# Medium Voltage Cables

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## 8.7/15 (17.5)kV Single-Core
## XLPE Insulated, Unarmoured & Armoured, PVC Sheathed Cable

Description: CU/XLPE/CTS/PVC or CU/XLPE/CTS/PVC/AWA/PVC-AT or CU/XLPE/CTS/PVC/DATA/PVC-AT



| | |
|---|---|
| Application : | This is an electric power distribution network cable typically used as primary supply to commercial, industrial, and urban residential networks. |
| Voltage rating : | 8.7/15 (17.5)kV |
| Construction : | Plain annealed copper (IEC 60228 Class 2), cross-linked semi-conducting compound, XLPE compound insulated, cross-linked semi-conducting compound (bonded or strippable), plain annealed copper tape screen, unarmoured, or aluminium wires or double aluminium tape armoured, PVC or anti-termite PVC (for armoured cable only) compound sheathed cable |
| Insulation colour : | Natural |
| Sheath colour : | Black (Other colour upon request) |
| Specification : | IEC 60502-2, BS 6622 |
| Operating temperature : | 90˚C |

| Conductor | | Insulation | Unarmoured | | | AWA Armoured | | | DATA Armoured | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Area | Approx. Diam. | Thickness | **Part No.** | Approx. Overall Diam. | Approx. Weight | **Part No.** | Approx. Overall Diam. | Approx. Weight | **Part No.** | Approx. Overall Diam. | Approx. Weight |
| ($mm^2$) | (mm) | (mm) | | (mm) | (kg/km) | | (mm) | (kg/km) | | (mm) | (kg/km) |
| 25 | 6.0 | 4.5 | **13019024** | 23.6 | 765 | **13019025** | 29.4 | 1190 | **13019026** | 28.3 | 1070 |
| 35 | 7.0 | 4.5 | **14019024** | 24.6 | 890 | **14019025** | 30.7 | 1345 | **14019026** | 29.4 | 1200 |
| 50 | 8.4 | 4.5 | **15019024** | 26.1 | 1040 | **15019025** | 32.1 | 1525 | **15019026** | 31.0 | 1380 |
| 70 | 10.0 | 4.5 | **16019024** | 27.7 | 1280 | **16019025** | 34.0 | 1805 | **16019026** | 32.6 | 1640 |
| 95 | 11.6 | 4.5 | **17019024** | 29.3 | 1565 | **17019025** | 36.6 | 2235 | **17019026** | 34.5 | 1965 |
| 120 | 13.0 | 4.5 | **18019024** | 30.9 | 1840 | **18019025** | 38.1 | 2525 | **18019026** | 35.8 | 2240 |
| 150 | 14.6 | 4.5 | **19019024** | 32.5 | 2140 | **19019025** | 39.6 | 2845 | **19019026** | 37.6 | 2575 |
| 185 | 16.2 | 4.5 | **20019024** | 34.5 | 2540 | **20019025** | 41.5 | 3290 | **20019026** | 39.3 | 2980 |
| 240 | 18.4 | 4.5 | **21019024** | 36.8 | 3135 | **21019025** | 44.0 | 3935 | **21019026** | 41.7 | 3610 |
| 300 | 20.6 | 4.5 | **22019024** | 39.1 | 3755 | **22019025** | 46.1 | 4605 | **22019026** | 44.1 | 4280 |
| 400 | 23.8 | 4.5 | **23019024** | 42.5 | 4625 | **23019025** | 51.0 | 5750 | **23019026** | 47.7 | 5215 |
| 500 | 26.6 | 4.5 | **24019024** | 45.6 | 5715 | **24019025** | 54.2 | 6945 | **24019026** | 51.0 | 6375 |
| 630 | 29.9 | 4.5 | **25019024** | 49.1 | 7140 | **25019025** | 57.7 | 8455 | **25019026** | 54.5 | 7860 |
| 800 | 34.1 | 4.5 | **26019024** | 54.0 | 8805 | **26019025** | 62.6 | 10190 | **26019026** | 59.3 | 9550 |
| 1000 | 37.8 | 4.5 | **27019024** | 57.9 | 10920 | **27019025** | 66.9 | 12475 | **27019026** | 63.7 | 11785 |

*MDPE, LSZH sheath is available if required.



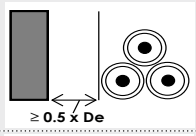
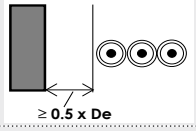
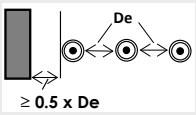
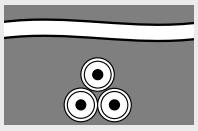
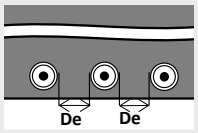
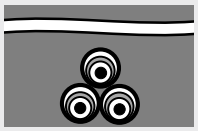
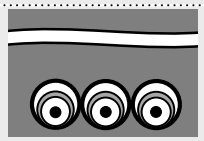
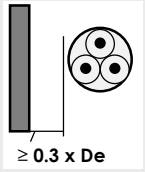





# Technical Information

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**Table 1 : Method of Installation**

| No. | Installation Method | Examples | Remarks |
|---|---|---|---|
| **1** | **Single-Core Cable (In Air)**<br>Cables are assumed to be spaced at least 0.5 x $D_e$ from any vertical surface and installed on brackets or ladder racks. | | |
| a) | Three single-core cables in trefoil formation touching throughout their length |  | Where $D_e$ is the external diameter of the cable |
| b) | Three single-core cables in horizontal flat formation touching throughout their length |  | |
| c) | Three single-core cables in horizontal flat formation with a spacing of one cable diameter, $D_e$ |  | |
| **2** | **Single-Core Cable (Buried Direct)**<br>Cables buried direct in the ground at a depth of 0.8m, soil thermal resistivity of 1.5 K·m/W, ground temperature 20°C. | | |
| a) | Three single-core cables in trefoil formation touching throughout their length |  | |
| b) | Three single-core cables in horizontal flat formation with a spacing of one cable diameter, $D_e$ |  | Where $D_e$ is the external diameter of the cable |
| **3** | **Single-Core Cable (In Earthenware Ducts)**<br>Cables in earthenware ducts buried at a depth of 0.8m with one cable per duct. The earthenware duct having an inside diameter of 1.5 x $D_e$ and with a wall thickness equal to 6% of the duct inside diameter. | | |
| a) | Three single-core cables in trefoil ducts touching throughout their length |  | |
| b) | Three single-core cables in horizontal flat formation, ducts touching throughout their length |  | |
| **4** | **3-Core Cables** | | |
| a) | One 3-core cable in air spaced at least 0.3 x $D_e$ from any vertical surface |  | Where $D_e$ is the external diameter of the cable |

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**Table 1** (Continued)**:**

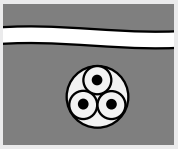
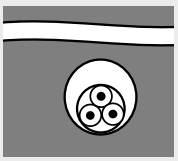
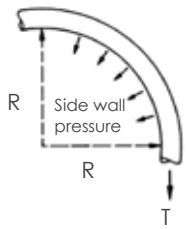
| No. | Installation Method | Examples | Remarks |
|---|---|---|---|
| b) | One 3-core cable buried direct in the ground at a depth of 0.8m |  | Where $D_e$ is the external diameter of the cable |
| c) | One 3-core cable in a buried earthenware duct having an inside diameter of 1.5 x $D_e$ and with a wall thickness equal to 6% of the duct inside diameter. The depth of burial of duct is 0.8m |  | |

**Table 2 : Recommended Minimum Bending Radius**

To install the cables safely without damaging the electrical and physical properties of the cables, the tabulated values (shown below) represent the permanent minimum bending radius the cables withstand in fixed installation and on dispatching reels. Other constraints may impose a greater bending radius.




| Type of Cable | On Drum | During Installation | Placed into Position Adjacent to Joint or Termination with Former |
|---|---|---|---|
| Armoured Single-Core | 8D | 15D | 12D |
| Unarmoured Single-Core | 10D | 20D | 15D |
| Armoured Multi-Core | 8D | 12D | 10D |
| Unarmoured Multi-Core | 10D | 15D | 12D |

Note : D means the overall diameter of cable (mm)

**Table 3 : Permissible Maximum Pulling Tension of Medium Voltage Cable**

With Pulling Eye on Conductor

| Material | Maximum Safe Tensile Stress (S) (N/mm²) |
|---|---|
| Stranded Copper Conductor | 70 |
| Stranded Aluminium Conductor | 50 |
| Solid Aluminium Conductor | 30 |

With Pulling Eye on Armour

| | |
|---|---|
| Galvanized Steel Wire Armour | 100 |
| Hard Drawn Aluminium Wire Armour | 60 |

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**Table 4 : Technical Properties to IEC 60502-2**

| No. | Technical Properties | | Rated Voltage (kV) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $U_m$ | 7.2 | 12 | 17.5 | 24 | 36 |
| | | | $U_0/U$ (IEC 60502-2) | 3.6/6 | 6/10 | 8.7/15 | 12/20 | 18/30 |
| 1 | Max. Conductor D.C. Resistance at 20°C (Ω/km) | | See Table 5 | | | | | |
| 2 | Routine Partial Discharge Test | | The magnitude of discharge shall not exceed 10 pC at the test voltage, raised gradually to and held at 2 $U_0$ for 10 s and then slowly reduced to 1.73 $U_0$ | | | | | |
| 3 | Routine A.C. High Voltage Test (kV/min) | | No breakdown of the insulation shall occur | 12.5/5 | 21/5 | 30.5/5 | 42/5 | 63/5 |
| 4 | A.C. Voltage Test for 4h (kV)<br>Note: Applicable for rated voltage above 3.6/6 (7.2)kV | | | - | 24 | 35 | 48 | 72 |
| 5 | Hot Set Test | Maximum Elongation under Load (%) | 175 | | | | | |
| 6 | | Maximum Permanent Elongation after Cooling (%) | 15 | | | | | |
| 7 | Shrinkage Test | Maximum shrinkage (%) | 4 | | | | | |
| 8 | Impulse Test Followed by a Voltage Test (kV) | | No breakdown of the insulation shall occur | 60 | 75 | 95 | 125 | 170 |
| 9 | Other Tests | | Reference to IEC 60502-2, including raw materials and finished cables | | | | | |

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**Table 5 : Maximum Resistance and Short-Circuit Current of Cu and Al Conductor**

| Nominal Area | Copper Conductor | | | Aluminium Conductor | | |
|---|---|---|---|---|---|---|
| | D.C. resistance at 20°C | A.C. resistance at 90°C | Short-circuit current for 1s | D.C. resistance at 20°C | A.C. resistance at 90°C | Short-circuit current for 1s |
| (mm²) | (Ω/km) | (Ω/km) | (kA) | (Ω/km) | (Ω/km) | (kA) |
| 25 | 0.727 | 0.927 | 3.575 | 1.20 | 1.539 | 2.350 |
| 35 | 0.524 | 0.668 | 5.005 | 0.868 | 1.113 | 3.290 |
| 50 | 0.387 | 0.494 | 7.150 | 0.641 | 0.822 | 4.700 |
| 70 | 0.268 | 0.342 | 10.010 | 0.443 | 0.568 | 6.580 |
| 95 | 0.193 | 0.247 | 13.585 | 0.320 | 0.411 | 8.930 |
| 120 | 0.153 | 0.196 | 17.160 | 0.253 | 0.325 | 11.280 |
| 150 | 0.124 | 0.159 | 21.450 | 0.206 | 0.265 | 14.100 |
| 185 | 0.0991 | 0.128 | 26.455 | 0.164 | 0.211 | 17.390 |
| 240 | 0.0754 | 0.0977 | 34.320 | 0.125 | 0.161 | 22.560 |
| 300 | 0.0601 | 0.0787 | 42.900 | 0.100 | 0.130 | 28.200 |
| 400 | 0.0470 | 0.0627 | 57.200 | 0.0778 | 0.102 | 37.600 |
| 500 | 0.0366 | 0.0502 | 71.500 | 0.0605 | 0.080 | 47.000 |
| 630 | 0.0283 | 0.0407 | 90.090 | 0.0469 | 0.063 | 59.220 |
| 800 | 0.0221 | 0.0340 | 114.400 | 0.0367 | 0.051 | 75.200 |
| 1000 | 0.0176 | 0.0293 | 143.000 | 0.0291 | 0.042 | 94.000 |

Note : Short-circuit current in Kiloampere, are approximate values under non-adiabatic conditions.

**Table 6 : Maximum Permissible Short-Circuit Current of Copper Tape Screen for Unarmoured Single-Core Cable**

The following short-circuit current in kiloamperes, are approximate values, calculated with copper tape screen of 0.12mm thickness applied helically with about 15% overlapping under non-adiabatic conditions.

| Nominal Area | Short-Circuit Current for 1 Second | | | | |
|---|---|---|---|---|---|
| | 3.6/6 (7.2)kV 3.8/6.6 (7.2)kV | 6/10 (12)kV 6.35/11 (12)kV | 8.7/15 (17.5)kV | 12/20 (24)kV 12.7/22 (24)kV | 18/30 (36)kV 19/33 (36)kV |
| (mm²) | (kA) | (kA) | (kA) | (kA) | (kA) |
| 25 | 1.075 | 1.083 | 1.094 | - | - |
| 35 | 1.074 | 1.082 | 1.092 | 1.096 | - |
| 50 | 1.072 | 1.080 | 1.091 | 1.095 | 1.284 |
| 70 | 1.070 | 1.079 | 1.090 | 1.091 | 1.281 |
| 95 | 1.069 | 1.077 | 1.086 | 1.272 | 1.280 |
| 120 | 1.068 | 1.077 | 1.286 | 1.271 | 1.279 |
| 150 | 1.067 | 1.076 | 1.265 | 1.270 | 1.278 |
| 185 | 1.064 | 1.251 | 1.264 | 1.267 | 1.275 |
| 240 | 1.241 | 1.250 | 1.262 | 1.266 | 1.274 |
| 300 | 1.239 | 1.246 | 1.261 | 1.265 | 1.271 |
| 400 | 1.240 | 1.245 | 1.256 | 1.260 | 1.270 |
| 500 | 1.243 | 1.244 | 1.253 | 1.257 | 1.266 |
| 630 | 1.236 | 1.238 | 1.252 | 1.253 | 1.265 |
| 800 | 1.260 | 1.260 | 1.280 | 1.280 | 1.300 |
| 1000 | 1.260 | 1.260 | 1.270 | 1.280 | 1.290 |

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**Table 7 : Reactance at 50 Hz for Single-Core XLPE Insulated Cable**

| Nominal Area | Reactance (Approximate) | | | | |
|---|---|---|---|---|---|
| | 3.6/6 (7.2)kV 3.8/6.6 (7.2)kV | 6/10 (12)kV 6.35/11 (12)kV | 8.7/15 (17.5)kV | 12/20 (24)kV 12.7/22 (24)kV | 18/30 (36)kV 19/33 (36)kV |
| (mm²) | (Ω/km) | (Ω/km) | (Ω/km) | (Ω/km) | (Ω/km) |
| 25 | 0.142 | 0.147 | 0.153 | - | - |
| 35 | 0.135 | 0.140 | 0.146 | 0.150 | - |
| 50 | 0.122 | 0.133 | 0.139 | 0.143 | 0.154 |
| 70 | 0.111 | 0.124 | 0.129 | 0.135 | 0.144 |
| 95 | 0.109 | 0.117 | 0.122 | 0.128 | 0.137 |
| 120 | 0.105 | 0.113 | 0.118 | 0.123 | 0.131 |
| 150 | 0.103 | 0.110 | 0.114 | 0.119 | 0.127 |
| 185 | 0.100 | 0.106 | 0.110 | 0.116 | 0.124 |
| 240 | 0.097 | 0.101 | 0.105 | 0.111 | 0.118 |
| 300 | 0.095 | 0.099 | 0.102 | 0.106 | 0.114 |
| 400 | 0.093 | 0.095 | 0.098 | 0.102 | 0.109 |
| 500 | 0.091 | 0.093 | 0.096 | 0.099 | 0.106 |
| 630 | 0.088 | 0.089 | 0.092 | 0.096 | 0.102 |
| 800 | 0.095 | 0.087 | 0.090 | 0.091 | 0.097 |
| 1000 | 0.093 | 0.085 | 0.089 | 0.089 | 0.094 |

**Table 8 : Capacitance**

| Nominal Area | Capacitance Per Phase (Approximate) | | | | |
|---|---|---|---|---|---|
| | 3.6/6 (7.2)kV 3.8/6.6 (7.2)kV | 6/10 (12)kV 6.35/11 (12)kV | 8.7/15 (17.5)kV | 12/20 (24)kV 12.7/22 (24)kV | 18/30 (36)kV 19/33 (36)kV |
| (mm²) | (μF/km) | (μF/km) | (μF/km) | (μF/km) | (μF/km) |
| 25 | 0.2423 | 0.1922 | 0.1576 | - | - |
| 35 | 0.2684 | 0.2116 | 0.1725 | 0.1502 | - |
| 50 | 0.3022 | 0.2367 | 0.1917 | 0.1661 | 0.1363 |
| 70 | 0.3462 | 0.2693 | 0.2167 | 0.1868 | 0.1508 |
| 95 | 0.3875 | 0.2999 | 0.2400 | 0.2060 | 0.1643 |
| 120 | 0.4236 | 0.3266 | 0.2603 | 0.2228 | 0.1760 |
| 150 | 0.4647 | 0.3570 | 0.2834 | 0.2418 | 0.1893 |
| 185 | 0.5059 | 0.3873 | 0.3123 | 0.2656 | 0.2060 |
| 240 | 0.5430 | 0.4290 | 0.3439 | 0.2916 | 0.2207 |
| 300 | 0.5589 | 0.4706 | 0.3755 | 0.3175 | 0.2387 |
| 400 | 0.5940 | 0.5311 | 0.4213 | 0.3551 | 0.2648 |
| 500 | 0.6167 | 0.5839 | 0.4613 | 0.3880 | 0.2876 |
| 630 | 0.6848 | 0.6481 | 0.5099 | 0.4278 | 0.3151 |
| 800 | 0.7293 | 0.6908 | 0.5391 | 0.4528 | 0.3308 |
| 1000 | 0.7987 | 0.7562 | 0.5889 | 0.4937 | 0.3592 |

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**Table 9 : Inductance for Single-Core XLPE Insulated Cable**

| Nominal Area | Inductance (Approximate) | | | | |
|---|---|---|---|---|---|
| | 3.6/6 (7.2)kV 3.8/6.6 (7.2)kV | 6/10 (12)kV 6.35/11 (12)kV | 8.7/15 (17.5)kV | 12/20 (24)kV 12.7/22 (24)kV | 18/30 (36)kV 19/33 (36)kV |
| ($mm^2$) | (mH/km) | (mH/km) | (mH/km) | (mH/km) | (mH/km) |
| 25 | 0.5954 | 0.6143 | 0.6474 | - | - |
| 35 | 0.5753 | 0.5932 | 0.6248 | 0.6390 | - |
| 50 | 0.5543 | 0.5711 | 0.6011 | 0.6145 | 0.6501 |
| 70 | 0.5357 | 0.5486 | 0.5765 | 0.5919 | 0.6252 |
| 95 | 0.5172 | 0.5318 | 0.5608 | 0.5726 | 0.6043 |
| 120 | 0.5059 | 0.5197 | 0.5473 | 0.5586 | 0.5891 |
| 150 | 0.4949 | 0.5079 | 0.5341 | 0.5449 | 0.5740 |
| 185 | 0.4885 | 0.5006 | 0.5252 | 0.5351 | 0.5640 |
| 240 | 0.4790 | 0.4890 | 0.5143 | 0.5216 | 0.5487 |
| 300 | 0.4749 | 0.4818 | 0.5032 | 0.5102 | 0.5376 |
| 400 | 0.4660 | 0.4702 | 0.4927 | 0.4991 | 0.5219 |
| 500 | 0.4600 | 0.4619 | 0.4848 | 0.4907 | 0.5128 |
| 630 | 0.4547 | 0.4563 | 0.4748 | 0.4827 | 0.5012 |
| 800 | 0.4149 | 0.4156 | 0.4237 | 0.4315 | 0.4505 |
| 1000 | 0.4092 | 0.4099 | 0.4175 | 0.4247 | 0.4430 |

**Table 10 : Inductance for 3-Core XLPE Insulated Cable**

| Nominal Area | Inductance (Approximate) | | | | |
|---|---|---|---|---|---|
| | 3.6/6 (7.2)kV 3.8/6.6 (7.2)kV | 6/10 (12)kV 6.35/11(12)kV | 8.7/15 (17.5)kV | 12/20 (24)kV 12.7/22 (24)kV | 18/30 (36)kV 19/33 (36)kV |
| ($mm^2$) | (mH/km) | (mH/km) | (mH/km) | (mH/km) | (mH/km) |
| 25 | 0.3686 | 0.3932 | 0.4197 | - | - |
| 35 | 0.3518 | 0.3748 | 0.3998 | 0.4201 | - |
| 50 | 0.3358 | 0.3572 | 0.3805 | 0.3996 | 0.4432 |
| 70 | 0.3117 | 0.3313 | 0.3529 | 0.3708 | 0.4118 |
| 95 | 0.2980 | 0.3159 | 0.3359 | 0.3525 | 0.3910 |
| 120 | 0.2889 | 0.3057 | 0.3245 | 0.3401 | 0.3768 |
| 150 | 0.2808 | 0.2965 | 0.3142 | 0.3289 | 0.3638 |
| 185 | 0.2711 | 0.2858 | 0.3024 | 0.3163 | 0.3494 |
| 240 | 0.2635 | 0.2753 | 0.2905 | 0.3033 | 0.3440 |
| 300 | 0.2614 | 0.2695 | 0.2834 | 0.2953 | 0.3228 |
| 400 | 0.2556 | 0.2604 | 0.2733 | 0.2843 | 0.3100 |
| 500 | 0.2534 | 0.2556 | 0.2672 | 0.2772 | 0.3006 |

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**Table 11 : Correction Factors for Ambient Air Temperature Other than 30°C**

| Maximum Conductor Temperature (°C) | Ambient Air Temperature (°C) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 90 | 1.08 | 1.04 | 1.00 | 0.96 | 0.91 | 0.87 | 0.82 | 0.76 | 0.71 |

**Table 12 : Correction Factors for Ambient Ground Temperature Other than 20°C**

| Maximum Conductor Temperature (°C) | Ambient Ground Temperature (°C) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 90 | 1.07 | 1.04 | 1.00 | 0.96 | 0.93 | 0.89 | 0.85 | 0.80 | 0.76 |

**Table 13 : Correction Factors for Depths of Laying Other than 0.8m for Direct Buried Cable**

| Depth of Laying (m) | Single-Core Cables | | 3-Core Cables |
|---|---|---|---|
| | Nominal Conductor Size | | |
| | (≤ 185mm²) | (≥ 185mm²) | |
| 0.5 | 1.04 | 1.06 | 1.04 |
| 0.6 | 1.02 | 1.04 | 1.03 |
| 0.8 | 1.00 | 1.00 | 1.00 |
| 1.0 | 0.98 | 0.97 | 0.98 |
| 1.25 | 0.96 | 0.96 | 0.96 |
| 1.5 | 0.95 | 0.93 | 0.95 |
| 1.75 | 0.94 | 0.91 | 0.94 |
| 2.0 | 0.93 | 0.90 | 0.93 |
| 2.5 | 0.91 | 0.88 | 0.91 |
| 3.0 | 0.90 | 0.86 | 0.90 |

**Table 14 : Correction Factors for Depths of Laying Other than 0.8m for Cables in Ducts**

| Depth of Laying (m) | Single-Core Cables | | 3-Core Cables |
|---|---|---|---|
| | Nominal Conductor Size | | |
| | (≤ 185mm²) | (≥ 185mm²) | |
| 0.5 | 1.04 | 1.05 | 1.03 |
| 0.6 | 1.02 | 1.03 | 1.02 |
| 0.8 | 1.00 | 1.00 | 1.00 |
| 1.0 | 0.98 | 0.97 | 0.99 |
| 1.25 | 0.96 | 0.95 | 0.97 |
| 1.5 | 0.95 | 0.93 | 0.96 |
| 1.75 | 0.94 | 0.92 | 0.95 |
| 2.0 | 0.93 | 0.91 | 0.94 |
| 2.5 | 0.91 | 0.89 | 0.93 |
| 3.0 | 0.90 | 0.88 | 0.92 |

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**Table 15 : Correction Factors for Soil Thermal Resistivities Other than 1.5 K · m/W for Direct Buried Single-Core Cables**

| Nominal Area (mm²) | Values of Soil Thermal Resistivity (K · m/W) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 0.8 | 0.9 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| 16 | 1.29 | 1.24 | 1.19 | 1.15 | 1.00 | 0.89 | 0.82 | 0.75 |
| 25 | 1.30 | 1.25 | 1.20 | 1.16 | 1.00 | 0.89 | 0.81 | 0.75 |
| 35 | 1.30 | 1.25 | 1.21 | 1.16 | 1.00 | 0.89 | 0.81 | 0.75 |
| 50 | 1.32 | 1.26 | 1.21 | 1.16 | 1.00 | 0.89 | 0.81 | 0.74 |
| 70 | 1.33 | 1.27 | 1.22 | 1.17 | 1.00 | 0.89 | 0.81 | 0.74 |
| 95 | 1.34 | 1.28 | 1.22 | 1.18 | 1.00 | 0.89 | 0.80 | 0.74 |
| 120 | 1.34 | 1.28 | 1.22 | 1.18 | 1.00 | 0.88 | 0.80 | 0.74 |
| 150 | 1.35 | 1.28 | 1.23 | 1.18 | 1.00 | 0.88 | 0.80 | 0.74 |
| 185 | 1.35 | 1.29 | 1.23 | 1.18 | 1.00 | 0.88 | 0.80 | 0.74 |
| 240 | 1.36 | 1.29 | 1.23 | 1.18 | 1.00 | 0.88 | 0.80 | 0.73 |
| 300 | 1.36 | 1.30 | 1.24 | 1.19 | 1.00 | 0.88 | 0.80 | 0.73 |
| 400 | 1.37 | 1.30 | 1.24 | 1.19 | 1.00 | 0.88 | 0.79 | 0.73 |

**Table 16 : Correction Factors for Soil Thermal Resistivities Other than 1.5 K · m/W for Single-Core Cables in Buried Ducts**

| Nominal Area (mm²) | Values of Soil Thermal Resistivity (K · m/W) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 0.8 | 0.9 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| 16 | 1.20 | 1.17 | 1.14 | 1.11 | 1.00 | 0.92 | 0.85 | 0.79 |
| 25 | 1.21 | 1.17 | 1.14 | 1.12 | 1.00 | 0.91 | 0.85 | 0.79 |
| 35 | 1.21 | 1.18 | 1.15 | 1.12 | 1.00 | 0.91 | 0.84 | 0.79 |
| 50 | 1.21 | 1.18 | 1.15 | 1.12 | 1.00 | 0.91 | 0.84 | 0.78 |
| 70 | 1.22 | 1.19 | 1.15 | 1.12 | 1.00 | 0.91 | 0.84 | 0.78 |
| 95 | 1.23 | 1.19 | 1.16 | 1.13 | 1.00 | 0.91 | 0.84 | 0.78 |
| 120 | 1.23 | 1.20 | 1.16 | 1.13 | 1.00 | 0.91 | 0.84 | 0.78 |
| 150 | 1.24 | 1.20 | 1.16 | 1.13 | 1.00 | 0.91 | 0.83 | 0.78 |
| 185 | 1.24 | 1.20 | 1.17 | 1.13 | 1.00 | 0.91 | 0.83 | 0.78 |
| 240 | 1.25 | 1.21 | 1.17 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |
| 300 | 1.25 | 1.21 | 1.17 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |
| 400 | 1.25 | 1.21 | 1.17 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |

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**Table 17 : Correction Factors for Soil Thermal Resistivities other than 1.5 K · m/W for Direct Buried 3-Core Cables**

| Nominal Area (mm²) | Values of Soil Thermal Resistivity (K · m/W) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 0.8 | 0.9 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| 16 | 1.23 | 1.19 | 1.16 | 1.13 | 1.00 | 0.91 | 0.84 | 0.78 |
| 25 | 1.24 | 1.20 | 1.16 | 1.13 | 1.00 | 0.91 | 0.84 | 0.78 |
| 35 | 1.25 | 1.21 | 1.17 | 1.13 | 1.00 | 0.91 | 0.83 | 0.78 |
| 50 | 1.25 | 1.21 | 1.17 | 1.14 | 1.00 | 0.91 | 0.83 | 0.77 |
| 70 | 1.26 | 1.21 | 1.18 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |
| 95 | 1.26 | 1.22 | 1.18 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |
| 120 | 1.26 | 1.22 | 1.18 | 1.14 | 1.00 | 0.90 | 0.83 | 0.77 |
| 150 | 1.27 | 1.22 | 1.18 | 1.15 | 1.00 | 0.90 | 0.83 | 0.77 |
| 185 | 1.27 | 1.23 | 1.18 | 1.15 | 1.00 | 0.90 | 0.83 | 0.77 |
| 240 | 1.28 | 1.23 | 1.18 | 1.15 | 1.00 | 0.90 | 0.83 | 0.77 |
| 300 | 1.28 | 1.23 | 1.19 | 1.15 | 1.00 | 0.90 | 0.82 | 0.77 |
| 400 | 1.28 | 1.23 | 1.19 | 1.15 | 1.00 | 0.90 | 0.82 | 0.76 |

**Table 18 : Correction Factors for Soil Thermal Resistivities Other than 1.5 K · m/W for 3-Core Cables in Ducts**

| Nominal Area (mm²) | Values of Soil Thermal Resistivity (K · m/W) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.7 | 0.8 | 0.9 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| 16 | 1.12 | 1.11 | 1.09 | 1.08 | 1.00 | 0.94 | 0.89 | 0.84 |
| 25 | 1.14 | 1.12 | 1.10 | 1.08 | 1.00 | 0.94 | 0.89 | 0.84 |
| 35 | 1.14 | 1.12 | 1.10 | 1.08 | 1.00 | 0.94 | 0.88 | 0.84 |
| 50 | 1.14 | 1.12 | 1.10 | 1.08 | 1.00 | 0.94 | 0.88 | 0.84 |
| 70 | 1.15 | 1.13 | 1.11 | 1.09 | 1.00 | 0.94 | 0.88 | 0.83 |
| 95 | 1.15 | 1.13 | 1.11 | 1.09 | 1.00 | 0.94 | 0.88 | 0.83 |
| 120 | 1.15 | 1.13 | 1.11 | 1.09 | 1.00 | 0.93 | 0.88 | 0.83 |
| 150 | 1.15 | 1.13 | 1.11 | 1.09 | 1.00 | 0.93 | 0.88 | 0.83 |
| 185 | 1.16 | 1.14 | 1.11 | 1.09 | 1.00 | 0.93 | 0.87 | 0.83 |
| 240 | 1.16 | 1.14 | 1.12 | 1.10 | 1.00 | 0.93 | 0.87 | 0.82 |
| 300 | 1.17 | 1.14 | 1.12 | 1.10 | 1.00 | 0.93 | 0.87 | 0.82 |
| 400 | 1.17 | 1.14 | 1.12 | 1.10 | 1.00 | 0.92 | 0.86 | 0.81 |

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**Table 19 : Correction Factors for Groups of the 3-Core Cables in Horizontal Formation Laid Direct in the Ground**

| No. of Cables in Group | Spacing between Cable Centres (mm) | | | | |
|---|---|---|---|---|---|
| | Touching | 200 | 400 | 600 | 800 |
| 2 | 0.80 | 0.86 | 0.90 | 0.92 | 0.94 |
| 3 | 0.69 | 0.77 | 0.82 | 0.86 | 0.89 |
| 4 | 0.62 | 0.72 | 0.79 | 0.83 | 0.87 |
| 5 | 0.57 | 0.68 | 0.76 | 0.81 | 0.85 |
| 6 | 0.54 | 0.65 | 0.74 | 0.80 | 0.84 |
| 7 | 0.51 | 0.63 | 0.72 | 0.78 | 0.83 |
| 8 | 0.49 | 0.61 | 0.71 | 0.78 | - |
| 9 | 0.47 | 0.60 | 0.70 | 0.77 | - |
| 10 | 0.46 | 0.59 | 0.69 | - | - |
| 11 | 0.45 | 0.57 | 0.69 | - | - |
| 12 | 0.43 | 0.56 | 0.68 | - | - |

**Table 20 : Correction Factors for Groups of the 3-Core Cables in Single Way Ducts in Horizontal Formation**

| No. of Cables in Group | Spacing between Cable Centres (mm) | | | | |
|---|---|---|---|---|---|
| | Touching | 200 | 400 | 600 | 800 |
| 2 | 0.85 | 0.88 | 0.92 | 0.94 | 0.95 |
| 3 | 0.75 | 0.80 | 0.85 | 0.88 | 0.91 |
| 4 | 0.69 | 0.75 | 0.82 | 0.86 | 0.89 |
| 5 | 0.65 | 0.72 | 0.79 | 0.84 | 0.87 |
| 6 | 0.62 | 0.69 | 0.77 | 0.83 | 0.87 |
| 7 | 0.59 | 0.69 | 0.76 | 0.82 | 0.86 |
| 8 | 0.57 | 0.65 | 0.75 | 0.81 | - |
| 9 | 0.55 | 0.64 | 0.74 | 0.80 | - |
| 10 | 0.54 | 0.63 | 0.73 | - | - |
| 11 | 0.52 | 0.62 | 0.73 | - | - |
| 12 | 0.51 | 0.61 | 0.72 | - | - |

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**Table 21 : Correction Factors for Groups of the 3-Phase Circuits of Single-Core Cable Laid Direct in the Ground**

| No. of Cables in Group | Spacing between Cable Centres (mm) | | | | |
|---|---|---|---|---|---|
| | Touching | 200 | 400 | 600 | 800 |
| 2 | 0.73 | 0.83 | 0.88 | 0.90 | 0.92 |
| 3 | 0.60 | 0.73 | 0.79 | 0.83 | 0.86 |
| 4 | 0.54 | 0.68 | 0.75 | 0.80 | 0.84 |
| 5 | 0.49 | 0.63 | 0.72 | 0.78 | 0.82 |
| 6 | 0.46 | 0.61 | 0.70 | 0.76 | 0.81 |
| 7 | 0.43 | 0.58 | 0.68 | 0.75 | 0.80 |
| 8 | 0.41 | 0.57 | 0.67 | 0.74 | - |
| 9 | 0.39 | 0.55 | 0.66 | 0.73 | - |
| 10 | 0.37 | 0.54 | 0.65 | - | - |
| 11 | 0.36 | 0.53 | 0.64 | - | - |
| 12 | 0.36 | 0.52 | 0.64 | - | - |

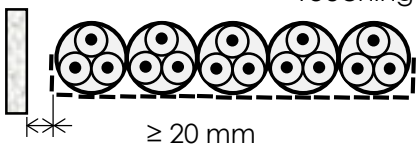
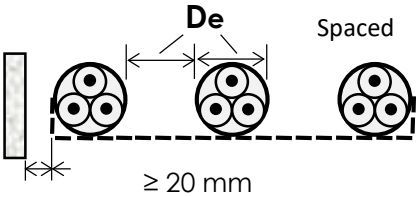
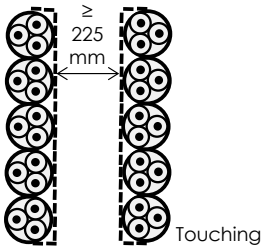
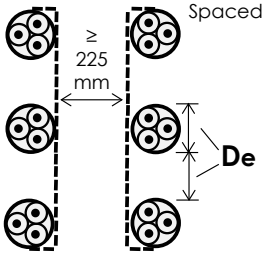
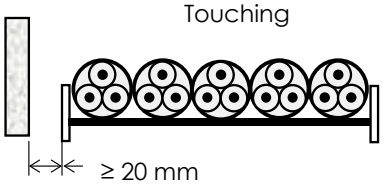
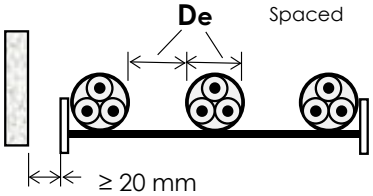
**Table 22 : Correction Factors for Groups of the 3-Phase Circuits of Single-Core Cable in Single Way Ducts**

| No. of Cables in Group | Spacing between Cable Centres (mm) | | | | |
|---|---|---|---|---|---|
| | Touching | 200 | 400 | 600 | 800 |
| 2 | 0.78 | 0.85 | 0.89 | 0.91 | 0.93 |
| 3 | 0.66 | 0.75 | 0.81 | 0.85 | 0.88 |
| 4 | 0.59 | 0.70 | 0.77 | 0.82 | 0.86 |
| 5 | 0.55 | 0.66 | 0.74 | 0.80 | 0.84 |
| 6 | 0.51 | 0.64 | 0.72 | 0.78 | 0.83 |
| 7 | 0.48 | 0.61 | 0.71 | 0.77 | 0.82 |
| 8 | 0.46 | 0.60 | 0.70 | 0.76 | - |
| 9 | 0.44 | 0.58 | 0.69 | 0.76 | - |
| 10 | 0.43 | 0.57 | 0.68 | - | - |
| 11 | 0.42 | 0.56 | 0.67 | - | - |
| 12 | 0.40 | 0.55 | 0.67 | - | - |

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**Table 23 : Reduction Factors for Groups of More than One 3-Core Cable in Air**

To be Applied to the Current-Carrying Capacity for One 3-Core Cable in Free Air

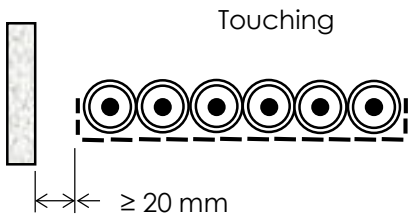
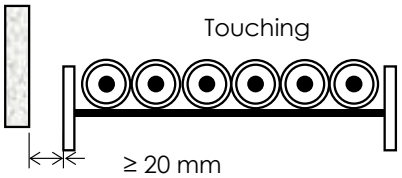
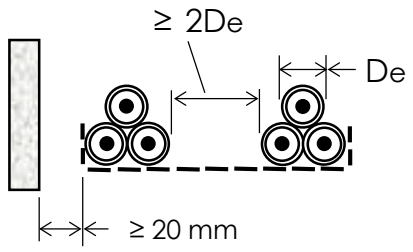
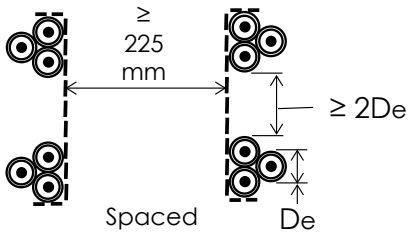
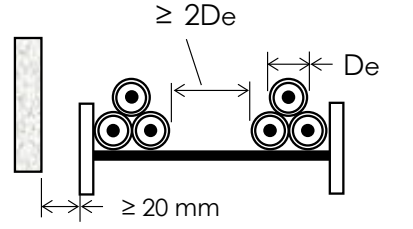
| Method of Installation | | No. of Tray | No. of Cables | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 6 | 9 |
| Cables on Perforated Trays |  | 1 | 1.00 | 0.88 | 0.82 | 0.79 | 0.76 | 0.73 |
| | | 2 | 1.00 | 0.87 | 0.80 | 0.77 | 0.73 | 0.68 |
| | | 3 | 1.00 | 0.86 | 0.79 | 0.76 | 0.71 | 0.66 |
| |  | 1 | 1.00 | 1.00 | 0.98 | 0.95 | 0.91 | - |
| | | 2 | 1.00 | 0.99 | 0.96 | 0.92 | 0.87 | - |
| | | 3 | 1.00 | 0.98 | 0.95 | 0.91 | 0.85 | - |
| Cables on Vertical Perforated Trays |  | 1 | 1.00 | 0.88 | 0.82 | 0.78 | 0.73 | 0.72 |
| | | 2 | 1.00 | 0.88 | 0.81 | 0.76 | 0.71 | 0.7 |
| |  | 1 | 1.00 | 0.91 | 0.89 | 0.88 | 0.87 | - |
| | | 2 | 1.00 | 0.91 | 0.88 | 0.87 | 0.85 | - |
| Cables on Ladder Supports, Cleats etc. |  | 1 | 1.00 | 0.87 | 0.82 | 0.80 | 0.79 | 0.78 |
| | | 2 | 1.00 | 0.88 | 0.80 | 0.78 | 0.76 | 0.73 |
| | | 3 | 1.00 | 0.85 | 0.79 | 0.76 | 0.73 | 0.70 |
| |  | 1 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | - |
| | | 2 | 1.00 | 0.99 | 0.98 | 0.97 | 0.96 | - |
| | | 3 | 1.00 | 0.98 | 0.97 | 0.96 | 0.93 | - |

Note :
1. Values given are averages for the cable types and range of conductor sizes considered. The spread of values is generally less than 5%.
2. Factors apply to single layer groups of cables as shown above and do not apply when cables are installed in more than one layer touching each other, Values for such installation may be significantly lower and must be determined by an appropriate method.
3. Values are given for vertical spacings between trays of 300mm and at least 20mm between trays and wall. For closer spacing, the factors should be reduced.
4. Values are given for horizontal spacing between trays of 225mm with trays mounted back to back. For closer spacing, the factors should be reduced.

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**Table 24 : Reduction Factors for Groups of More than One Circuit of Single-Core Cables (See Note 2)**

To be Applied to the Current-Carrying Capacity for One Circuit of Single-Core Cables in Free Air

| Method of Installation | | No. of Tray | No. of 3-phase Circuits (See Note 5) | | | Use as a Multiplier to Rating for |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | |
| Perforated Trays (Note 3) |  | 1 | 0.98 | 0.91 | 0.87 | 3 Cables in Horizontal Formation |
| | | 2 | 0.96 | 0.87 | 0.81 | |
| | | 3 | 0.95 | 0.85 | 0.78 | |
| Ladder Supports Cleats etc. (Note 3) |  | 1 | 1.00 | 0.97 | 0.96 | 3 Cables in Horizontal Formation |
| | | 2 | 0.98 | 0.93 | 0.89 | |
| | | 3 | 0.97 | 0.90 | 0.86 | |
| Perforated Trays (Note 3) |  | 1 | 1.00 | 0.98 | 0.96 | 3 Cables in Trefoil Formation |
| | | 2 | 0.97 | 0.93 | 0.89 | |
| | | 3 | 0.96 | 0.92 | 0.86 | |
| Vertical Perforated Trays (Note 4) |  | 1 | 1.00 | 0.91 | 0.89 | |
| | | 2 | 1.00 | 0.90 | 0.86 | |
| Ladder Supports Cleats etc. (Note 3) |  | 1 | 1.00 | 1.00 | 1.00 | |
| | | 2 | 0.97 | 0.95 | 0.93 | |
| | | 3 | 0.96 | 0.94 | 0.90 | |

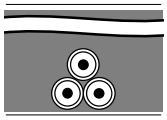
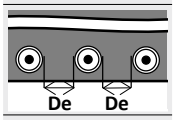
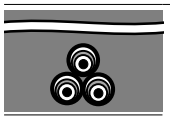
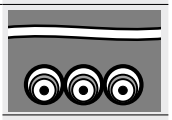
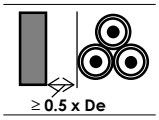
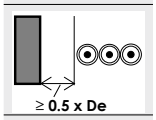
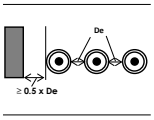
Note :
1. Values given are averages for the cable types and range of conductor sizes considered. The spread of values is generally less than 5%.
2. Factors are given for single layers of cables (or trefoil groups) as shown in the table and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and should be determined by an appropriate method.
3. Values are given for vertical spacings between trays of 300mm. For closer spacing, the factors should be reduced.
4. Values are given for horizontal spacings between trays of 225mm with trays mounted back to back. For closer spacing, the factors should be reduced.
5. For circuits having more than one cable in parallel per phase, each 3-phase set of conductors should be considered as a circuit for the purpose of this table.

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**Table 25 : Single-Core Cables with Copper Conductor, XLPE Insulation, 3.6/6kV to 18/30kV**

Conductor Operating Temperature : 90°C
Ambient Temperature : 30°C
Ground Temperature : 20°C
Depth of Laying : 0.8m

IEC 60502-2
Thermal Resistivity of Soil : 1.5 K · m/W
Thermal Resistivity of Earthenware Ducts : 1.2 K · m/W
Screens Bonded at Both Ends

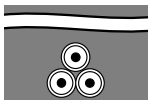
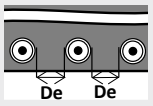
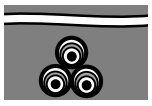
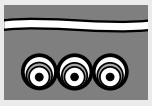
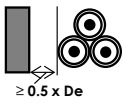
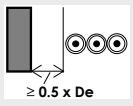
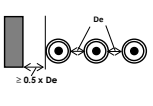
| Conductor Cross-sectional Area | Buried Direct in the Ground | | In Single-way Ducts | | In Air | | |
|---|---|---|---|---|---|---|---|
| | Trefoil | Flat Spaced | Trefoil Ducts | Flat Touching Ducts | Trefoil | Flat Touching | Flat Spaced |
| |  |  |  |  |  |  |  |
| (mm²) | (A) | (A) | (A) | (A) | (A) | (A) | (A) |
| 16 | 109 | 113 | 103 | 104 | 125 | 128 | 150 |
| 25 | 140 | 144 | 132 | 133 | 163 | 167 | 196 |
| 35 | 166 | 172 | 157 | 159 | 198 | 203 | 238 |
| 50 | 196 | 203 | 186 | 188 | 238 | 243 | 286 |
| 70 | 239 | 246 | 227 | 229 | 296 | 303 | 356 |
| 95 | 285 | 293 | 271 | 274 | 361 | 369 | 434 |
| 120 | 323 | 332 | 308 | 311 | 417 | 426 | 500 |
| 150 | 361 | 366 | 343 | 347 | 473 | 481 | 559 |
| 185 | 406 | 410 | 387 | 391 | 543 | 550 | 637 |
| 240 | 469 | 470 | 447 | 453 | 641 | 647 | 745 |
| 300 | 526 | 524 | 504 | 510 | 735 | 739 | 846 |
| 400 | 590 | 572 | 564 | 571 | 845 | 837 | 938 |
| 500 | 640 | 635 | 608 | 603 | 942 | 944 | 1003 |
| 630 | 712 | 703 | 676 | 668 | 1071 | 1070 | 1117 |
| 800 | 781 | 770 | 742 | 732 | 1210 | 1207 | 1240 |
| 1000 | 841 | 827 | 799 | 786 | 1332 | 1328 | 1344 |

Note : Current ratings table (calculated for cables having a rated voltage of 6/10kV) as per IEC 60502-2:2014.

**Table 26 : Single-Core Cables with Aluminium Conductor, XLPE Insulation, 3.6/6kV to 18/30kV**

Conductor Operating Temperature : 90°C
Ambient Temperature : 30°C
Ground Temperature : 20°C
Depth of Laying : 0.8m

IEC 60502-2
Thermal Resistivity of Soil : 1.5 K · m/W
Thermal Resistivity of Earthenware Ducts : 1.2 K · m/W
Screens Bonded at Both Ends

| Conductor Cross-sectional Area | Buried Direct in the Ground | | In Single-way Ducts | | In Air | | |
|---|---|---|---|---|---|---|---|
| | Trefoil | Flat Spaced | Trefoil Ducts | Flat Touching Ducts | Trefoil | Flat Touching | Flat Spaced |
| |  |  |  |  |  |  |  |
| (mm²) | (A) | (A) | (A) | (A) | (A) | (A) | (A) |
| 16 | 84 | 88 | 80 | 81 | 97 | 99 | 116 |
| 25 | 108 | 112 | 102 | 103 | 127 | 130 | 153 |
| 35 | 129 | 134 | 122 | 123 | 154 | 157 | 185 |
| 50 | 152 | 157 | 144 | 146 | 184 | 189 | 222 |
| 70 | 186 | 192 | 176 | 178 | 230 | 236 | 278 |
| 95 | 221 | 229 | 210 | 213 | 280 | 287 | 338 |
| 120 | 252 | 260 | 240 | 242 | 324 | 332 | 391 |
| 150 | 281 | 288 | 267 | 271 | 368 | 376 | 440 |
| 185 | 317 | 324 | 303 | 307 | 424 | 432 | 504 |
| 240 | 367 | 373 | 351 | 356 | 502 | 511 | 593 |
| 300 | 414 | 419 | 397 | 402 | 577 | 586 | 677 |
| 400 | 470 | 466 | 451 | 457 | 673 | 676 | 769 |
| 500 | 550 | 560 | 485 | 494 | 779 | 764 | 837 |
| 630 | 622 | 640 | 534 | 555 | 893 | 882 | 950 |
| 800 | 704 | 720 | 582 | 618 | 1017 | 1009 | 1070 |
| 1000 | 776 | 800 | 621 | 679 | 1150 | 1140 | 1193 |

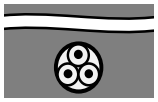
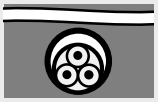
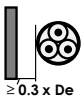
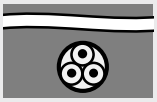
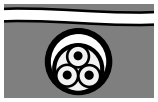
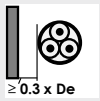
Note : Current ratings table (calculated for cables having a rated voltage of 6/10kV) as per IEC 60502-2:2014.

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**Table 27 : 3-Core Cables with Copper Conductor, XLPE Insulation, Unarmoured and Armoured, 3.6/6kV to 18/30kV**

Conductor Operating Temperature : 90°C
Ambient Temperature : 30°C
Ground Temperature : 20°C
Depth of Laying : 0.8m

IEC 60502-2
Thermal Resistivity of Soil : 1.5 K · m/W
Thermal Resistivity of Earthenware Ducts : 1.2 K · m/W
Screens Bonded at Both Ends

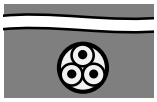
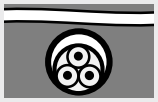
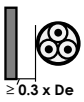
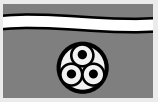
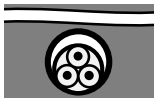
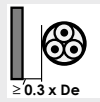
| Conductor Cross-sectional Area | Unarmoured | | | Armoured | | |
|---|---|---|---|---|---|---|
| | Buried Direct in Ground | Buried in a Duct | In Air | Buried Direct in Ground | Buried in a Duct | In Air |
| |  |  |  |  |  |  |
| (mm²) | (A) | (A) | (A) | (A) | (A) | (A) |
| 16 | 101 | 87 | 109 | 101 | 88 | 110 |
| 25 | 129 | 112 | 142 | 129 | 112 | 143 |
| 35 | 153 | 133 | 170 | 154 | 134 | 172 |
| 50 | 181 | 158 | 204 | 181 | 158 | 205 |
| 70 | 221 | 193 | 253 | 220 | 198 | 253 |
| 95 | 262 | 231 | 304 | 263 | 232 | 307 |
| 120 | 298 | 264 | 351 | 298 | 264 | 352 |
| 150 | 334 | 297 | 398 | 332 | 296 | 397 |
| 185 | 377 | 336 | 455 | 374 | 335 | 453 |
| 240 | 434 | 390 | 531 | 431 | 387 | 529 |
| 300 | 489 | 441 | 606 | 482 | 435 | 599 |
| 400 | 553 | 501 | 696 | 541 | 492 | 683 |

Note : Current ratings table (calculated for cables having a rated voltage of 6/10kV) as per IEC 60502-2:2014.

**Table 28 : 3-Core Cables with Aluminium Conductor, XLPE Insulation, Unarmoured and Armoured, 3.6/6kV to 18/30kV**

Conductor Operating Temperature : 90°C
Ambient Temperature : 30°C
Ground Temperature : 20°C
Depth of Laying : 0.8m

IEC 60502-2
Thermal Resistivity of Soil : 1.5 K · m/W
Thermal Resistivity of Earthenware Ducts : 1.2 K · m/W
Screens Bonded at Both Ends

| Conductor Cross-sectional Area | Unarmoured | | | Armoured | | |
|---|---|---|---|---|---|---|
| | Buried Direct in Ground | Buried in a Duct | In Air | Buried Direct in Ground | Buried in a Duct | In Air |
| |  |  |  |  |  |  |
| (mm²) | (A) | (A) | (A) | (A) | (A) | (A) |
| 16 | 78 | 67 | 84 | 78 | 68 | 85 |
| 25 | 100 | 87 | 110 | 100 | 87 | 111 |
| 35 | 119 | 103 | 132 | 119 | 104 | 133 |
| 50 | 140 | 122 | 158 | 140 | 123 | 159 |
| 70 | 171 | 150 | 196 | 171 | 150 | 196 |
| 95 | 203 | 179 | 236 | 204 | 180 | 238 |
| 120 | 232 | 205 | 273 | 232 | 206 | 274 |
| 150 | 260 | 231 | 309 | 259 | 231 | 309 |
| 185 | 294 | 262 | 355 | 293 | 262 | 354 |
| 240 | 340 | 305 | 415 | 338 | 304 | 415 |
| 300 | 384 | 346 | 475 | 380 | 343 | 472 |
| 400 | 438 | 398 | 552 | 432 | 393 | 545 |

Note : Current ratings table (calculated for cables having a rated voltage of 6/10kV) as per IEC 60502-2:2014.

# XLPE Insulation Thickness (UL 1072) & Wire Gauge Conversion

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### Table 29 : XLPE Insulation Thickness for Shielded Single and Multiple Conductor Cable

| Voltage Rating | Conductor Size | Conductor Size | Insulation Thickness (mm) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 100% Level | | 133% Level | | 173% Level | |
| (V) | (AWG or kcmil) | (mm²) | Min. at Any Point | Max. at Any Point | Min. at Any Point | Max. at Any Point | Min. at Any Point | Max. at Any Point |
| 5000 | 8~1000 | 8.37~506.7 | 2.16 | 3.05 | 2.16 | 3.05 | 3.43 | 4.32 |
| | 1001~2000 | 506.8~1013.4 | 3.43 | 4.32 | 3.43 | 4.32 | 3.43 | 4.32 |
| 5001~8000 | 6~1000 | 13.3~506.7 | 2.79 | 3.68 | 3.43 | 4.32 | 4.19 | 5.21 |
| | 1001~2000 | 506.8~1013.4 | 4.19 | 5.21 | 4.19 | 5.21 | 5.33 | 6.35 |
| 8001~15000 | 2~1000 | 33.6~506.7 | 4.19 | 5.21 | 5.33 | 6.35 | 6.22 | 7.37 |
| | 1001~2000 | 506.8~1013.4 | 5.33 | 6.35 | 5.33 | 6.35 | 6.22 | 7.37 |
| 15001~25000 | 1~2000 | 42.4~1013.4 | 6.22 | 7.37 | 7.75 | 8.89 | 10.2 | 11.4 |
| 25001~28000 | 1~2000 | 42.4~1013.4 | 6.73 | 7.87 | 8.38 | 9.53 | 10.8 | 12.1 |
| 28001~35000 | 1/0~2000 | 53.5~1013.4 | 8.38 | 9.53 | 10.2 | 11.4 | 14.1 | 15.5 |

### Table 30 : Wire Gauge Conversion

| U.S. Standard | Equivalent IEC Cross-section Area | Nearest available IEC Cross-section Area | U.S. Standard | Equivalent IEC Cross-section Area | Nearest available IEC Cross-section Area |
|---|---|---|---|---|---|
| (AWG/kcmil) | (mm²) | (mm²) | (AWG/kcmil) | (mm²) | (mm²) |
| 20 AWG | 0.519 | 0.5 or 0.75 | 350 kcmil | 177.3 | 185 |
| 18 AWG | 0.823 | 1 | 400 kcmil | 202.7 | 185 |
| 16 AWG | 1.31 | 1.5 | 450 kcmil | 228.0 | 240 |
| 14 AWG | 2.08 | 2.5 | 500 kcmil | 253.4 | 240 |
| 12 AWG | 3.31 | 4 | 550 kcmil | 278.7 | 300 |
| 10 AWG | 5.26 | 6 | 600 kcmil | 304.0 | 300 |
| 8 AWG | 8.37 | 10 | 650 kcmil | 329.4 | 300 |
| 6 AWG | 13.3 | 16 | 700 kcmil | 354.7 | 400 |
| 4 AWG | 21.2 | 25 | 750 kcmil | 380.0 | 400 |
| 2 AWG | 33.6 | 35 | 800 kcmil | 405.4 | 400 |
| 1 AWG | 42.4 | 50 | 850 kcmil | 430.7 | 400 |
| 1/0 kcmil | 53.5 | 70 | 900 kcmil | 456.0 | 400 |
| 2/0 kcmil | 67.2 | 70 | 950 kcmil | 481.4 | 500 |
| 3/0 kcmil | 85.0 | 95 | 1000 kcmil | 506.7 | 500 |
| 4/0 kcmil | 107.2 | 120 | 1250 kcmil | 633.4 | 630 |
| 250 kcmil | 126.7 | 120 | 1500 kcmil | 760.0 | 800 |
| 300 kcmil | 152.0 | 150 | 1750 kcmil | 886.7 | 800 or 1000 |
| | | | 2000 kcmil | 1013.4 | 1000 |

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**Table 31 : Recommended Ordering Parameters**

In order to respond to your requirement promptly, please provide the following information in your request for quotation:

| No. | Information |
|---|---|
| 1 | International or Special Standard<br>(Alternatively, please provide the precise use of the cable for our technical team to make the recommendation.) |
| 2 | Rated Voltage |
| 3 | Copper or Aluminium Conductors |
| 4 | Size of Each Conductor |
| 5 | Insulation Material: XLPE or Others |
| 6 | Number and Identification of Conductors |
| 7 | Armour Type |
| 8 | Packing |
| 9 | Required Delivery Time |
| 10 | Required Validity |

**Table 32 : Identification of Pairs for Pilot Cable**

| Pair | A - wire | B - wire | Pair | A - wire | B - wire |
|---|---|---|---|---|---|
| 1 | White | Blue | 11 | Black | Blue/black stripe |
| 2 | White/orange stripe | Orange | 12 | Black/orange stripe | Orange/black stripe |
| 3 | White/green stripe | Green | 13 | Black/green stripe | Green/black stripe |
| 4 | White/brown stripe | Brown | 14 | Black/brown stripe | Brown/black stripe |
| 5 | White/grey stripe | Grey | 15 | Black/grey stripe | Grey/black stripe |
| 6 | Red | Blue/red stripe | 16 | Yellow | Blue/yellow stripe |
| 7 | Red/orange stripe | Orange/red stripe | 17 | Yellow/orange stripe | Orange/yellow stripe |
| 8 | Red/green stripe | Green/red stripe | 18 | Yellow/green stripe | Green/yellow stripe |
| 9 | Red/brown stripe | Brown/red stripe | 19 | Yellow/brown stripe | Brown/yellow stripe |
| 10 | Red/grey stripe | Grey/red stripe | 20 | Yellow/grey stripe | Grey/yellow stripe |

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**Copper Rod / Aluminium Rod**

Copper rod of diameter of 8.0mm, made from electrolytic copper, with copper purity higher than 99.95%. Aluminium rod of diameter of 9.5mm, drawn from aluminium ingots with minimum aluminium purity requirement of 99.70%.

**Drawing (Annealing for Copper Wire; Hard Drawn for Aluminium Wire)**

A variety of required copper wire sizes are drawn from the copper rod, and treated at specified temperatures to restore ductility to the copper, making it soft and flexible. The heat treatment process is known as annealing and the resulting metal is known as soft annealed copper.

Hard drawn: A variety of required aluminium wire sizes are hard drawn from aluminium rod. As a result, the strength of the wire is increased, and it has a better surface finish.

**Stranding**

The conductor consists of annealed copper or aluminium wires. Usually conductors up to 1000mm$^2$ will be circular compacted stranded and shall comply with the requirement of IEC 60228 Class 2.

**Triple Extrusion Process: Conductor Screen / Insulation / Insulation Screen**

The three layers are extruded in one step using state-of-the-art Catenary Continuous Vulcanization (CCV) technology with advanced automatic concentricity control system which guarantees the highest quality of the insulated conductor.

- **Conductor Screen (Stress Control Layer)**

A cross-linked semi-conducting compound is extruded over the metallic conductor. This semi-conductive layer acts as a stress control layer as it smooths out any irregularities that could cause protrusions into the insulation. Such protrusions into the insulation increases the localized stress that may weaken the long-term breakdown strength of the insulation.

- **Insulation**

Each core conductor is insulated by extruding cross-linked low density polyethylene. This insulating compound is specially developed for the CCV technology.

- **Insulation Screen (Stress Relief Layer)**

A cross-linked semi-conducting compound is extruded over the insulation. This layer, which has a very smooth surface, serves as a transition material between the insulation where electric field exists and the conductive metallic screen and where the electric field is zero. This helps to reduce the stress at the insulation layer. This insulation screen layer could be bonded to the insulation or is a strippable type for easy removal to facilitate splicing and terminating works.

**Metallic Screen**

The metallic screen usually consists of a layer of copper tape, applied helically with an overlap, over the insulation screen. The metallic screens in a 3-core cable are in contact with each other.

**Cable Assembly (Optional)**

For a 3-core cable, the screened cores will have identification tapes (Brown, Black, Grey) under the metallic screen, before the cores are laid up. A non-hygroscopic polypropylene filler is applied between the laid up cores to provide a circular shape to the overall cable. Polypropylene tape(s) or PETP (Polyester) tape(s) is used as a barrier tape over the laid up cores.

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**Separation Sheath (Optional)**

All armoured cables have an extruded layer of Black PVC, MDPE or LSZH separation sheath, applied over the core or laid-up cores to separate the different metals to prevent the corrosion of metal due to galvanic effect.

**Armour (Optional)**

In the case of armoured cables, the armour is applied over a separation sheath which is used to provide additional mechanical protection. For single-core cables, the armour consists of layer of aluminium wires, double aluminium tape or other non-magnetic armour, and for multi-core cables, the armour consists of a layer of galvanized steel wires, or double galvanized tape.

**Outer Sheath Extrusion**

All cables have an extruded layer of PVC, MDPE or LSZH outersheath over the core, laid-up cores or the armour. This outersheath has anti-termite properties and also protects the cable from sunlight and other atmospheric conditions. The outer sheath is normally black but another colour may be provided upon agreement between the manufacturer and the purchaser.

**Inspection**

**Packing**

# Characteristics of XLPE-Insulated Cables

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### XLPE-Insulated Cables

Cross-linked polyethylene (XLPE) insulated power cable offers various advantages compared with conventional paper insulated oil-filled cable. XLPE cable is lighter in weight, has more flexibility, and does not require an oil supplying system, hence requires less maintenance. In addition it boasts smaller charging current and dielectric loss. XLPE cable also has excellent thermal properties which improves performance in continuous and short circuit current carrying capacity. Based on these features, XLPE cable is used in up to 500kV extra-high voltage line.

### Characteristics of XLPE Insulated Cable

Polyethylene (PE) is superior in electrical characteristics and chemical resistance, however it faces a thermal instability issue and starts to melt when it reaches a temperature of 110°C.

Cross-linked polyethylene (XLPE), which is the result of a molecular bonding chemical process called 'cross-linking', solves this melting issue.

The molecular structure of cross-linked polyethylene allows excellent ozone resistance as well as outstanding stability and resistance to heat. The mainstream process of 'cross-linking' is to blend peroxide (e.g. dicumyl peroxide) into polyethylene and extrude it around the conductor, and heat it up to a high temperature sufficient to achieve the peroxidation.

### Comparison of Characteristics between 'Cross-linked Polyethylene' and 'Pure Polyethylene'

| Item | | Material | |
|---|---|---|---|
| | | Cross-linked Polyethylene | Pure Polyethylene |
| Specific Gravity | | 0.92 | 0.92 |
| Dielectric Strength | (kV/mm) | 35~50 | 35~50 |
| Volume Resistivity | (Ω•cm) | $10^{18}$ | $10^{18}$ |
| Dielectric Constant | | 2.3 | 2.3 |
| Power Factor | (%) | 0.03 | 0.03 |
| Tensile Strength | ($kg/mm^2$) | 1.2~1.5 | 1.2~1.5 |
| Elongation | (%) | 500~600 | 500~700 |
| Max. Operating Temperature | (°C) | 90 | 75 |
| Max. Short Circuit Temperature | (°C) | 250 | 150 |
| Heat Deformation | | G | F |
| Ozone Resistivity | | G | G |
| Water Resistance | | F | F |
| Oil Resistivity | | E | E |

Note: E - Excellent, G - Good, F - Fair

# Rated Voltage of Medium Voltage Cables

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The rated voltage of the cable for a given application shall be suitable for the operating conditions in the system in which the cable is used.

- $U_0/U$ ($U_m$) - Cable rated voltage which applies to system voltage and operating condition of the cable
- $U_0$- the rated power frequency voltage between conductor and earth or metallic screen
- U- the rated power frequency voltage between conductors
- $U_m$- the maximum value of the 'highest system voltage' for which the equipment may be used

To facilitate the selection of the cable, systems are divided into three categories:

- Category A: Systems in which any phase conductor that comes in contact with earth or an earth conductor is disconnected from the system within 1 min.
- Category B: Systems which, under fault conditions, will operate for a short period with one phase earthed. This period, according to IEC 60183, should not exceed 1 h. For cables that are covered by IEC 60502-2, this period should not exceed 8 h.
- Category C: Systems that do not fall into Category A or B.

The following table provides the maximum permissible operating voltage relative to each rated voltage ($U_0/U$).

| Highest System Voltage ($U_m$) | Rated Voltage ($U_0/U$) | |
|---|---|---|
| (kV) | IEC 60502-2 | BS 6622, BS 7835 |
| | (kV) | |
| 7.2 | 3.6/6 | 3.8/6.6 |
| 12 | 6/10 | 6.35/11 |
| 17.5 | 8.7/15 | 8.7/15 |
| 24 | 12/20 | 12.7/22 |
| 36 | 18/30 | 19/33 |

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## Cable Testing

All cables will go through the relevant tests in accordance with IEC 60502-2 before delivery.

**Routine Tests**

Routine tests are carried out on each finished length of cable to verify overall cable quality. They consist of:

1. Measurement of conductor resistance
2. Partial discharge test
3. High voltage test

**Sample Tests**

1. Conductor examination
2. Check of dimensions
3. Voltage test for cables of rated voltage above 3.6/6 (7.2)kV
4. Hot set test for XLPE insulation

**Type Tests**

1. Electrical type test
2. Non-electrical type test

## Main Applicable Standards

| Standards | Description |
|---|---|
| IEC 60502-2 | Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m$ = 1.2 kV) up to 30 kV ($U_m$ = 36 kV) – Part 2: Cables for rated voltages from 6 kV ($U_m$ = 7.2 kV) up to 30 kV ($U_m$ = 36 kV) |
| IEC 60228 | Conductors of insulated cables |
| IEC 60840 | Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m$ = 36 kV) up to 150 kV ($U_m$ = 170 kV) |
| BS 6622 | Electric cables – Armoured cables with thermosetting insulation for rated voltages from 3.8/6.6 kV to 19/33 kV |
| BS 7835 | Electric cables – Armoured cables with thermosetting insulation for rated voltages from 3.8/6.6 kV to 19/33 kV having low emission of smoke and corrosive gases when affected by fire |
| ICEA S-66-524 | Cross-linked polyethylene wire and cable for the transmission and distribution of electricalenergy |
| ICEA S-93-639 | 5-46kV shielded power cable for use in the transmission and distribution of electrical energy |
| UL 1072 | Medium voltage power cables |
| IEC 60811 | Electric and optical fibre cables – Test methods for non-metallic materials |
| IEC 60332 | Tests on electric and optical fibre cables under fire conditions |
| IEC 60331-4 | Tests for electric cables under fire conditions – Circuit integrity – Part 4: Test method for fire with shock at a temperature at least 830°C for cables of rated voltage higher than 1kV up to and including 30kV |
| IEC 61034 | Measurement of smoke density of cables burning under defined conditions |
| IEC 60754 | Test on gases evolved during combustion of materials from cables |

Note: Low Smoke Zero Halogen (LSZH) cables comply with IEC 61034 and IEC 60754
Fire resistant cables comply with IEC 60331-4
Flame retardant cables comply with IEC 60332