

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					
		NY	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

Document No.: PSE-100-R622_CP Cable

Sheet: 1 of 1

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 U₀/U.

U₀ 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 U₀, 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:

$$U_0/U = 0.6/1; 3.6/6; 6/10; 12/20 \text{ kV}$$

The maximum continuous permissible operating voltage (U_m) during undisturbed operation in DC systems is 1.8 kV for cables in which U₀=0.6 kV

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

$$U_0 = 0.6 \text{ kV}$$

$$U_m = 1.2 \text{ kV in three-phase systems}$$

$$U_m = 1.4 \text{ kV in single-phase systems both conductors insulated.}$$

$$U_m = 0.7 \text{ kV in single-phase systems one conductor earthed.}$$

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	1150	1 000
1 x 120 RM	1.8	23	0.153	0.196	1400	1 000
1 x 150 RM	1.8	26	0.124	0.192	1700	1 000
1 x 185 RM	1.8	28	0.099	0.184	2100	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.: PSE-100-R622_CP Cable

Sheet: 1 of 1

SINGLE CORE (Cu / XLPE / PVC) Cable 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) Cable 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) Cable 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) Cable 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

Document No.: PSE-100-R622_CP Cable

Sheet: 1 of 1

**PSE ENGINEERING
GMBH**

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

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
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

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

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
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

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

Document No.: PSE-100-R622_CP Cable

Sheet: 1 of 1

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 NSSHÖU

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)

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

Voltage rating:

Rated voltage : U0/U = 0.6/1 kV

Maximum permissible voltage

- DC System : Um = 1.8 kV

- AC single-phase system

Phase-to-Phase : Um = 1.4 kV

Phase-to-Earth : Um = 0.7 kV

- AC three-phase system : Um = 1.2 kV

CABLES

TYPE: HYDROFIRM (T)

Document No.: PSE-100-R622_CP Cable

Sheet: 1 of 1

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 VDE0207.

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.: PSE-100-R622_CP Cable

Sheet: 1 of 1

Polyvinylidene fluoride (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

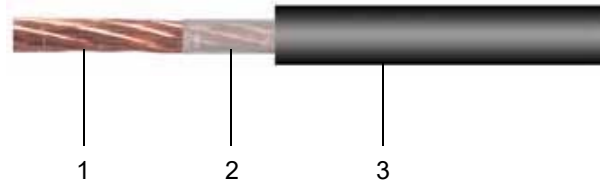
Rated voltage : 600 V

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

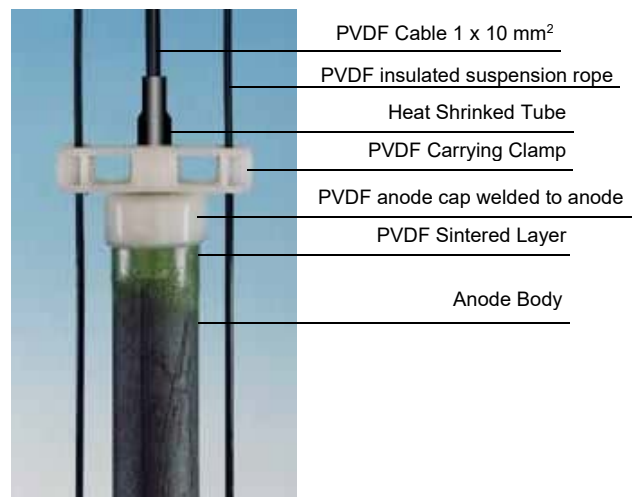
Ambient temperature : -10 up to +125°C
Bending radius : 200 mm
Max. tension load : 800 N



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 (polyvinylidene fluoride)
Thickness min. 1.8 mm
Outside diameter min. 8.4 mm
Weight approx. 193 kg/km

Typical Application



CABLE CONNECTIONS

Compression Cable Lugs and Joints

Document No.: PSE-09-100-R622

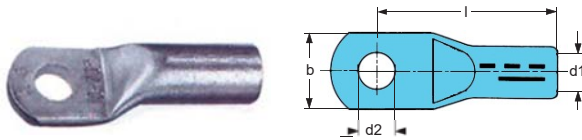
Sheet: 1 of 1

Tubular compression cable lugs DIN 46235

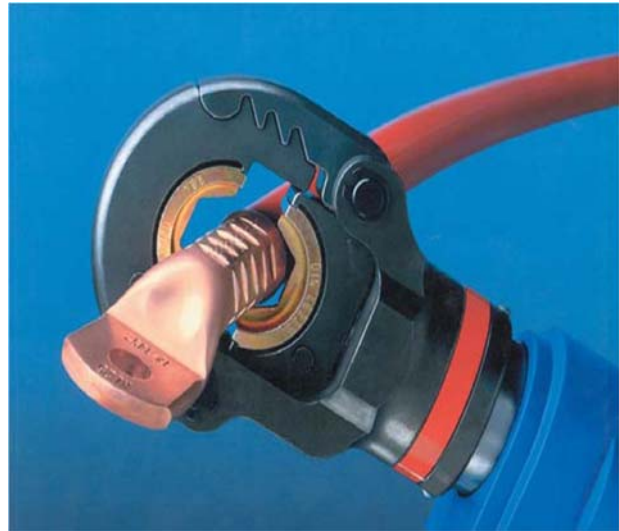
for circular stranded copper conductors and circular stranded/sector shaped copper conductors.

Material: E-copper

Surface: tin plated, optional copper finished



Conductor mm ²	Bolt size	Dimensions (mm)				Type No.
		b	d1	d2	l	
6	M6	8.5	3.8	6.4	24	KL101/R6
10	M6	9	4.5	6.4	27	KL102/R6
16	M6	13	5.5	6.4	36	KL103/R6
16	M8	13	5.5	8.4	36	KL103/R8
16	M10	17	5.5	10.5	36	KL103/R10
25	M8	16	7	8.4	38	KL104/R8
25	M10	17	7	10.5	38	KL104/R10
25	M12	19	7	13	38	KL104/R12
35	M8	17	8.2	8.4	42	KL105/R8
35	M10	19	8.2	10.5	42	KL105/R10
35	M12	21	8.2	13	42	KL105/R12
50	M8	20	10	8.4	52	KL106/R8
50	M10	22	10	10.5	52	KL106/R10
50	M12	24	10	13	52	KL106/R12
50	M16	28	10	17	52	KL106/R16
70	M8	24	11.5	8.4	55	KL107/R8
70	M10	24	11.5	10.5	55	KL107/R10
70	M12	24	11.5	13	55	KL107/R12
70	M16	30	11.5	17	55	KL107/R16
95	M10	28	13.5	10.5	65	KL108/R10
95	M12	28	13.5	13	65	KL108/R12
95	M16	32	13.5	17	65	KL108/R16
120	M10	32	15.5	10.5	70	KL109/R10
120	M12	32	15.5	13	70	KL109/R12
120	M16	32	15.5	17	70	KL109/R16
150	M10	34	17	10.5	78	KL110/R10
150	M12	34	17	13	78	KL110/R12
150	M16	34	17	17	78	KL110/R16
150	M20	40	17	21	78	KL110/R20
185	M10	37	19	10.5	82	KL111/R10
185	M12	37	19	13	82	KL111/R12
185	M16	37	19	17	82	KL111/R16
185	M20	40	19	21	82	KL111/R20
240	M12	42	21.5	13	92	KL112/R12
240	M16	42	21.5	17	92	KL112/R16
240	M20	45	21.5	21	92	KL112/R20



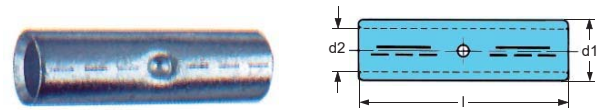
Compression joints DIN 46267 Part 1

for non-tension connections

for circular stranded copper conductors and circular stranded/sector shaped copper conductors.

Material: E-copper

Surface: tin plated, optional copper finished



Conductor mm ²	Conductor dia. mm	Dimensions (mm)			Type No.
		d1	d2	l	
6	2.7 - 3.3	5.5	3.8	30	KL121 R
10	3.5 - 4.2	6	4.5	30	KL122 R
16	4.5 - 5.3	8.5	5.5	50	KL123 R
25	5.6 - 6.6	10	7	50	KL124 R
35	6.6 - 7.9	12.5	8.2	50	KL125 R
50	7.7 - 9.1	14.5	10	56	KL126 R
70	9.3 - 11.0	16.5	11.5	56	KL127 R
95	11.0 - 12.9	19	13.5	70	KL128 R
120	12.5 - 14.5	21	15.5	70	KL129 R
150	13.9 - 16.2	23.5	17	80	KL130 R
185	15.5 - 18.0	25.5	19	85	KL131 R
240	17.8 - 20.6	29	21.5	90	KL132 R

CABLE CONNECTIONS

Compression Cable Joints and Tap Connectors

Document No.: PSE-09-200-R622

Sheet: 1 of 1

Split bolt connector Cellp-Cu FK

Usable as branch-off or connection clamp.

Material: Electrolyte copper



Type	Cat. no.	Main cable		Cross section branch-off	Width across flat
		cross section	Ø mm		
FK 10	126 179	10 mm ²	4.1	2.5 - 10 mm ²	13 mm
FK 16	126 180	16 mm ²	5.1	2.5 - 16 mm ²	17 mm
FK 25	126 181	25 mm ²	6.4	4 - 25 mm ²	19 mm
FK 35	126 182	35 mm ²	7.5	4 - 35 mm ²	22 mm
FK 50	126 183	50 mm ²	9.0	10 - 50 mm ²	24 mm
FK 95	126 184	95 mm ²	12.5	10 - 70 mm ²	32 mm

Universal tap connectors

for circular stranded copper conductors and circular stranded/sector shaped copper conductors.

Material: brass, electro tinned

Bolts: steel 8.8, hot galvanized



with 1 cover for single service taps			
Type No.	Main conductor mm ²	Tap conductor mm ²	Bolt size
PF 330 433 433	16 - 95	4 - 25	M8
PF 330 434 434	50 - 120	6 - 50	M8
PF 330 435 435	50 - 185	6 - 50	M8

Universal tap connectors

for circular stranded copper conductors and circular stranded/sector shaped copper conductors.

Material: brass, electro tinned

Bolts: steel 8.8, hot galvanized



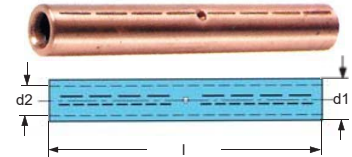
with 2 covers for double service taps			
Type No.	Main conductor mm ²	Tap conductor mm ²	Bolt size
PF 330 824 824	16 - 95	4 - 25	M8
PF 330 437 437	50 - 185	6 - 50	M8

Compression joints DIN 48085 Part 1

for full-tension connections

for circular stranded copper conductors and circular stranded/sector shaped copper conductors.

Material: copper



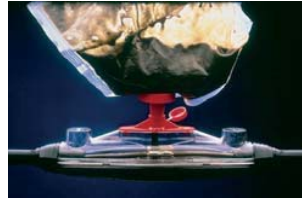
Conductor mm ²	Conductor dia. mm	Dimensions (mm)			Type No.
		d1	d2	l	
6	2.7 - 3.3	6.5	3.5	65	KL181 R
10	3.5 - 4.2	8.5	4.5	80	KL182 R
16	4.5 - 5.3	8.5	5.5	95	KL183 R
25	5.6 - 6.6	10	7.0	95	KL184 R
35	6.6 - 7.9	12.5	8.2	95	KL185 R
50	7.7 - 9.1	14.5	10.0	110	KL186 R
70	9.3 - 11.0	16.5	11.5	110	KL187 R
95	11.0 - 12.9	21	13.5	145	KL188 R
120	12.5 - 14.5	23.5	15.0	160	KL189 R
150	13.9 - 16.2	25.5	16.5	180	KL190 R
185	15.5 - 18.0	31.5	18.5	260	KL191 R
240	17.8 - 20.6	34.5	21.0	310	KL192 R

CABLE CONNECTIONS

Cable Splicing Kits

Document No.: PSE-09-300-R622

Sheet: 1 of 1



3M™ Scotchcast™ Cable Joint Kits

Scotchcast™ 82-A, 91 A and 92-A series suitable for armoured PVC, rubber and XLPE insulated cables. The mold body & mold cover made of halogen-free flame-retardant material.

These inline jointing sleeves are used for making reliable and weather-proof joints on solid insulated or mass impregnated paper insulated cables. Designed for those customers whose preference is a resin cold pour jointing system. Each kit can also be used with various cable types and sizes.

The basic kit is rated up to 1 kV and includes:

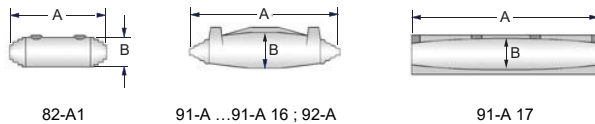
- Pre-shaped moulds
- Tape to seal the mould ends
- Scotchcast resin
- Assembly instruction

Conductor connectors are to be ordered separately.

Scotchcast™ No. 4 resin is an unfilled solvent free two component **epoxy resin** for room temperature curing.

Scotchcast™ No. 1471 resin is an unfilled solvent free two component **polyether urethane** resin for room temperature curing.

Applicable Code/Standards : DIN VDE 0278 Part 623



Type of kit	Cable outside diameter	Max. cable cross section mm ²	Resin type no.	Dimensions mm	
				A	B
82-A 1	7-16 mm	4 x 4	4	182	25
82-A 1,5	7-16 mm	4 x 6	4	270	43
91-A 11	8-22 mm	4 x 10	1471	190	36
91-A 11,5	8-22 mm	4 x 16	1471	215	39
91-A 12	14-30 mm	4 x 25	1471	276	49
91-A 13	23-35 mm	4 x 50	1471	360	54
91-A 14	28-47 mm	4 x 95	1471	400	69
91-A 15	33-55 mm	4 x 150	1471	520	100
91-A 16	45-70 mm	4 x 240	1471	700	128
91-A 17	55-77 mm	4 x 400	1471	870	140
92-A 1	8-22 mm	4 x 10	4	190	36
92-A 2	14-30 mm	4 x 25	4	276	49
92-A 3	23-35 mm	4 x 50	4	360	54
92-A 4	28-47 mm	4 x 95	4	400	69



3M™ Scotchcast™ Branch Cable Joint Kits

Scotchcast™ branch joints 91-AB series kits consist of 2 semi-transparent mould bodies which snap easily around the prepared cables. A specially shaped foam fills the gaps at either end of the joint and guarantees seal against resin leakage.

In the 91-AB kits the branch cable is prepared on the top of the main cable, the mould body is then snapped around both cables.

Should a double branch be required, both ends of the mould body are suitable to accept a branch cable.

The 91-AB series can also be used as inline joint.

The full range of sizes of the 91-AB series start from 4 x 1.5 mm² and go up to 4 x 240 mm² for the main cable, and 4 x 1.5 mm² to 4 x 150 mm² for the branch cable.

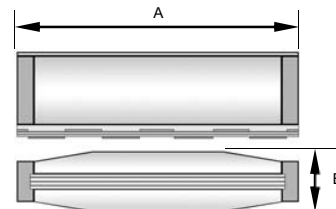
Scotchcast™ No. 1471 resin is utilised to ensure a tough reliable joint.

The basic kit is rated up to 1 kV and includes:

- Pre-shaped moulds
- Tape to seal the mould ends
- Scotchcast resin
- Assembly instruction

Conductor connectors are to be ordered separately.

Applicable Code/Standards : DIN VDE 0278 Part 623



Type of kit	Main cable mm ²	Branch cable mm ²	Max. Ø main cable	Max. Ø branch cable	Dimensions mm	
					A	B
91-AB 111	4 x 6	4 x 4	15 mm	15 mm	140	40
91-AB 112	4 x 10	4 x 10	22 mm	21 mm	170	58
91-AB 113	4 x 25	4 x 16	29 mm	22 mm	225	75
91-AB 114	4 x 70	4 x 25	35 mm	25 mm	350	95
91-AB 115	4 x 150	4 x 50	50 mm	30 mm	445	112
91-AB 116	4 x 185	4 x 70	58 mm	35 mm	540	125
91-AB 117	4 x 240	4 x 150	65 mm	45 mm	440	145

The Thermit Welding Process

Thermit welding connections are the accepted method of attaching Cathodic Protection leads to pipes (steel or cast iron), tanks and structures.

Thermit welding connections weld the conductors and the structure to be protected so no galvanic corrosion can occur at the interface. The Thermit welding process is specifically formulated to provide minimum heat effect on steel, which is especially important on thin-wall, high-stress pipes.

Thermit welding connections are also used for header cable taps, conductor splices and terminations, and ground rod connections.

A Thermit welding connection ...

- Has current carrying capacity equal to that of the conductor.
- Is permanent with a low resistance connection that cannot loosen or corrode.
- Uses lightweight, inexpensive equipment.
- Requires no external source of power or heat.
- Requires no special skills.
- Can be easily checked for quality.

Thermit welding connections are made with a semi-permanent graphite mould, which holds the conductors to be welded. Weld metal (a mixture of copper oxide and aluminum) is dumped into the top of the mould. The mold is covered and the weld metal ignited. The exothermic reaction produces molten copper, which results in a permanent, high conductivity connection.

Weld powder

Each tube contains a measured quantity of weld-metal powder, together with the correct amount of silver-coloured starting powder. The powder supplied is sufficient to make the appropriate joint.

Graphite mould

The graphite mould comprises a crucible, a tap hole and a weld cavity. The exothermic reaction takes place in the crucible, the molten copper is directed by the tap hole into the weld cavity, which is designed to allow easy removal of the mould from the finished joint.

This design prolongs the mould's life to allow approximately 75 joints, on an average, depending upon the level of care in use.

Mould holder

In most cases the graphite mould is split so it can be clamped around the conductors to be joined. The mould holder can secure different types of moulds and should be ordered separately according to the type and size of joint required.

**Cable cleaner**

Designed for cleaning circular conductors, i.e. rods and cables

**Standard tool kit**

The tool kit comprises:

- File card brush for cleaning conductors.
- Flint igniter for starting the reaction.
- Mould scraper for removing slag left in the crucible after a joint has been made.
- Mould brush for final cleaning of the crucible, tap hole and weld cavity after making the joint.

CABLE CONNECTIONS

Thermit Welding

Document No.: PSE-09-400-R622

Sheet: 2 of 2



Equipment for copper conductor to steel pipe connections

		GRAPHITE MOULD	POWDER CARTRIDGE	MOULD HOLDER	MOULD SCRAPER	CONDUCTOR SLEEVE
SOLID CONDUCTOR	Nominal area 2.5 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 4 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 6 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 10 mm ²	221466	PC-32	MH-129	MS-B136A	CS-H102
	Nominal area 16 mm ²	GM-01	PC-15	MH-129	MS-B136A	---
STRANDED CONDUCTOR	Nominal area 2.5 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 4 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 6 mm ²	GM-01	PC-15	MH-129	MS-B136A	CS-H105
	Nominal area 10 mm ²	GM-02	PC-32	MH-129	MS-B136A	CS-H102
	Nominal area 16 mm ²	GM-01	PC-15	MH-129	MS-B136A	---
	Nominal area 25 mm ²	GM-02	PC-32	MH-129	MS-B136A	---
	Nominal area 35 mm ²	GM-03	PC-32	MH-129	MS-B136A	---
	Nominal area 50 mm ²	GM-04	PC-45	MH-129	MS-B136A	---
	Nominal area 70 mm ²	GM-05	PC-65	MH-129	MS-B136A	---
	Nominal area 95 mm ²	GM-06	PC-115	MH-160	MS-B136B	---
	Nominal area 120 mm ²	GM-07	PC-115	MH-160	MS-B136B	---
Nominal area 150 mm ²	GM-08	PC-150	MH-160	MS-B136B	---	

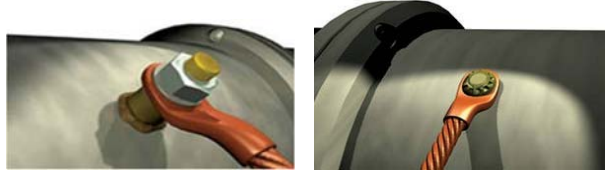
CABLE CONNECTIONS

Electronic Pin Brazing Unit S30XC

Document No.: PSE-22-800-R622

Sheet: 1 of 1

When a cathodic protection system is applied to steel, ductile or cast-iron pipelines, vessels, tanks or reinforcement bars. No more confusion and maintenance with thermit weld molds and weld portions. Just pin braise your cables, easy and quick!



The advantages with pin brazing

- Works in any weather condition
- Fast, the pin brazing process takes only a second Does not affect internal coatings
- Economical
- Safe for the operator
- Low temperature, much less than thermit welding Does not melt the work material down
- No need for special moulds
- The whole preparation takes less than 1 minute

Electronic Pin Brazing Unit S30XC

S30 X/C is a small hand bearable pin brazing unit made specially for cathodic protection and grounding installations. S30 X/C is electronically steered, driven by 3 pcs of 12 V batteries which is easily exchangeable with a cassette system. The power (36V DC) comes from sealed high power batteries placed in a separate battery box for easy exchanging.

The well-reputed patented Automatic S4 gun is standard. Brazing pins without fuse wire is used.

Technical Specification

Voltage	36 V DC	Width	230 mm
Number of brazes	40-60	Height	390 mm
Weight (13Ah/16Ah)	22/25 kg	Length	280 mm

Unit S30XC is delivered with:

Braze pistol S4 Automatic	SAFE 9105
Battery case for 13 Ah with cables	SAFE 9321
Batteries 13 Ah 3 pcs required	SAFE 8092
Battery Charger 5 A	SAFE 8049
Ground magnet, std.	SAFE 8067

Brazing pins

The Pin brazing system use a special patented silver containing brazing pin with a melting temperature of less than 700°C (1300°F). The special pin brazing technique ensure that it is only the solder material that melts. Never the steel structure.



SAFE No.	Dimensions mm	Qty. pack
10051	Ø 8	100
10301	Ø 8 extra	100
10191	Ø 9.5	100
10381	M8, Threaded brazing pin, L=16	50
10401	M10, Threaded brazing pin, L=24	50
10421	M12, Threaded brazing pin, L=24	50

Ferrules

Ferrules are used when Pin brazing to avoid the brazing gun to be stuck to the work piece and also for distribute the oxygen even to the process.

SAFE No.	Dimensions mm	Qty. pack
2003	Ø 8	100
2009	Ø 9.5	100
2012	Ø 12 use for all threaded brazing pins (M8/M10/M12)	100



Accessories

Grinding machine	SAFE 8005
Tool case	SAFE 9524
Shoulder strap	SAFE 9523
Battery Charger 3A	SAFE 8052
Battery Charger 5A	SAFE 8049
Battery charger, for car use	SAFE 8055
High power batteries 13 Ah	SAFE 8092
High power batteries 16 Ah	SAFE 8093
Ground with super magnet for CP	SAFE 8069
Ground Grip	SAFE 8071
Grinding wheel, silicon free	SAFE 8025
Carbide burr, type C	SAFE 8014
Carbide burr, type C extended (XL)	SAFE 8014
Handy 2, rail trolley	SAFE 9361
Separate battery box for 16 Ah exl. batteries. With lid and handle.	SAFE 9320
Separate battery box for 13 Ah exl. batteries. With lid and handle.	SAFE 9321
Battery adapter for charging of separate battery box	SAFE 9318
Angle device for S4 gun	SAFE 9232
Pin holder 8-9.5	SAFE 9211
Pin holder M8	SAFE 9213
Pin holder M10	SAFE 9215
Pin holder M12	SAFE 9217
Ring holder 8-9.5	SAFE 9202
Ring holder M8/M10/M12	SAFE 9204
Extension set for S4 / 8-9.5	SAFE 9227
Extension set threaded pins	SAFE 9229

Cable lugs - Field made bonds

It is possible to make your own bond with a special cable lug made for Pin brazing. It is very important that this lug is exactly manufactured for the pin brazing method to secure a perfect bond.

You crimp the cable to the lug with a crimping tool.

The lugs are supplied in a cpl. kit with brazing pins and ferrules so there is no risk of mixing the material.



Cable lug SAFE No.	Cable area	D inner	D outer	Qty. pack	Complete kit incl. Brazing pin
6056CP	10 mm²	6	9	100	SAFE 10051
6057Cp	16 mm²	6.5	9	100	SAFE10051
6080CP	25 mm²	8	12	100	SAFE10301
6091CP	Ø 8 mm	8.5	12	100	SAFE10301
6081CP	35 mm²	9	12	100	SAFE10301
6079CP	50 mm²	11	14	100	SAFE10301

For connecting smaller cable sizes use terminal sleeves and lugs as follow:

2.5 mm², use sleeve SAFE 6700 + lug SAFE 6056

4.0 mm², use sleeve SAFE 6701 + lug SAFE 6056

6.0 mm², use sleeve SAFE 6702 + lug SAFE 6056

CABLE CONNECTIONS

Capacitor Discharge Stud Welding Unit

Document No.: PSE-22-800-R622

Sheet: 1 of 2

Compact stud welding unit LBS 80

for capacitor discharge stud welding according to DIN EN ISO 14555 (contact and gap welding)

Capacitor Discharge stud welding is an extremely efficient method of welding fasteners to a wide variety of metals like mild steel, stainless steel, brass, copper, etc. The process utilizes a powerful bank of capacitors to store energy at a specific voltage determined by stud size and material. When a weld is initiated, this energy is "discharged" through a special "ignition tip" at the base of the stud, creating an instantaneous arc which melts both the base of the stud and the adjoining surface on the work piece. At the same time, the welding gun forces the stud into the work piece, resulting in a permanent bond.

- welding range: \varnothing 2-10 mm
- welding material: steel, stainless steel, brass
- highest operational reliability
- excellent welding quality, simple handling indication of all functions by LED
- display of potential error messages
- electronic control of all functions
- digital display of charging voltage
- short charging time and thus quick welding sequences through electronically clocked inverter charging board
- low-loss charging of capacitors through electronically clocked inverter charging board
- low thermal power loss
- charging voltage not influenced by supply voltage variations
- optimal safety during welding through integrated safety switching
- internal charging time regulation in order to prevent overheating
- light and handy, especially suitable for mobile use



Characteristics

- thermic controlled ventilation
- compact construction, low weight
- robust, powder - coated metal housing
- front plate with screen print (scratch resistant)
- 50 mm² welding cable sockets
- automatic function test after switch-on
- tensile secure welding cable sockets
- electromagnetic compatibility (EMC) tested
- CE conformity

Technical data

Welding range	\varnothing 1-10 mm
Welding material	steel, stainless steel, brass
Welding rate	up to 25 studs/min. (depending on stud diameter)
Welding method (acc. to DIN EN ISO 14555)	capacitor discharge (contact and gap welding)
Welding time	1 - 3 ms
Capacitance	90 000 μ F
Charging voltage	60-200 V, continuously adjustable
Charging energy	1800 Ws
Power source	capacitor battery
Mains plug	earth contact plug acc. to DIN 49441
Mains fuse external	\geq 10 AT
Protection class	IP 21
Dimensions (W x H x L)	195 x 265 x 410 mm
Weight	13.5 kg
Suitable welding guns	PKM-1B , PKM-101, PHM-1A, PHM-101, PIM-1B

CABLE CONNECTIONS

Capacitor Discharge Stud Welding Unit

Document No.: PSE-22-800-R622

Sheet: 2 of 2

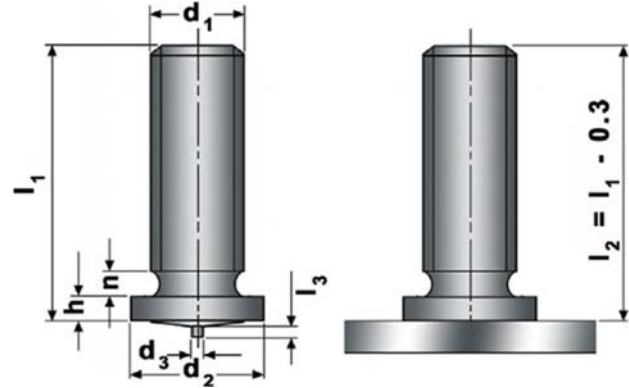
Compact Stud Welding Gun PKM-1B

compact stud welding gun for capacitor discharge stud welding (contact method) according to DIN EN ISO 14555



Threaded studs (Type PT)

according to DIN EN ISO 13918



- welding range: \varnothing 1-10 mm
- welding materials: steel (unalloyed and alloyed), weldable special alloys
- highest operational reliability
- simple handling, excellent welding quality light and handy
- very well suited for welding on problematic surfaces (e.g. zinc, tinder)
- all stud types weldable (special chuck might be required)
- short retooling time (quickly changeable chucks)
- robust housing made of impact resistant plastic
- highest stud positioning accuracy

Technical data

Welding range	\varnothing 1-10 mm
Welding material	steel, stainless steel, brass
Stud length	standard: 6 - 40 mm with intermediate rings: any length
Welding method acc. to DIN EN ISO 14555	capacitor discharge (contact method)
Welding cable	6.5 m highly flexible, 25 mm ²
Dimension (WxHxL)	40x130x183 mm
Weight	0.7 kg

Characteristics

- Spring pressure adjustable
- Indication of adjusted spring pressure in sight window
- Light handy
- CE conformity

d ₁	l ₁	d ₂	d ₃	l ₃	n	h	Material (Article-No.)			Chuck
							steel 4,8 copper-plated	A2-50	CuZn37	
M4	15	5.5	0.65	0.55	max 1.5	0.7 - 1.4	11-04-015	12-04-015	13-04-015	82-50-004
M4	20						11-04-020	12-04-020	13-04-020	
M4	25						11-04-025	12-04-025	13-04-025	
M4	30						11-04-030	12-04-030	13-04-030	
M4	35						11-04-035	12-04-035	13-04-035	
M4	40						11-04-040	12-04-040	13-04-040	
M5	10	6.5	0.75	0.8	max 2	0.7 - 1.4	11-05-010	12-05-010	13-05-010	82-50-005
M5	15						11-05-015	12-05-015	13-05-015	
M5	20						11-05-020	12-05-020	13-05-020	
M5	25						11-05-025	12-05-025	13-05-025	
M5	30						11-05-030	12-05-030	13-05-030	
M5	35						11-05-035	12-05-035	13-05-035	
M5	40						11-05-040	12-05-040	13-05-040	
M6	10	7.5	0.75	0.8	max 2	0.7 - 1.4	11-06-010	12-06-010	13-06-010	82-50-006
M6	15						11-06-015	12-06-015	13-06-015	
M6	20						11-06-020	12-06-020	13-06-020	
M6	25						11-06-025	12-06-025	13-06-025	
M6	30						11-06-030	12-06-030	13-06-030	
M6	35						11-06-035	12-06-035	13-06-035	
M6	40						11-06-040	12-06-040	13-06-040	
M8	10	9	0.75	0.85	max 3	0.7 - 1.4	11-08-010	12-08-010	13-08-010	82-50-008
M8	15						11-08-015	12-08-015	13-08-015	
M8	20						11-08-020	12-08-020	13-08-020	
M8	25						11-08-025	12-08-025	13-08-025	
M8	30						11-08-030	12-08-030	13-08-030	
M8	35						11-08-035	12-08-035	13-08-035	
M8	40						11-08-040	12-08-040	13-08-040	
M8	45						11-08-045	12-08-045	13-08-045	
M8	50						11-08-050	12-08-050	13-08-050	
M8	55						11-08-055	12-08-055	13-08-055	
M8	60	11-08-060	12-08-060	13-08-060						
M10	15	10.5	0.75	0.75	max 3	0.7 - 1.4	11-10-015	12-10-015	-	82-50-010
M10	20						11-10-020	12-10-020	-	
M10	25						11-10-025	12-10-025	-	
M10	30						11-10-030	12-10-030	-	
M10	35						11-10-035	12-10-035	-	
M10	40						11-10-040	12-10-040	-	
M10	45						11-10-045	12-10-045	-	
M10	50						11-10-050	12-10-050	-	
M10	55						11-10-055	12-10-055	-	
M10	60						11-10-060	12-10-060	-	

CABLE CONNECTIONS

ROYSTON Handy Cap™ IP

Document No.: PSE-09-600-R622

Sheet: 1 of 1

Passive corrosion protection for exothermic cable connections

Handy Cap IP is a prefabricated assembly designed to provide quick, field-applied corrosion protection to anode and test lead wire welds on metal pipe and tanks. This economical product is ideal for use in limited access applications.



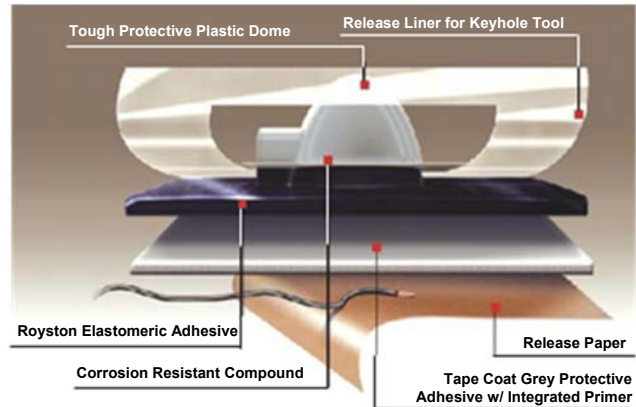
New Handy Cap IP now adds the innovative technology of Tape Coat Gray Adhesive to its unique design. The integration of a primer in Tape coat

Gray makes field application of Handy Cap IP easier and more economical.

- No liquid primer needed easy field-applied corrosion
- Protection ideal for keyhole applications
- Dome and tunnel provide easy access
- Tape coat gray adhesive eliminates liquid primer
- Elastomeric compound encases weld profile
- Serrations conform to small diameters

Application Procedure

- Clean all mud, dirt, grease, oil and other contaminants from the metal surface and mill coating which is to be covered. The Handy Cap IP incorporates an integrated primer in its Tape Coat Gray Adhesive and does not require the use of a liquid primer prior to application.
- Remove the release paper from the bottom of the Handy Cap IP. Bend the plastic sheet inward at the serrations when applying to small diameter pipe. Position and place the Handy Cap IP on the welded area with the tunnel over the lead wire.
- Push the dome of the cap firmly into the weld area. Lift the lead wire away from the pipe and squeeze the adhesive compound completely around and underneath the wire. Push the lead wire back down on the pipe and press the elastomeric compound into firm contact with the pipe over the entire area.
- No further protection is required when the Handy Cap IP covers the entire exposed metal area. Uncovered areas should be protected with primer less Tape coat or Royston tapes. Remove the narrow plastic release. film to accommodate tool use for keyhole applications.
- NO LIQUID PRIMER REQUIRED



Easy Field-Applied Corrosion Protection

Tape coat Gray Adhesive bonds the tough outer shell of the Handy Cap IP to the bare metal weld area and surrounding plant applied coating. Innovative Tape Coat Gray incorporates an integrated primer in its adhesive and provides exceptional bonding without the costly application of liquid primer. A protective compound within the dome molds itself over the irregular welded profile and encases the exothermic connection.

Typical Properties

Construction	Molded plastic cap filled with corrosion resistant compound on a base of thick elastomeric tape
Dimensions	Overall : 5" x 5"
	Plastic sheet : 2.75" x 4"
	Sheet thickness : 10 mils
	Plastic dome : 1.75" dia., 1.5" height
	Tape thickness : 180 mils
Weight	approx. 4.8 oz
Application temperature	-29°C to +49°C (-20°F to +120°F)
Service temperature	-40°C to +66°C (-40°F to +150°F)
Shelf life	Rotate yearly

CABLE CONNECTIONS

Cable Potting Set for Pipeline Connections

Document No.: PSE-09-610-R622

Sheet: 1 of 1

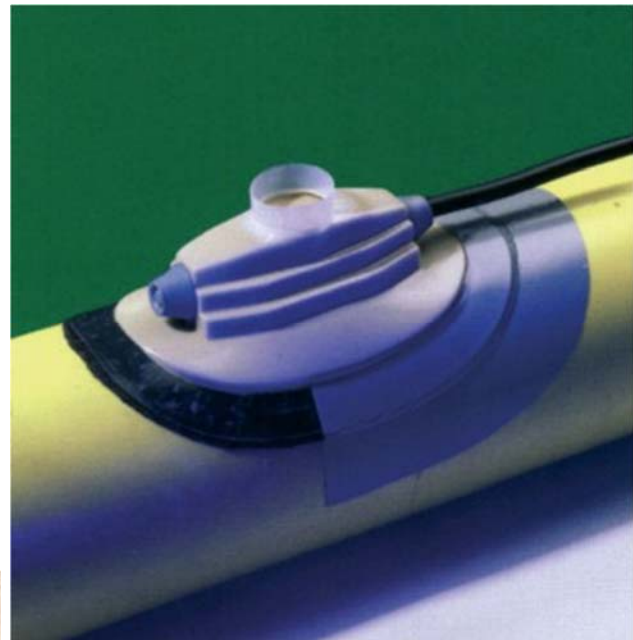
Cable Potting Set

With the cable potting set passive corrosion protection of cable connections is reliable and economical for cathodic corrosion protection on pipelines.

In terms of design and selection of materials the cable potting set housing allows use of pipelines with nominal diameters of 80 - 1600 mm.

Three different housing sizes cover the space requirement for one to four welding points (contacts) as well as all cable diameters from 9-17 mm.

The two components resin is easy to use and environmentally compatible, allowing the use of PE and bituminous pipeline coating.



The cable potting set includes:

- Housing with cap
- Potting material
- Emery cloth
- Disposable gloves
- Templates for removal of PE jacket
- Adhesive strips for resealing the cable sleeves, if required

Cable Potting Set

Type	Housing length	Item-no.
1	130 mm	GHS 10010
2	230 mm	GHS 10012
3	340 mm	GHS 10014

Underground warning tape Type 94

Underground warning tape Type 94 with perforated rated break points, in accordance with EN 12613.

The safest method to avoid disruption to gas, electricity and water supplies is an early and accurate warning system, to signal the existence of utility cables during excavation work. The majority of damages are caused by excavators.

Until now, the warning principle used was based on high elongation value of underground warning tape placed over cables. During excavation work these tapes would be unearthed and would only tear in the excavator shovel. The technological development, especially with today's excavator lifting speed of up to 300 mm per sec., invalidates this warning principle. The tapes tear due to great force unseen in the ground. Their warning effect is lost.

Underground warning tapes Type 94 represent a complete new generation. It complies with safety - and production specification in accordance to EN 12613, developed in association with the Institute for Bauschadensforschung Hannover, FH Mainz und Deutsche Telekom AG. The outdated warning principle of elongated tapes are replaced by the new principle of extreme tensile strength. In combination with the perforated rated break point, the underground warning tape Type 94 guarantees a perfect warning function.



The product tears only by extreme high excavator force. This tear-off procedure at the rated break point, developed by, assures the recovery of fragmented tape even at high lifting speed. The product characteristics support the warning effect in an optimal way. Due to the bright colours it is impossible not to take notice of the underground warning tape. The imprint immediately identifies type and ownership of the cable or pipe below. The warning effect is permanent due to the tape's resistance to ageing. It is colour-fast even in aggressive grounds.

The print is sealed with a laminated film, making it resistant even to mechanical damage and it remains legible.

The underground warning tape Type 94 is produced of Polyethylene and therefore environmentally neutral.

Standard Legends (additional legends available on request)

**CAUTION BURIED CABLE BELOW
CAUTION BURIED ELECTRIC LINE BELOW
CAUTION BURIED FIBER OPTIC LINE BELOW
CAUTION BURIED GAS LINE BELOW**

**CAUTION BURIED WATER LINE BELOW
CAUTION BURIED TELEPHONE LINE BELOW
CAUTION BURIED SEWER LINE BELOW
CAUTION BURIED OIL LINE BELOW**

Coextruded PE, resistant to ageing and temperatures, colourfast, free of PVC and heavy metals, permanently legible with film lamination.

Article-No.	Thickness	Width	Length	Packaging	
				Box	Pallet
940 250 0500 250	0.25 mm	50 mm	250 m	4	120
940 250 1000 250	0.25 mm	100 mm	250 m	2	60
940 250 1500 250	0.25 mm	150 mm	250 m	1	40
940 250 2500 250	0.25 mm	250 mm	250 m	1	24



Colours: yellow, red, blue, green (other colours and sizes available on request) Detectable underground warning tapes are available on request.

CABLE CONNECTIONS

Heat-Shrinkable Insulating Tubing

Document No.: PSE-09-800-R622

Sheet: 1 of 1

WCSM

Heat-shrinkable heavy-wall insulating tubing

WCSM is a heat-shrinkable heavy wall tubing for insulating and sealing power cables and accessories. In WCSM tubing, the electrical and physical properties of a cable over sheath material are combined with ruggedness and easy installation.

WCSM material is halogen free. On heating, WCSM tubing recovers to a smaller diameter, fitting tightly over a wide range of cable sizes and accessories because of its high shrink ratio. At the same time the tubing's inner adhesive wall gives a dependable moisture seal over the most irregular shapes.

WCSM tubing's mechanical strength enables immediate back-filling of cable trenches after jointing. Widely used to insulate, protect and seal power cable joints, accessories and electrical connections.



WCSM Properties	Test Method	Material Requirements
Tensile Strength	ISO 37	12 MPa min
Ultimate Elongation	ISO 37	350 % min
Density	ISO/R1183MethodA	1.0 - 1.2 g/cm ³
Hardness	ISO 868	40 - 60 shore D
Accelerated Ageing 7 days at 150°C ± 2° C Tensile Strength Ultimate Elongation	ISO 188 ISO 37 ISO 37	12 MPa min 350 % min
Low Temp. Flexibility 4 h at -50° C ± 2° C	ASTM D2671 Procedure C	no cracking
Electric Strength	IEC 60243 Part 1/2	120 kV/cm
Volume Resistivity	IEC 60093	1 x 10 ¹² Ωcm min
Dielectric Constant	IEC 60250	5.0 max
Water Absorption	ISO/R62ProcedureA	* 0.2 % max
Weathering	The material contains carbon black to protect it from ultra-violet light.	

* after 14 days at 23°C ± 2°C

Tubing Size	Application Range (diameter)	Diameter of Tube		Wall Thickness	
		min. delivered	max. shrinked	A	B
WCSM 9/3	3.5 - 8.0	9.0	3.0	0.6	2.0
WCSM 13/4	4.5 - 11.5	13.0	4.0	0.6	2.4
WCSM 20/6	6.5 - 18.0	20.0	6.0	0.7	2.5
WCSM 33/8	9.0 - 29.5	33.0	8.0	0.7	3.2
WCSM 43/12	13.0 - 38.5	43.0	12.0	0.8	4.3
WCSM 51/16	17.5 - 46.0	51.0	16.0	1.0	4.5
WCSM 70/21	23.0 - 63.0	70.0	21.0	1.0	4.4
WCSM 85/25	27.5 - 76.5	85.0	25.0	1.0	4.3
WCSM 90/30*	33.0 - 81.0	90.0	30.0	1.0	4.3
WCSM 130/36	40.0 - 117.0	130.0	36.0	1.0	4.3
WCSM 160/50	55.0 - 145.0	160.0	50.0	1.0	4.3
WCSM 180/50	55.0 - 162.0	180.0	50.0	1.0	4.3

**Size 90/30 available without adhesive only

Notes:

1. Dimensions in millimeters
2. Longitudinal change +0% to -15%
3. Dimensions in table: A = as supplied, B = after free recovery

Lengths

All sizes are available in the standard lengths: 1000 mm and 1500 mm.

On request: other lengths and on spools.

All lengths subject to standard cutting tolerances.

Adhesive

WCSM tubing is available with or without an inner adhesive wall. The adhesive exhibits excellent bonding and sealing characteristics to all materials commonly used in the various cable insulation and sheath constructions, such as plastic, rubber, lead, and aluminium.

Ordering Example

WCSM 9/3-1500/S

Product Type _____

Size _____

Standard Length _____

/S = adhesive

/U = without adhesive

CABLE CONNECTIONS

Heat-Shrinkable Cable Caps

Document No.: PSE-09-810-R622

Sheet: 1 of 1

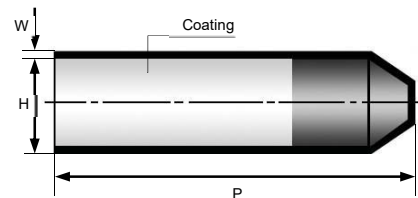
Heat-shrinkable cable caps

Wherever power cables are transported or installed, electrical engineers must deal with the risk of moisture and contamination. The methods they use to reduce these risks are often as long-established as cable technology itself.

But even the most tried and tested engineering practices can be suddenly rendered obsolete by new technological advances. Cable caps, a technique based on heat shrinkable materials which has brought unprecedented simplicity and reliability to the problem of protecting and sealing cable ends.

Cable caps shrink when heated to tightly fit a range of cable sizes and constructions. At the same time a special adhesive also melts and flows under the shrinking action, gripping the cable and ensuring a high-integrity moisture seal.

Cable caps, however, are far more than an exceptionally effective sealing system. The materials ensure that these cross-linked polymer products also provide high-quality electrical insulation while at the same time resisting abrasion, weathering, and chemical attack.



Material Properties		Test Method	Requirement
Tensile Strength		ISO 37	12 MPa min.
Ultimate Elongation		ISO 37	200% min.
Density		ISO 1183/3 Method A	0.9 - 1.2 g/cm ³
Hardness		ISO 868	50 - 70 Shore D
Accelerated Ageing	7 days at 150°C ±2%	ISO 188	
Ageing	Tensile Strength	ISO 37	12 MPa min.
	Ultimate Elongation	ISO 37	200% min.
Low Temperature Flexibility	4 h at -40°C ±3°C	ASTM D2671 Procedure C	no cracking
Water Absorption		ISO 62 Method 1	0.5% max. at 23°C ± 2°C after 24 hours
Weathering	The material from which cable caps are made contains carbon black to protect it from ultra-violet radiation.		

Ordering Information

Cap Type	Diameter H		Length P	Thickness W
	min. delivered	max. shrunked		
102L011/S	10	4.0	+15/-10%	± 20%
102L022/S	20	7.5		
102L027/S	29	13.0		
102L033/S	35	15.0		
102L044/S	55	25.0		
102L048/S	75	32.0		
102L050/S	93	38.0		
102L055/S	100	45.0		
102L066/S	120	70.0		

Notes: Dimensions in millimeters

Material

Cable Caps are made from materials specially formulated for sealing applications for all commonly used cables and cable sheath materials.

Coating

The adhesive can be used on plastic, rubber and paper insulated cables.