm)		Max. DC resistance at 20°C (Ohm/km)
	Nom. Area (mm ²)	No./Nom. Wire dia. (mm)	Approx. conductor Dia. (mm)	Insulation	Jacket	Nom.	Max.	
1000 V grade cable								
1.	2.0	19/0.37	1.9	1.1	0.64	5.5	6.0	9.13
2.	3.4	19/0.45	2.4	1.2	0.64	6.2	6.7	5.66
3.	7.5	37/0.5	2.6	1.3	0.80	7.8	8.9	2.57
4.	18.6	91/0.5	5.5	1.5	0.80	10.6	12.1	1.04
5.	46.0	225/0.5	9.9	2.0	1.20	16.4	17.4	0.422
6.	133.9	650/0.5	16.9	2.4	1.60	24.9	26.1	0.146
7.	271.4	1325/0.5	24.1	2.8	1.60	33.1	34.3	0.0717
8.	394.5	1925/0.5	29.0	2.8	1.60	37.1	39.6	0.0493
1500 V grade cable								
1.	2.0	19/0.37	1.9	1.8	1.20	8.0	8.5	9.13
2.	3.4	19/0.47	2.4	1.8	1.20	8.5	9.0	5.16
3.	133.0	650/0.5	16.8	2.5	1.80	25.6	26.8	0.146
4.	271.4	1325/0.5	24.1	2.8	1.80	33.8	35.1	0.0717
5.	300.0	1525/0.5	26.0	2.2	2.00	37.0	38.0	0.066
6.	394.5	1925/0.5	29.0	3.0	1.90	38.5	40.1	0.0493

Railway Cables

Cable Type : R, RR
As per CLW/ES/C-41

Application : These cables are used on diesel electric locos, diesel hydraulic locos, and diesel rail cars.

Construction : **Construction of Power cables 1500 V shall be :**

- Tinned, fully annealed, electrolytic copper, stranded conductor.
- A coloured polyester tape or coloured melinex separator tape applied over the bare conductor.
- Heat resisting Elastomeric insulation in one or more layers.
- Textile rubberized tape separator (optional)
- Heat resisting, oil resisting, flame retardant sheathing in accordance with type SE-4 of IS : 6380-1984.

Construction of Auxiliary and control cables 750 V :

- Tinned, fully annealed, electrolytic copper stranded conductor
- Separator Polyester tape (deep coloured) shall be provided to avoid any ingress of insulation penetrating through the strands.

Construction of Multi core cable 750 V shall be :

- Each core having construction as indicated in 750 V single core.
- Group of cores bound in rubberised tape.
- Heat resisting, oil resisting, flame retardant CSP based sheath in accordance with type SE-4 of IS:6380-1984.

Specifications : CLW/ES/C-41 (Earlier version C-22 has been withdrawn)

Voltage Grade : 750,1500V

Ship wiring Cables

Cable Type : MGCG, MGCY, MGG

Application : **Shielded Cables:**
These cables are ideally suited for permanent installation on ships and boats, especially on desks and in cabins. A copper braid, if provided, not only minimises HF disturbances due to electronic equipments, it also serves as mechanical protection.

General Cables :
Used in areas of ships where disturbance from radio/ radar equipment is minimal.

Construction : MGCG/MGCY : ATC conductor (Non flexible), EPR insulated, cores stranded together, Rubber/ PVC inner sheathed, ATC/GI wire braided and overall sheathed with Rubber/PVC.

MGG: ATC conductor (Non flexible), EPR insulated, cores stranded together, Rubber/ PVC inner sheathed, and overall sheathed with Rubber/PVC.

Specifications : ABS, Lloyds, BV, NVS, DGS212, DNV, IEC 92-353, IRS, JIS C 3410-1987.

Voltage Grade : ABS, Lloyds, BV, NVS, S212, DNV, : 150/250 V
IRS : 440/750 V
ABS, Lloyds, BV, NVS, S212, DNV, : 250V, 660 V
IRS : 0.6/1.0 kV

Technical data : Refer Annexure VI

Technical data for Ship wiring

- **Manufacturing range for MGCG & MGG**

No. of cores	Size Sq. mm
1	1.5-300
2	1.5-25
3	1.5-120
4	1.5-95
5-24(control cables)	1.5

- As per IEC : 332-3 tests under fire conditions shall be as per category A for metal braided cables & as per category C for non metallic braided cables.
- **Current carrying capacity for rubber insulated ship wiring cables:**
As per IEC-92-353 current carrying capacity in continuous service for **single-core** cables.

Normal cross-sectional area (mm ²)	Current rating (Amp) Max conductor Temp. 85 °C	Normal cross-sectional area (mm ²)	Current rating (Amp) Max conductor Temp. 85 °C
1	16	35	145
1.5	20	50	180
2.5	28	70	225
4	38	95	275
6	48	120	320
10	67	150	365
16	90	185	415
25	120	240	490
		300	560

For 2, 3 & 4 core cables the current ratings given in above table shall be multiplied by following approximate correction factors :

2 cores : 0.85

3 & 4 cores : 0.70

Welding Cables

Cable Type : R

Application : These cables have been specifically designed to work in dry, damp, wet locations, also outdoors, for machine welding and hand welding.

Construction * : Very fine stranded copper conductor followed Chloroprene rubber sheath.

Specifications : VDE 0250

Voltage Grade : 200 V

Special features : Chloroprene rubber sheaths, oil and flame resistant. Permissible operating temperature at conductor : 80 ° C

* Notes : Further details for Welding cables shall be made available on request.

Heat resistant silicon Elastomer Cables

Cable Type : RG

Application :	These cables are used for high temperature operations like furnaces, ovens, steel rolling mills, Foundries, Electric motors, Ships, Nuclear & thermal power stations, Autostress boilers, dryers, High voltage equipment, Electrical machinery for class B, F & H.
Construction :	Single core / multi core flexible, annealed, tinned copper conductor, Melinex taped, Silicon rubber insulated, cores stranded together(only for multi core cables), glass fibre braided & suitably varnished.
Specifications :	BS, VDE, IS : 9968 –Part I & Customer's Specification
Voltage Grade :	IS : Up to 1.1 kV VDE : Up to 3.3 kV BS : 6195 Up to 6.6 kV Customer's Spec. Up to 11 kV
Special features :	Silicon Insulation possess following properties: <ul style="list-style-type: none">• High temperature operation: Continuous operation : 150⁰ C – 180⁰ C Emergency overload : 250⁰ C Short circuit : 350⁰ C• Flexibility over a range of temperature• Moisture resistance• Arc resistance• Ozone & corona resistance• Radiation resistance• High thermal conductivity• Long service life.
Technical data	Refer Annexure VII & VIII

Technical Data for Heat Resisting Silicon Insulated Cables:

Sr. No.	Conductor Annealed Tinned Copper			Insulation Thickness (mm)	Covering (Glass braided & Varnished)	Approx. Overall Diameter (mm)
	Cross sectional Area (mm ²)	Max. Diam. of wire(mm)	Approx. Overall Diameter (mm)			

1.1kV Grade

1	1.5	0.25	1.6	1.0	0.5	4.8
2	2.5	0.25	2.0	1.0	0.5	5.3
3	4	0.30	2.6	1.0	0.5	5.9
4	6	0.30	3.0	1.0	0.5	6.3
5	10	0.40	4.0	1.2	0.5	7.8
6	16	0.40	5.7	1.2	0.5	9.6
7	25	0.40	7.1	1.4	0.5	11.4
8	35	0.40	8.5	1.4	0.5	12.9
9	50	0.40	10.2	1.6	0.5	15.1
10	70	0.50	11.8	1.6	0.5	16.8

3.3 kV Grade

1	35	0.41	9.2	2.2	0.5	15.3
2	95	0.51	5.2	2.4	0.5	11.6

6.6 kV Grade

1	25	0.41	7.5	3.0	0.5	15.2
2	35	0.41	9.2	3.0	0.5	15.3
3	50	0.41	11.0	3.0	0.5	18.9
4	70	0.51	13.0	3.0	0.5	21.0
5	95	0.51	15.2	3.0	0.5	23.3

11 kV Grade

1	35	0.41	9.2	4.0	0.5	17.0
2	50	0.41	11.0	4.0	0.5	18.9
3	95	0.51	15.2	4.0	0.5	23.3

*** - Other sizes available on request.

**Annexure
VIII**

**Current-carrying capacities for 150°C rubber insulated flexible cables
(Heat resistant silicon elastomer cables)**

Conductor operating temperature 95 °C

Nominal cross-sectional of conductor	Maximum diameter of wires forming conductor	Current carrying capacity	
		D.C. of single-phase AC (one twin cable, with or without protective conductor, or two single core cables bunched)	Three-phase a.c.(one three, four or five core cables)
mm ²	mm ²	A	A
4	0.31	40	34
6	0.31	51	44
10	0.41	70	60
16	0.41	93	81
25	0.41	120	105
35	0.41	145	125
50	0.41	185	160
70	0.51	225	195
95	0.51	270	235
120	0.51	305	270
150	0.51	355	305
185	0.51	405	350
240	0.51	465	405
300	0.51	530	470

NOTE :

The tabulated current carrying capacities are not applicable to flexible cables wound on drum. The current carrying capacities of a cable on a drum depends on the type of drum and may be less than one-half of the corresponding capacity stated in the table.

Correction factor for ambient temperature for 150 C rubber insulated cables:

Ambient temperature	35 °C to 95°C	100°C	105°C	110°C	115°C	120°C	125°C	130°C	135°C	140°C
Correction	1.0	0.94	0.88	0.82	0.77	0.71	0.64	0.56	0.48	0.39

factor										
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Mining Cables

Application : These cables have been specifically designed for the conditions prevailing in mines above and below ground. Their outstanding feature, attributable to the special construction & materials, is a long service life under the most rigorous operating conditions.

Special features : Insulation of Mining cables shall possess following properties:

- High insulation resistance (Dielectric Strength)
- Good high-temperature deformation resistance
- Excellent high-temperature resistance
- Resistance to ozone.

Features of Overall sheath of Mining Cables are:

- High resistance to tearing and nicking
 - High resistance to abrasion, impact, compression.
 - Resistant to grease, chemicals, humidity, radiation and water absorption.
 - Oil and flame-resistant.
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Mining Cables

Coal Cutting & Drilling Cables

Cable Type : FT3,FT4,FT6 FTD3 and 7 M
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Application : These cables are used for power supplies to mobile equipment, mainly coal cutting machines, underground in mines. Non-armoured cables may only be used when the tensile forces are relatively low. Armoured version must be used when the tensile forces are large.

Construction : General construction for **FT/FTD type**
Annealed tinned copper conductor, optional separator tape, heat resisting elastomer, optional proofed tape, laying up of core-three power cores, one earth core and one pilot core shall be laid around a cradle separator; optional proofed tape; protective screen collective or individually over three power cores; and tough rubber outer sheath .

General construction for **7 M type :**
5 core 3 power core & one pilot core having same nominal cross sectional area, each having protective metallic screen, laid around a bare earth conductor with which the screens are in electrical contact, PCP sheathed overall.

Specifications : NCB 188 Types 7, 7M, 7S,10,11, 14, 16.
IS : 14494/98

Voltage Grade : From 0.6 / 1.0 kV up to 11 kV

Mining Cables

Pliable Wire Armoured Trailing Cables

Cable Type : RWR

Application : In dry, moist and damp locations as well as outdoors and in mining where there are high mechanical stresses. These cables are used for supplying large conveyors and hoisting gear, building sites and as a provisional link in power system in an emergency.

Construction : Annealed tinned copper conductor, optional separator tape, heat resisting elastomer, optional proofed tape, laying up of cores, followed by rubber inner sheath, pliable wire armour consisting of Galvanised Steel strands and HD HOFR rubber outer sheath .

Specifications : IS 1026,IS 9968,IS 14494
VDE 0250

Voltage Grade : Up to 11 kV

Material handling

**Reeling/Unreeling
Trailing Cables & Lift cables**

Cable Type : RR, RCR, RBR/ RSR

Application : **Reeling & Unreeling cables** are used in dry, damp & wet locations as well as outdoors, as universal reeling cables for hoisting equipment, transportation & handling equipment with heavy mechanical stresses.
Lift cables are used in dry damp, and wet locations, for application where the cables are suspended freely e.g. on lifts, hoists, conveyor etc. They are not suitable for forced guiding devices such as drums.

Construction : **Type RCR**
Annealed tinned copper conductor, optional separator tape, heat resisting elastomer, optional proofed tape, laying up of cores, followed by rubber inner sheath, ATC wire screening or Galvanised Steel wire screening between inner and outer sheath

Type RSR/RBR
Same as RCR except Nylon/ Cotton braid reinforcement between sheaths

Type RR
Same as RCR except textile tape reinforcement between sheaths

Specifications : IS 9968
VDE 0250

Voltage Grade : Up to 11 kV

Material handling

SShoeu type cable

Cable Type : SShoeu

Application : These cables are used in dry, damp & wet locations as well as outdoors, as universal reeling cables for hoisting equipment, transportation & handling equipment with heavy mechanical stresses.

Construction : Annealed tinned copper conductor, optional separator tape, heat resisting elastomer, optional proofed tape, laying up of cores, followed by EPR inner sheath, textile tape reinforcement between inner and outer sheath

Specifications : VDE 0250

Voltage Grade : 0.6/1.0 kV

General Technical particulars of rubber insulated copper conductor cables for voltage grade upto and including 11 kV

1. Current Ratings :

Normal cross-sectional area (mm ²)	Current Rating (Amp) Max conductor Temp 90 ⁰ C	Normal cross-sectional area (mm ²)	Current Rating (Amp) Max conductor Temp 90 ⁰ C
1.5	21	70	234
2.5	28	95	288
4	38	120	329
6	50	150	378
10	69	185	432
16	93	240	512
25	123	300	592
25	123	400	699
35	152	500	788
50	190	630	890

Remarks :

1. Above current rating will hold good for both single core as well as multi core cables to be used in fixed installation or flexible duty.
2. Above current rating will hold good for Festooning as well as winding/rewinding duties.
3. The maximum conductor temperature for EPR insulated cable is 90⁰ C.

2. Rating factors for variation in ambient air temperature

Air temp. (°C)	25	30	35	40	45	50	55
Cable with a max conductor temp. 90 ⁰ C	1.17	1.12	1.06	1.0	0.94	0.87	0.79

3. Group rating factors

(for cables grouped together, equally loaded and of same size.)

Number of circuits *	2	3	4	5	6	8	10	12	14	16	18
Rating factors	0.8	0.7	0.65	0.6	0.57	0.52	0.48	0.45	0.43	0.41	0.39

* Circuit shall have :

- i.1 cable in case of multi core cable
- ii.2 cables in case of single core cables for single AC or DC system.
- iii.3 or 4 cables in case of single core cables for 3-phase AC system.

4. Rating factors for cable wound on drum for reeling unreeling duty :

Number of layers	1	2	3	4
Rating factors	0.76	0.58	0.47	0.4

5. Rating factors for monospiral reeling drum winding duty : 0.76

6. Derating factors for number of cores :

Number of cores	5	7	10	12	14	19	24	40	61
Rating Factors	0.75	0.65	0.55	0.52	0.50	0.45	0.40	0.35	0.30

7. Safe pulling tension load for normal reeling and unreeling duty (For multi core cables)

$$T = \frac{21 \times AC}{F_s \times F_i}$$

Where T = Safe pulling Tension load in kg.

AC = Total Copper Area in sq.mm.(Screen to be ignored)

F_s = 2 for 0.2 mm dia wires.
 = 1.75 for 0.25 mm dia wires.
 = 1.50 for 0.3 mm dia wires.
 = 1.40 for 0.4 mm dia wires.
 = 1.30 for 0.5 mm dia wires.

F_i = 10 for normal reeling .
 = 20 for hazardous reeling .
 = 4 for constant tension.
 = 6 for easy tension.

8. Maximum conductor temperature for short circuit.

Type of insulation	Conductor temperature (Maximum)	
	Prior to Short Circuit	During Short Circuit
Heat resistance Synthetic (Propylene)	90 °C	250 °C

Rubber		
Silicon Rubber	150 °C	350 °C

9. Short circuit ratings of the cable :

$$I_k = \frac{K \times A}{\sqrt{t}}$$

Where I_k = is short circuit current in kA.

A is the cross-sectional area of the conductor in mm^2 .

t is the duration in second.

K is the constant (copper conductor)

0.143 for cables with EPR insulation

0.146 for cables with Silicon Rubber insulation

SHORT CIRCUIT RATINGS:

Cross section	Short Circuit Rating in kA (For 1 sec.duration)	
	EPR Insulation (CU conductor)	Silicon Rubber Insulation (CU conductor)
1.5	0.214	0.219
2.5	0.357	0.365
4	0.572	0.584
6	0.858	0.876
10	1.430	1.460
16	2.288	2.336
25	3.575	3.650
35	5.005	5.110
50	7.150	1.043
70	10.01	10.220
95	13.580	13.870
120	17.160	17.520
150	21.450	21.90
185	26.450	27.010
225	32.175	32.850
240	34.320	35.040
300	42.90	43.80
400	57.20	58.40
500	71.50	73.00
630	90.090	91.980

10. Recommended minimum bending radius for Reeling & Unreeling duty cables & Pliable armoured cables

12 times the overall diameter of cables for Voltage grade up to 1100 V.

15 times the overall diameter of cables for Voltage grade up to 3.3 kV to 11 kV.

◆ MAXIMUM D.C. RESISTANCE OF EACH CONDUCTOR AT 20 °C (Ohm/km)

Size of Conductor mm ²	D.C Resistance
1.5	13.7
2.06 *	11.15
2.5	8.21
3	6.031
3.42 *	7.0
4	5.09
6	3.39
7.55 *	2.85
10	1.95
16	1.24
18.64 *	1.15
25	0.795
35	0.565
46.06	0.440
50	0.393
70	0.277
95	0.210
120	0.164
133.6	0.150
150	0.132
185	0.108
225	0.0911
240	0.0817
270	0.0728
271.4	0.074
300	0.066
500	0.0391
630	0.0306

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