

CABLES

Selection guide

This guide is applicable to cables used for cathodic protection systems. It is intended to give guidance in the selection of conductor size, insulation level and construction of cable to be used on AC and DC current systems operating at low voltages. It also summarises the information needed to select the appropriate materials.



| | | CABLES | | | | | |
|----------------------|---------------------------|---------------------------|------------|------------------|--------|-----------|------|
| | | NYN | XLPE / PVC | XLPE / SWA / PVC | NSSHÖU | HYDROFIRM | PVDF |
| INSTALLATION GENERAL | AIR | ■ | ■ | ■ | | | |
| | UNDERGROUND | ■ | ■ | ■ | | | |
| | WATER | ■ | ■ | ■ | | ■ | |
| DEEP GROUNDBED | OPEN HOLE | CHLORIDE-FREE WATER | ■ | ■ | | | |
| | | WATER CONTAINING CHLORIDE | | | | | ■ |
| | CLOSED HOLE | CHLORIDE-FREE SOIL | ■ | ■ | | | |
| | | SOIL CONTAINING CHLORIDE | | | | | ■ |
| SHALLOW GROUNDBED | CHLORIDE-FREE SOIL | ■ | ■ | | | | |
| | SOIL CONTAINING CHLORIDE | | | | | ■ | |
| OFFSHORE ANODES | WATER CONTAINING CHLORIDE | | | | ■ | ■ | |
| INTERNAL ANODES | CHLORIDE-FREE WATER | ■ | ■ | ■ | ■ | | |
| | WATER CONTAINING CHLORIDE | | | | ■ | ■ | |

CABLES

Type: NYY 0.6/1 kV

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German Cathodic Protection



Conductors: Plain annealed copper conductors
 Insulation: PVC (Polyvinylchloride)
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 70°C
 Short circuit temperature: Maximum 160°C
 Types: O - without protective earth conductor
 J - with protective earth conductor
 Standard: VDE0271 / IEC60502



Core identification:

RE - Circular solid conductor
 RM - Circular stranded conductor

Core colour code NYY-J

3 cores (green-yellow, black, blue)
 4 cores (green-yellow, black, blue, brown)
 5 cores (green-yellow, black, blue, brown, black)

Core colour code NYY-O

1 core (black)
 2 cores (black, blue)
 3 cores (black, blue, brown)
 4 cores (black, blue, brown, black)
 5 cores (black, blue, brown, black, black)

Voltage rating:

Cables are classified by the rated voltages U_0/U .

U_0 is the voltage between the conductor and earth or earthed metallic cover (concentric conductor screen, armouring, metal sheath).

U is the voltage between the phase conductors.

Cables are insulated against voltage stress in three-phase systems, the rated voltage $U=1$ kV being laid down in accordance with the VDE Standard voltage insulation levels (1,6,10, 20 kV).

The rated voltage U_0 , by which the conductor insulation to earth is measured, is calculated from the equation
 $U_0 = U / 1.73$

The standard, rounded-off rated voltages employed in three-phase systems in compliance with VDE and IEC are accordingly :
 $U_0/U = 0.6/1; 3.6/6; 6/10; 12/20$ kV

The maximum continuous permissible operating voltage (U_m) during undisturbed operation in DC systems is 1.8 kV for cables in which $U_0=0.6$ kV

In single and three-phase systems the following maximum continuous permissible operating voltages (U_m) apply:

$U_0 = 0.6$ kV

$U_m = 1.2$ kV in three-phase systems
 $U_m = 1.4$ kV in single-phase systems both conductors insulated.
 $U_m = 0.7$ kV in single-phase systems one conductor earthed.

| CORES x CROSS SECTIONAL AREA | SHEATH | | RESISTANCE | | WEIGHT | NOMINAL DELIVERY LENGTH |
|------------------------------|-----------|----------------|------------|-----------------------------|--------|-------------------------|
| | THICKNESS | OUTER DIAMETER | DC 20° C | INDUCTIVE PER CORE AT 50 Hz | | |
| mm ² | mm | mm | Ohm/km | Ohm/km | kg/km | m |
| 1 x 10 RE | 1.8 | 12 | 1.830 | - | 190 | 2 000 |
| 1 x 16 RE | 1.8 | 13 | 1.150 | 0.254 | 260 | 2 000 |
| 1 x 25 RM | 1.8 | 15 | 0.727 | 0.240 | 390 | 1 000 |
| 1 x 35 RM | 1.8 | 16 | 0.524 | 0.228 | 490 | 1 000 |
| 1 x 50 RM | 1.8 | 18 | 0.387 | 0.219 | 640 | 1 000 |
| 1 x 70 RM | 1.8 | 19 | 0.268 | 0.210 | 850 | 1 000 |
| 1 x 95 RM | 1.8 | 21 | 0.193 | 0.203 | 1 150 | 1 000 |
| 1 x 120 RM | 1.8 | 23 | 0.153 | 0.196 | 1 400 | 1 000 |
| 1 x 150 RM | 1.8 | 26 | 0.124 | 0.192 | 1 700 | 1 000 |
| 1 x 185 RM | 1.8 | 28 | 0.099 | 0.184 | 2 100 | 1 000 |
| 2 x 1.5 RE | 1.8 | 11 | 12.10 | 0.108 | 175 | 1 000 |
| 2 x 2.5 RE | 1.8 | 13 | 7.410 | 0.104 | 230 | 1 000 |
| 2 x 4 RE | 1.8 | 14 | 4.610 | 0.100 | 295 | 1 000 |
| 2 x 6 RE | 1.8 | 15 | 3.080 | 0.094 | 360 | 1 000 |
| 2 x 10 RE | 1.8 | 17 | 1.830 | 0.088 | 480 | 1 000 |
| 2 x 16 RE | 1.8 | 19 | 1.150 | 0.083 | 650 | 1 000 |
| 3 x 1.5 RE | 1.8 | 12 | 12.10 | 0.108 | 200 | 1 000 |
| 3 x 2.5 RE | 1.8 | 13 | 7.410 | 0.104 | 260 | 1 000 |
| 3 x 4 RE | 1.8 | 15 | 4.610 | 0.100 | 345 | 1 000 |
| 3 x 6 RE | 1.8 | 16 | 3.080 | 0.094 | 425 | 1 000 |
| 3 x 10 RE | 1.8 | 19 | 1.830 | 0.088 | 580 | 1 000 |
| 3 x 25 RM | 1.8 | 24 | 0.727 | 0.080 | 1 270 | 1 000 |
| 4 x 1.5 RE | 1.8 | 13 | 12.10 | 0.115 | 235 | 1 000 |
| 4 x 2.5 RE | 1.8 | 14 | 7.410 | 0.110 | 310 | 1 000 |
| 4 x 4 RE | 1.8 | 16 | 4.610 | 0.107 | 410 | 1 000 |
| 4 x 6 RE | 1.8 | 17 | 3.080 | 0.100 | 520 | 1 000 |
| 4 x 10 RE | 1.8 | 19 | 1.830 | 0.094 | 710 | 1 000 |
| 4 x 16 RE | 1.8 | 22 | 1.150 | 0.090 | 1 020 | 1 000 |
| 4 x 25 RM | 1.8 | 27 | 0.727 | 0.086 | 1 590 | 1 000 |
| 4 x 35 RM | 1.8 | 29 | 0.524 | 0.083 | 1 650 | 1 000 |
| 4 x 50 RM | 1.9 | 33 | 0.387 | 0.083 | 2 200 | 1 000 |
| 4 x 70 RM | 2.1 | 37 | 0.268 | 0.082 | 3 000 | 1 000 |
| 5 x 1.5 RE | 1.8 | 14 | 12.10 | 0.115 | 350 | 1 500 |
| 5 x 2.5 RE | 1.8 | 15 | 7.410 | 0.110 | 450 | 1 000 |
| 5 x 4 RE | 1.8 | 17 | 4.610 | 0.107 | 600 | 1 000 |
| 5 x 6 RE | 1.8 | 20 | 3.080 | 0.100 | 750 | 1 000 |
| 5 x 10 RE | 1.8 | 22 | 1.830 | 0.094 | 1 000 | 1 000 |
| 5 x 16 RE | 1.8 | 24 | 1.150 | 0.090 | 1 400 | 1 000 |
| 5 x 25 RM | 1.8 | 30 | 0.727 | 0.086 | 2 100 | 1 000 |
| 5 x 35 RM | 1.9 | 34 | 0.524 | 0.083 | 2 750 | 1 000 |

CABLES

Type: XLPE / PVC 0.6/1 kV

Document No.: 08-200-R2

Sheet: 1 of 1

German Cathodic Protection



SINGLE CORE (Cu/XLPE/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: Cables up to and including 35 mm²
 IEC 502 -1994
 All cables other conform generally to
 BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Outer sheath | Approx. Overall Diameter | DC Resistance at 20° C | Current Capacity at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|---------------------------|--------------------------|------------------------|---------------------------|----------------------|
| mm ² | mm | mm | mm | Ohm/km | A | kg/km |
| 1 x 16 | 0.7 | 1.4 | 9.5 | 1.150 | 105 | 215 |
| 1 x 25 | 0.9 | 1.4 | 11.0 | 0.727 | 140 | 310 |
| 1 x 35 | 0.9 | 1.4 | 12.0 | 0.524 | 174 | 410 |
| 1 x 50 | 1.0 | 1.4 | 13.5 | 0.387 | 212 | 540 |
| 1 x 70 | 1.1 | 1.4 | 15.5 | 0.268 | 269 | 745 |
| 1 x 95 | 1.1 | 1.4 | 17.5 | 0.193 | 331 | 1 010 |
| 1 x 120 | 1.2 | 1.5 | 19.0 | 0.153 | 386 | 1 250 |
| 1 x 150 | 1.4 | 1.6 | 21.0 | 0.124 | 442 | 1 535 |
| 1 x 185 | 1.6 | 1.6 | 23.5 | 0.099 | 511 | 1 910 |
| 1 x 240 | 1.7 | 1.7 | 26.0 | 0.074 | 612 | 2 470 |
| 1 x 300 | 1.8 | 1.8 | 28.5 | 0.059 | 707 | 3 080 |

TWO CORE (Cu/XLPE/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Outer sheath | Approx. Overall Diameter | DC Resistance at 20° C | Current Capacity at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|---------------------------|--------------------------|------------------------|---------------------------|----------------------|
| mm ² | mm | mm | mm | Ohm/km | A | kg/km |
| 2 x 4 | 0.7 | 1.8 | 13.0 | 4.610 | 34 | 240 |
| 2 x 6 | 0.7 | 1.8 | 14.2 | 3.080 | 43 | 300 |
| 2 x 10 | 0.7 | 1.8 | 15.6 | 1.830 | 105 | 405 |
| 2 x 16 | 0.7 | 1.8 | 17.8 | 1.150 | 120 | 565 |
| 2 x 25 | 0.9 | 1.8 | 21.0 | 0.727 | 160 | 825 |
| 2 x 35 | 0.9 | 1.8 | 23.2 | 0.524 | 200 | 1 070 |
| 2 x 50 | 1.0 | 1.8 | 26.3 | 0.387 | 240 | 1 240 |
| 2 x 70 | 1.1 | 1.8 | 29.3 | 0.268 | 260 | 1 700 |
| 2 x 95 | 1.1 | 1.9 | 33.9 | 0.193 | 320 | 2 280 |
| 2 x 120 | 1.2 | 2.0 | 37.5 | 0.153 | 370 | 2 830 |
| 2 x 150 | 1.4 | 2.2 | 41.5 | 0.099 | 430 | 3 510 |

THREE CORE (Cu/XLPE/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: Cables up to and including 10 mm²
 IEC 502 -1994
 All cables other conform generally to
 BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Outer sheath | Approx. Overall Diameter | DC Resistance at 20° C | Current Capacity at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|---------------------------|--------------------------|------------------------|---------------------------|----------------------|
| mm ² | mm | mm | mm | Ohm/km | A | kg/km |
| 3 x 10 | 0.7 | 1.8 | 16.5 | 1.830 | 74 | 500 |
| 3 x 16 | 0.7 | 1.8 | 18.9 | 1.150 | 105 | 705 |
| 3 x 25 | 0.9 | 1.8 | 19.9 | 0.727 | 140 | 955 |
| 3 x 35 | 0.9 | 1.8 | 22.3 | 0.524 | 174 | 1 250 |
| 3 x 50 | 1.0 | 1.8 | 25.5 | 0.387 | 212 | 1 610 |
| 3 x 70 | 1.1 | 1.9 | 28.2 | 0.268 | 269 | 2 230 |
| 3 x 95 | 1.1 | 2.0 | 32.2 | 0.193 | 331 | 3 000 |
| 3 x 120 | 1.2 | 2.1 | 35.8 | 0.153 | 386 | 3 750 |
| 3 x 150 | 1.4 | 2.2 | 39.0 | 0.124 | 442 | 4 640 |
| 3 x 185 | 1.6 | 2.4 | 43.6 | 0.099 | 511 | 5 730 |
| 3 x 240 | 1.7 | 2.6 | 49.6 | 0.075 | 612 | 7 360 |

FOUR CORE (Cu/XLPE/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: Cables up to and including 16 mm²
 IEC 502 -1994
 All cables other conform generally to
 BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Outer sheath | Approx. Overall Diameter | DC Resistance at 20° C | Current Capacity at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|---------------------------|--------------------------|------------------------|---------------------------|----------------------|
| mm ² | mm | mm | mm | Ohm/km | A | kg/km |
| 4 x 10 | 0.7 | 1.8 | 17.9 | 1.830 | 74 | 615 |
| 4 x 16 | 0.7 | 1.8 | 20.6 | 1.150 | 105 | 880 |
| 4 x 25 | 0.9 | 1.8 | 22.0 | 0.727 | 140 | 1 220 |
| 4 x 35 | 0.9 | 1.8 | 25.4 | 0.524 | 174 | 1 620 |
| 4 x 50 | 1.0 | 1.8 | 28.3 | 0.387 | 212 | 2 100 |
| 4 x 70 | 1.1 | 1.9 | 32.1 | 0.268 | 269 | 2 930 |
| 4 x 95 | 1.1 | 2.0 | 36.3 | 0.193 | 331 | 3 950 |
| 4 x 120 | 1.2 | 2.1 | 39.7 | 0.153 | 386 | 4 920 |
| 4 x 150 | 1.4 | 2.2 | 44.8 | 0.124 | 442 | 6 150 |
| 4 x 185 | 1.6 | 2.4 | 49.7 | 0.099 | 511 | 7 600 |
| 4 x 240 | 1.7 | 2.6 | 54.8 | 0.075 | 612 | 9 730 |

CABLES

Type: XLPE / (AWA) SWA / PVC 0.6/1 kV

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German Cathodic Protection



SINGLE CORE (Cu/XLPE/AWA/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Armour: Aluminium wire
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: Cables up to and including 120 mm²
 IEC 502 -1994
 All cables other conform generally to BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Extruded Bedding | Thickness of Outer sheath | Diameter of Armour wire | Approx. Overall Diameter | DC Resistance at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|-------------------------------|---------------------------|-------------------------|--------------------------|------------------------|----------------------|
| mm ² | mm | mm | mm | mm | mm | Ohm/km | kg/km |
| 1 x 50 | 1.0 | 0.8 | 1.5 | 1.6 | 18.8 | 0.387 | 765 |
| 1 x 70 | 1.1 | 0.8 | 1.5 | 1.6 | 20.6 | 0.268 | 1000 |
| 1 x 95 | 1.1 | 0.8 | 1.6 | 1.6 | 22.7 | 0.193 | 1300 |
| 1 x 120 | 1.2 | 0.8 | 1.6 | 1.6 | 24.4 | 0.153 | 1560 |
| 1 x 150 | 1.4 | 1.0 | 1.7 | 1.6 | 26.8 | 0.124 | 1920 |
| 1 x 185 | 1.6 | 1.0 | 1.8 | 1.6 | 29.0 | 0.099 | 2300 |
| 1 x 240 | 1.7 | 1.0 | 1.8 | 1.6 | 31.7 | 0.075 | 2890 |
| 1 x 300 | 1.8 | 1.0 | 1.9 | 1.6 | 34.1 | 0.060 | 3530 |
| 1 x 400 | 2.0 | 1.2 | 2.0 | 2.0 | 38.8 | 0.047 | 4590 |
| 1 x 500 | 2.2 | 1.2 | 2.1 | 2.0 | 42.4 | 0.037 | 5660 |
| 1 x 630 | 2.4 | 1.2 | 2.2 | 2.0 | 48.6 | 0.028 | 7100 |

TWO CORE (Cu/XLPE/SWA/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Armour: Steel wire
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: All cables conform to BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Extruded Bedding | Thickness of Outer sheath | Diameter of Armour wire | Approx. Overall Diameter | DC Resistance at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|-------------------------------|---------------------------|-------------------------|--------------------------|------------------------|----------------------|
| mm ² | mm | mm | mm | mm | mm | Ohm/km | kg/km |
| 2 x 4 | 0.7 | 0.8 | 1.4 | 0.9 | 15.2 | 4.610 | 440 |
| 2 x 6 | 0.7 | 0.8 | 1.4 | 0.9 | 16.4 | 3.080 | 520 |
| 2 x 10 | 0.7 | 0.8 | 1.5 | 0.9 | 18.0 | 1.830 | 670 |
| 2 x 16 | 0.7 | 0.8 | 1.5 | 1.25 | 20.9 | 1.150 | 965 |
| 2 x 25 | 0.9 | 0.8 | 1.6 | 1.25 | 24.3 | 0.727 | 1310 |
| 2 x 35 | 0.9 | 1.0 | 1.7 | 1.6 | 27.8 | 0.524 | 1810 |
| 2 x 50 | 1.0 | 1.0 | 1.8 | 1.6 | 30.9 | 0.387 | 2070 |
| 2 x 70 | 1.1 | 1.0 | 1.9 | 2.0 | 34.7 | 0.268 | 2650 |
| 2 x 95 | 1.1 | 1.2 | 2.0 | 2.0 | 39.9 | 0.193 | 3640 |
| 2 x 120 | 1.2 | 1.2 | 2.1 | 2.0 | 43.5 | 0.153 | 4330 |
| 2 x 150 | 1.4 | 1.2 | 2.2 | 2.0 | 47.3 | 0.124 | 5140 |

THREE CORE (Cu/XLPE/SWA/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Armour: Steel wire
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: All cables conform to BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Extruded Bedding | Thickness of Outer sheath | Diameter of Armour wire | Approx. Overall Diameter | DC Resistance at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|-------------------------------|---------------------------|-------------------------|--------------------------|------------------------|----------------------|
| mm ² | mm | mm | mm | mm | mm | Ohm/km | kg/km |
| 3 x 2.5 | 0.7 | 0.8 | 1.4 | 0.9 | 14.8 | 7.410 | 415 |
| 3 x 4 | 0.7 | 0.8 | 1.4 | 0.9 | 15.9 | 4.610 | 490 |
| 3 x 6 | 0.7 | 0.8 | 1.4 | 0.9 | 17.2 | 3.080 | 580 |
| 3 x 10 | 0.7 | 0.8 | 1.5 | 1.25 | 19.6 | 1.830 | 850 |
| 3 x 16 | 0.7 | 0.8 | 1.6 | 1.25 | 22.2 | 1.150 | 1110 |
| 3 x 25 | 0.9 | 1.0 | 1.7 | 1.6 | 24.3 | 0.727 | 1520 |
| 3 x 35 | 0.9 | 1.0 | 1.8 | 1.6 | 26.9 | 0.524 | 1910 |
| 3 x 50 | 1.0 | 1.0 | 1.8 | 1.6 | 30.1 | 0.387 | 2400 |
| 3 x 70 | 1.1 | 1.0 | 1.9 | 1.6 | 32.8 | 0.268 | 3100 |
| 3 x 95 | 1.1 | 1.2 | 2.1 | 2.0 | 38.2 | 0.193 | 4310 |
| 3 x 120 | 1.2 | 1.2 | 2.2 | 2.0 | 41.8 | 0.153 | 5170 |

FOUR CORE (Cu/XLPE/SWA/PVC) Cables 0.6/1 kV



Conductors: Copper circular stranded
 Insulation: XLPE
 Armour: Steel wire
 Sheath/Jacket: PVC (Polyvinylchloride)
 Colour: Black
 Operating temperature: Maximum 90°C
 Short circuit temperature: Maximum 250°C
 Standard: All cables conform to BS 5467 - 1997 and IEC 60502

| Cores and Cross-sectional area | Thickness of Insulation | Thickness of Extruded Bedding | Thickness of Outer sheath | Diameter of Armour wire | Approx. Overall Diameter | DC Resistance at 20° C | Approx. Cable Weight |
|--------------------------------|-------------------------|-------------------------------|---------------------------|-------------------------|--------------------------|------------------------|----------------------|
| mm ² | mm | mm | mm | mm | mm | Ohm/km | kg/km |
| 4 x 2.5 | 0.7 | 0.8 | 1.4 | 0.9 | 15.8 | 7.410 | 470 |
| 4 x 4 | 0.7 | 0.8 | 1.4 | 0.9 | 17.0 | 4.610 | 570 |
| 4 x 6 | 0.7 | 0.8 | 1.5 | 1.25 | 18.3 | 3.080 | 790 |
| 4 x 10 | 0.7 | 0.8 | 1.5 | 1.25 | 21.0 | 1.830 | 1020 |
| 4 x 16 | 0.7 | 0.8 | 1.6 | 1.25 | 23.9 | 1.150 | 1350 |
| 4 x 25 | 0.9 | 1.0 | 1.7 | 1.6 | 26.4 | 0.727 | 1850 |
| 4 x 35 | 0.9 | 1.0 | 1.8 | 1.6 | 30.0 | 0.524 | 2360 |
| 4 x 50 | 1.0 | 1.0 | 1.9 | 1.6 | 33.1 | 0.387 | 2970 |
| 4 x 70 | 1.1 | 1.2 | 2.1 | 2.0 | 38.1 | 0.268 | 4190 |
| 4 x 95 | 1.1 | 1.2 | 2.2 | 2.0 | 42.3 | 0.193 | 5370 |
| 4 x 120 | 1.2 | 1.4 | 2.3 | 2.5 | 47.1 | 0.153 | 6910 |

CABLES

Type: NSSHÖU 0.6/1 kV

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German Cathodic Protection



Ethylene Propylene Rubber (EPR) has excellent physical and ageing properties and a high maximum permissible operating temperature. Therefore, EPR insulated cables are generally used in heavy-duty equipment subject to high mechanical stresses such as in mines and quarries, and also in areas with a risk of explosion.

Conductors: Finely-stranded copper conductor of tinned copper wires. Class 5 according to DIN VDE 0295 and IEC 228

Insulation: EPR insulation (Ozone and weather resistant)

Inner sheath: Rubber for all multi-core cables

Outer sheath: Synthetic vulcanised rubber, oil-resistant according to DIN VDE 0473 Part 811-2-1, EN/IEC 60811-2-1

Colour: Colour of outer sheath: yellow

Operating temperature: 90° C

Short circuit temperature: 200° C

Special application: Multicore cables marked with (*) can be used for equipment in waste water process, cooling, surface and rain water. * Tested as flame retardant cables and accepted by US Mine Safety and Health Administration (MSHA)

Standard: DIN VDE 0298 Part 3, Minimum bending radii
VDE 0482 Part 332-1-2, Behaviour in case of fire, EN/IEC 60332-1-2
VDE 0250, Cables, wires and flexible cords for power insulation.
Rubber insulated flexible cable NS-SHÖU
VDE 0298 Part 4, Current carrying capacity

Types: J - with protective earth conductor
O - without protective earth conductor

Core identification:

Core colour code NSSHÖU-J

3 cores (green-yellow, black, blue)
4 cores (green-yellow, black, blue, brown)
5 cores (green-yellow, black, blue, brown, black)

Core colour code NSSHÖU-O

1 core (black)
2 cores (black, blue)
3 cores (black, blue, brown)
4 cores (black, blue, brown, black)
5 cores (black, blue, brown, black, black)

Voltage rating:

Rated voltage : $U_0/U = 0.6/1$ kV

Maximum permissible voltage

- DC System : $U_m = 1.8$ kV

- AC single-phase system

Phase-to-Phase : $U_m = 1.4$ kV

Phase-to-Earth : $U_m = 0.7$ kV

- AC three-phase system : $U_m = 1.2$ kV



| CORES x CROSS SECTIONAL AREA | CONDUCTOR | | SHEATH | | RESISTANCE DC 20° C | CURRENT CAPACITY AMBIENT TEMP 30° C | WEIGHT | NOMINAL DELIVERY LENGTH |
|------------------------------|-----------|----------------------|----------------|-----------|---------------------|-------------------------------------|--------|-------------------------|
| | DIAMETER | INSULATION THICKNESS | OUTER DIAMETER | THICKNESS | | | | |
| mm ² | mm | mm | mm | mm | Ohm/km | A | kg/km | m |
| 1 x 16 | 6.3 | 1.2 | 12.5 | 1.6 | 1.240 | 99 | 255 | 1 000 |
| 1 x 25 | 7.8 | 1.4 | 15.0 | 2.0 | 0.795 | 131 | 283 | 1 000 |
| 1 x 35 | 9.2 | 1.4 | 16.5 | 2.0 | 0.565 | 162 | 493 | 1 000 |
| 1 x 50 | 11.0 | 1.6 | 18.5 | 2.0 | 0.393 | 202 | 670 | 1 000 |
| 1 x 70 | 13.1 | 1.6 | 20.5 | 2.2 | 0.277 | 250 | 900 | 1 000 |
| 1 x 95 | 15.1 | 1.8 | 23.5 | 2.2 | 0.210 | 301 | 1 140 | 1 000 |
| 1 x 120 | 17.0 | 1.8 | 25.5 | 2.5 | 0.164 | 352 | 1 430 | 1 000 |
| 1 x 150 | 19.0 | 2.0 | 27.5 | 2.5 | 0.132 | 404 | 1 740 | 1 000 |
| 1 x 185 | 21.0 | 2.2 | 31.0 | 3.0 | 0.108 | 461 | 2 150 | 500 |
| 1 x 240 | 24.0 | 2.4 | 34.5 | 3.0 | 0.082 | 633 | 2 760 | 500 |
| 2 x 1.5* | 1.6 | 0.8 | 13.0 | 1.6 | 13.70 | 23 | 187 | 1 000 |
| 2 x 2.5* | 2.6 | 0.9 | 14.0 | 1.6 | 8.210 | 30 | 239 | 1 000 |
| 2 x 4* | 3.2 | 1.0 | 17.0 | 2.0 | 5.090 | 41 | 356 | 1 000 |
| 3 x 1.5* | 1.6 | 0.8 | 13.5 | 1.6 | 13.70 | 23 | 210 | 1 000 |
| 3 x 2.5* | 2.6 | 0.9 | 15.0 | 1.6 | 8.210 | 30 | 273 | 1 000 |
| 3 x 4* | 3.2 | 1.0 | 1.0 | 2.0 | 5.090 | 41 | 408 | 1 000 |
| 3 x 6* | 3.9 | 1.0 | 19.5 | 2.0 | 3.390 | 53 | 510 | 1 000 |
| 3 x 10* | 5.1 | 1.2 | 23.0 | 2.2 | 1.950 | 74 | 770 | 1 000 |
| 4 x 1.5* | 1.6 | 0.8 | 14.0 | 1.6 | 13.70 | 23 | 239 | 1 000 |
| 4 x 2.5* | 2.6 | 0.9 | 17.0 | 2.0 | 8.210 | 30 | 364 | 1 000 |
| 4 x 4* | 3.2 | 1.0 | 19.0 | 2.0 | 5.090 | 41 | 477 | 1 000 |
| 4 x 6* | 3.9 | 1.0 | 20.5 | 2.0 | 3.390 | 53 | 600 | 1 000 |
| 4 x 10* | 5.1 | 1.2 | 25.0 | 2.2 | 1.950 | 74 | 920 | 1 000 |
| 4 x 16* | 6.3 | 1.2 | 30.0 | 2.5 | 1.240 | 99 | 1 370 | 1 000 |
| 4 x 25* | 7.8 | 1.4 | 35.5 | 3.0 | 0.795 | 131 | 2 010 | 1 000 |
| 4 x 35* | 9.2 | 1.4 | 38.5 | 3.0 | 0.565 | 162 | 2 530 | 1 000 |
| 4 x 50* | 11.0 | 1.8 | 45.0 | 3.5 | 0.393 | 202 | 3 520 | 1 000 |
| 5 x 1.5 | 1.6 | 0.8 | 15.0 | 1.6 | 13.70 | 23 | 266 | 1 000 |
| 5 x 2.5 | 2.6 | 0.9 | 18.0 | 2.0 | 8.210 | 30 | 403 | 1 000 |
| 5 x 4 | 3.2 | 1.0 | 20.5 | 2.0 | 5.090 | 41 | 540 | 1 000 |
| 5 x 6 | 3.9 | 1.0 | 23.0 | 2.2 | 3.390 | 53 | 720 | 1 000 |
| 5 x 10 | 5.1 | 1.2 | 27.0 | 2.2 | 1.950 | 74 | 1 050 | 1 000 |
| 5 x 16 | 6.3 | 1.2 | 32.5 | 2.5 | 1.240 | 99 | 1 580 | 500 |
| 5 x 25 | 7.8 | 1.4 | 38.5 | 3.0 | 0.795 | 131 | 2 320 | 500 |

CABLES**Type: HYDROFIRM (T)**

Document No.: 08-500-R1

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German Cathodic Protection**Application**

HYDROFIRM (T) cables are intended for continuous immersion in drinking or ground water at depths up to 500 m, for use under medium mechanical stresses, and for use as a connection cable for electrical equipment. They may also be submerged in rain, sea, or surface water, as well as in industrial process or cooling water. However, these cables have limited suitability for mixed water types as defined by DIN 4045 and 4046.

They are not suitable for use in water containing more than 0.5 mg/l of chlorine.

Suitability for continuous immersion in water is verified by a certificate that includes manufacturing supervision from the VDE Test and Certification Institute (German Institute of Electrical Engineers).

Whereas tests conducted by the Federal Authority of Materials Testing (BAM), based on the KTW recommendations (Area C, "Installation Materials"), prove the suitability of this cable's use in drinking water.

HYDROFIRM (T) cables may be used indoors and outdoors, but not in areas exposed to explosion hazards. For protected, fixed installation within equipment, pipes or wells, these cables may be operated with an AC voltage to 1000V or a DC voltage to 750V dependent on earthing.

Technical details

The design is based on DIN VDE 0282 Part 810. HYDROFIRM (T) cables are at least equivalent to type 07RN rubber-insulated flexible cables with respect to their electrical and mechanical properties.

Finely stranded conductor of bare copper wires, Class 5 to DIN VDE 0295 and IEC 228

Insulation and sheath consist of special EPR-based materials, adapted for use in ground water and drinking water.

Insulation: Special rubber compound, at least equivalent to compound type 3G13 in DIN VDE 0207, colour coding to DIN VDE 0293.

Inner sheath (for sizes >16mm² or more than 5 conductors): Special rubber compound at least equivalent to compound type GM1b to DIN VDE 0207.

Outer sheath: Special rubber compound, mechanical and thermal properties equivalent/identical to compound type 5GM3 to DIN VDE 0207 coloured blue.

Tensile strength: The maximum allowable tensile stress is 15N/mm².

Voltage rating

Rated Voltage: $U_0/U = 450/750$ V

Max. operating voltages in: 3 phase AC operation $U_0/U = 475/825$ V

DC operation $U_0/U = 619/1238$ V

AC test voltage = 2.5kV



| Cores and Cross-sectional area | Approx. Number of strands | Max. Strand diameter | Approx. Core diameter | Overall diameter | | Approx. Cable Weight |
|--|---------------------------|----------------------|-----------------------|------------------|------|----------------------|
| | | | | min | max | |
| mm ² | | mm | mm | mm | mm | kg/km |
| 1 x 6 | 75 | 0.31 | 3.2 | 7.5 | 8.8 | 120 |
| 1 x 10 | 77 | 0.41 | 4.1 | 9.5 | 11.0 | 180 |
| 1 x 16 | 123 | 0.41 | 5.6 | 11.5 | 13.5 | 265 |
| 1 x 25 | 190 | 0.41 | 6.8 | 13.5 | 15.5 | 380 |
| 1 x 35 | 268 | 0.41 | 8.1 | 15.0 | 17.5 | 500 |
| 1 x 50 | 384 | 0.41 | 9.6 | 17.5 | 20.0 | 690 |
| 1 x 70 | 545 | 0.41 | 11.2 | 20.0 | 22.5 | 920 |
| 1 x 95 | 724 | 0.41 | 13.2 | 22.5 | 25.0 | 1180 |
| 1 x 120 | 926 | 0.41 | 14.9 | 24.0 | 26.0 | 1470 |
| HYDROFIRM (T) round, without ground conductor | | | | | | |
| 3 x 1.5 | 28 | 0.26 | 1.5 | 9.5 | 11.0 | 137 |
| 3 x 2.5 | 45 | 0.26 | 1.9 | 11.0 | 13.0 | 197 |
| 3 x 4 | 51 | 0.31 | 2.5 | 13.0 | 15.0 | 280 |
| 3 x 6 | 75 | 0.31 | 3.2 | 14.5 | 16.0 | 370 |
| 3 x 10 | 77 | 0.41 | 4.1 | 19.0 | 21.5 | 665 |
| 3 x 16 | 123 | 0.41 | 5.6 | 23.5 | 26.0 | 1000 |
| 3 x 25 | 190 | 0.41 | 6.8 | 28.5 | 31.0 | 1440 |
| 3 x 35 | 268 | 0.41 | 8.1 | 32.0 | 35.5 | 1870 |
| 3 x 50 | 384 | 0.41 | 9.6 | 37.0 | 41.0 | 2560 |
| 3 x 70 | 545 | 0.41 | 11.2 | 42.0 | 45.5 | 3370 |
| HYDROFIRM (T) round, with ground conductor | | | | | | |
| 3 G 1.5 | 28 | 0.26 | 1.5 | 9.5 | 11.0 | 137 |
| 3 G 2.5 | 45 | 0.26 | 1.9 | 11.0 | 13.0 | 197 |
| 3 G 4 | 51 | 0.31 | 2.5 | 13.0 | 15.0 | 280 |
| HYDROFIRM (T) round, with ground conductor | | | | | | |
| 4 G 1.5 | 28 | 0.26 | 1.5 | 10.0 | 12.0 | 175 |
| 4 G 2.5 | 45 | 0.26 | 1.9 | 12.0 | 14.0 | 250 |
| 4 G 4 | 51 | 0.31 | 2.5 | 14.0 | 16.0 | 375 |
| 4 G 6 | 75 | 0.31 | 3.2 | 15.5 | 18.0 | 475 |
| 4 G 10 | 77 | 0.41 | 4.1 | 21.0 | 23.5 | 825 |
| 4 G 16 | 123 | 0.41 | 5.6 | 25.5 | 29.0 | 1250 |
| 4 G 25 | 190 | 0.41 | 6.8 | 31.0 | 34.0 | 1800 |
| 4 G 35 | 268 | 0.41 | 8.1 | 35.0 | 39.0 | 2360 |
| 4 G 50 | 384 | 0.41 | 9.6 | 41.0 | 45.0 | 3250 |
| 4 G 70 | 545 | 0.41 | 11.2 | 46.5 | 50.0 | 4300 |
| 4 G 95 | 724 | 0.41 | 13.2 | 51.6 | 55.6 | 5650 |
| 4 G 120 | 926 | 0.41 | 14.9 | 56.1 | 56.1 | 6950 |

Core colour code

1 core (black)

3 cores (green-yellow, brown, blue)

4 cores (green-yellow, brown, blue, black)

CABLES

Type: PVDF 1 x 10 mm²

Document No.: 08-600-R1

Sheet: 1 of 1

German Cathodic Protection



Polyvinylidenfluoride (PVDF) insulated cables are used in highly corrosive environments inside deep anode groundbeds of cathodic protection systems.

PVDF 1 x 10 mm² type has been specially developed for extremely corrosive environments of anodes/groundbeds, caused mainly due to the presence of chlorine gas or ions in water.

PVDF is rated for continuous use over a temperature range of -10° to +125°C. It has high resistance to corrosive chemicals and organic solvents. Although this material is very hard with high tensile strength, abrasion resistance and excellent cut-through, limitations of flexibility are evident. It is resistant against creeping and fatigue.

Design and tests

DIN 40 500

Copper for electrical purposes;
wires of copper; technical conditions of delivery

DIN VDE 0472 Part 501

Testing of cables, wires and flexible cords;
conductor resistance

DIN VDE 0472 Part 502

Testing of cables, wires and flexible cords;
insulation resistance and volume resistivity

DIN VDE 0472 Part 509

Testing of cables, wires and flexible cords;
dielectric strength on cables, wires and cords

Voltage rating

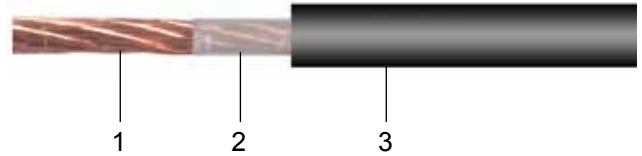
Rated voltage : 600 V

Electrical characteristics at 20° C

DC Resistance : 1.84 Ohm/km
Insulation resistance : 100 MOhm x km
Dielectric strength of insulation : 15 kV

Mechanical characteristics

Ambient temperature : -10 up to +125° C
Bending radius : 200 mm
Max. tension load : 800 N



Construction

- 1 Copper conductor, stranded
Strands 320 x 0.20 acc. to DIN 40 500
Cross-section 10 mm²
Diameter : approx. 4.8 mm
- 2 Separating tape 1 x 16 x 0.19 lapped
Material : PET (polyethyleneglycolterephthalate)
- 3 Outer sheath, black
Material: PVDF (polyvinylidenefluoride)
Thickness min. 1.8 mm
Outside diameter min. 9.2 mm
Weight approx. 193 kg/km

Typical application

