

## CABLE CONNECTIONS

### Compression cable lugs and joints

Document No.: 09-100-R1

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German Cathodic Protection

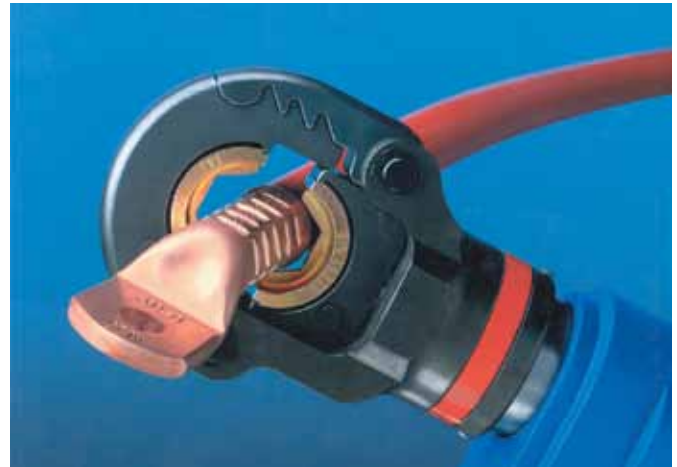
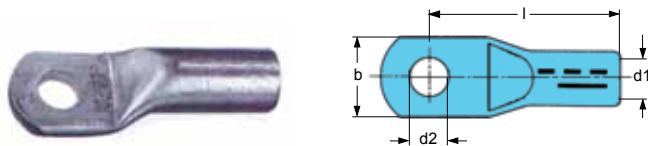


#### Tubular compression cable lugs DIN 46235

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

Material: Copper

Surface: tin plated, optional copper finishing



Conductor mm <sup>2</sup>	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

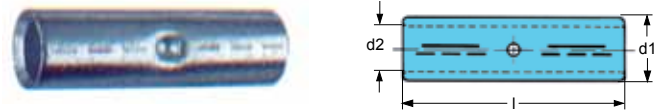
#### Compression joints DIN 46267 Part 1

for non-tension connections

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

Material: Copper

Surface: tin plated, optional copper finishing



Conductor mm <sup>2</sup>	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

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German Cathodic Protection



### Split bolt connector Cellp-Cu FK

Usable as a branch-off or connection clamp.  
Material: Copper



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



with 1 cover for single service taps			
Type No.	Main conductor mm <sup>2</sup>	Tap conductor mm <sup>2</sup>	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 galvanised

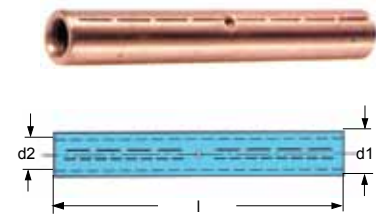


with 2 covers for double service taps			
Type No.	Main conductor mm <sup>2</sup>	Tap conductor mm <sup>2</sup>	Bolt size
PF 330 824 824	16 - 95	4 - 25	M8
PF 330 437 437	50 - 185	6 - 50	M8

### 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 <sup>2</sup>	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

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German Cathodic Protection



### Resin Kits 92-NBA 0 up to 92-NBA 7 Inline Joint Kit Series with Resin 40G

#### Application

3M™ Scotchcast™ resin joint kits 92-NBA x are designed to be used for 1-core up to 5-core non shielded, polymeric, low voltage energy cables. The application incorporates electrical insulation and mechanical protection of joints with compression or mechanical connectors. They can be used for indoor and outdoor, underground and submerged applications.

These joints are also suitable for Single Core Airfield Ground Lighting Cables rated to 6kV with the use of additional components.

#### Features

- Resin 40G in transparent two chamber bags with integrated Closed Mixing and Pouring (CMP) system.
- One part Mould Body with Snap Fit closing system for quick and easy handling.
- Transparent Mould Body for easy control of connector distances in the joint.
- Snap in 5-core spacer to ensure the distance between connectors.
- Pre-cut foam sealing elements to provide reliable sealing to the Mould Body without tooling for all cable application diameters.
- Closure cap to prevent any pollution.

Type of kit	Cable outside diameter	Max. cable cross section mm <sup>2</sup>	Resin type no.	Dimensions mm	
				Ø	Length
92-NBA-0	4-16 mm	4 x 4	40G	32	148
92-NBA-1	10-22 mm	4 x 10	40G	36	178
92-NBA-2	12-25 mm	4 x 16	40G	38	230
92-NBA-3	13-32 mm	4 x 25	40G	55	270
92-NBA-4	18-36 mm	4 x 50	40G	63	319
92-NBA-5	19-45 mm	4 x 95	40G	76	369
92-NBA-6	27-54 mm	4 x 120	40G	101	479
92-NBA-7	29-64 mm	4 x 240	40G	130	643

#### Product Description

3M™ Scotchcast™ resin inline joint kit will be delivered with a one part transparent mould body for simple and easy handling.

Distances inside the body can be checked easily. All necessary dimensions, like application range, cable preparation are given in the detailed instruction. The two foam sealing elements can be adapted to the required cable diameter by removing the pre-cut adapter rings.

A snap in spacer ensures the minimum required distance to each connector. It can be applied for 3-core up to 5-core cables.

The resin 40G is delivered in two chamber bag with integrated spout and aluminium Bag for protection against humidity.

The re-openable seam and integrated spout with a membrane provides a Closed, Mixing and Pouring system.

After the seam of the two chamber bag was opened, the resin components can be mixed. To pour the resin into the mould body, the spout is connected with the dome by turning 180°. While turning, the membrane is pierced to enable the resin to be poured.

The Closed Mixing and Pouring System provides resin handling without any skin contact.

For protection against pollution, a closure cap is applied onto the dome. After curing, the remaining resin in the bag can be disposed as household waste.

#### Kit content

- Transparent mould body with closure cap
- Scotchcast™ 40G Resin bag with CMP
- Pre-cut sealing elements
- Snap in 5-core spacer
- Abrasive sponge
- Detailed instruction

Conductor connectors must be ordered separately.

#### Testing

The full Scotchcast™ Resin Kit Series 92-NBA 0 up to 92-NBA-7 were tested according EN50393 Table 3 / I / A1

Type of Test according to EN50393 Table 3 / I / A1	Results
AC Voltage Withstand Test in air 4kV AC/ 1 min	passed
Insulation Resistance Test in air 1kV DC	> 10.000MΩ
Heat Cycle in air 63 cycles: 5h/3h	passed
Heat Cycle in water 63 cycles: 5h/3h	passed
AC Voltage Withstand Test in water 4kV AC/ 1 min	passed
Insulation Resistance Test in water 1kV DC	> 10.000MΩ

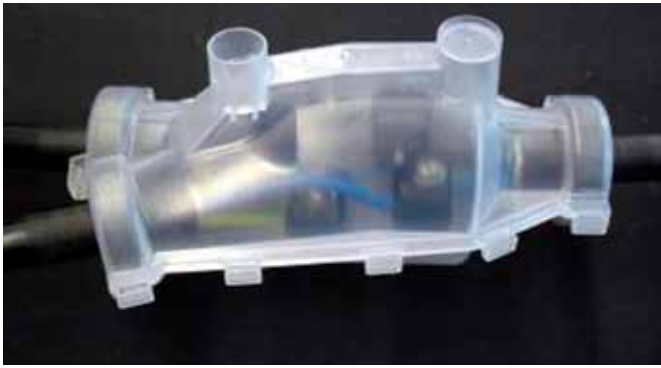
## CABLE CONNECTIONS

### Cable splicing kits

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German Cathodic Protection



### Resin Kits 92-NBB 0 up to 92-NBB 2 Y-Branch Kit Series with Resin 40

#### Application

3M™ Scotchcast™ resin joint kits 92-NBB x are designed to be used for 1-core up to 5-core non shielded, polymeric, low voltage energy cables. The application incorporates electrical insulation and mechanical protection of joints with compression or mechanical connectors. They can be used for indoor and outdoor, underground and submerged applications.

#### Features

- Resin 40G in transparent two chamber bags with integrated Closed Mixing and Pouring (CMP) system.
- One part Mould Body with Snap Fit closing system for quick and easy handling.
- Transparent Mould Body for easy control of connector distances in the joint.
- Snap in 5-core spacer to ensure the distance between connectors.
- Pre-cut foam sealing elements to provide reliable sealing to the Mould Body without tooling for all cable application diameters.
- Closure cap to prevent any pollution.

#### Product Description

3M™ Scotchcast™ resin Y-Branch joint kit will be delivered with two part (upper and lower) transparent mould shelves for simple and easy handling. Distances inside the body can be checked easily. All necessary dimensions, like application range, cable preparation are given in the detailed instruction.

The three foam sealing elements can be adapted to the required cable diameter by removing the pre-cut adapter rings.

The resin 40 is delivered in two chamber bag with integrated spout and aluminium Guard Bag for protection against humidity.

The re-openable seam and integrated spout with a membrane does provide a Closed, Mixing and Pouring system.

After the seam of the two chamber bag was opened, the resin components can be mixed. To pour the resin into the mould body, the spout shall be connected with the dome by turning for 180°. While turning, the membrane is cut open to pour the resin.

The Closed Mixing and Pouring System does provide resin handling without any skin contact. For protection against pollution, a closure cap is applied onto the dome. After curing, the remaining resin in the bag can be disposed as house waste.

#### Kit content

- Two part (upper and lower) transparent mould shelves with closure cap
- Scotchcast™ 40G Resin bag with CMP
- Pre-cut sealing elements
- Snap in 5-core spacer
- Abrasive sponge
- Detailed instruction

Conductor connectors must be ordered separately.

#### Testing

The full Scotchcast™ Resin Kit Series 92-NBB 0 up to 92-NBB 2 were tested according EN50393 Table 3 / I / B1

Type of Test according to EN50393 Table 3 / I / B1	Results
AC Voltage Withstand Test in air	4kV AC/ 1 min
Insulation Resistance Test in air	1kV DC
Heat Cycle in air	63 cycles: 5h/3h
Heat Cycle in water	63 cycles: 5h/3h
AC Voltage Withstand Test in water	4kV AC/ 1 min
Insulation Resistance Test in water	1kV DC

Application Range [mm²]					
Body Size	4 x		5 x		Ø mm
	1.5 - 4	1.5 - 4	1.5 - 10	1.5 - 10	
92-NBB 0	1.5 - 4	1.5 - 4	-	-	9 - 18
92-NBB 1	2.5 - 16	2.5 - 16	1.5 - 10	1.5 - 10	11 - 23
92-NBB 2	4 - 35	4 - 25	2.5 - 25	2.5 - 25	16 - 33

### The Thermite Welding Process

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

Thermite welding connections attach the conductors and the structure to be protected so that no galvanic corrosion can occur at the interface. The Thermite welding process is specially designed to provide minimum heat effect on steel, which is especially important on thin-wall, high-stress pipes. Thermite welding connections are also used for header cable taps, conductor splices and terminations, as well as ground rod connections.

A Thermite welding connection ...

- Has a 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.

Thermite welding connections are made using a semi-permanent graphite mould, which holds the conductors to be welded. Weld metal (a mixture of copper oxide and aluminum) is placed in the mould. The mould is covered and the weld metal ignited. The exothermic reaction produces molten copper, which provides a permanent, high conductivity connection.

#### Weld powder

Each tube contains metal weld 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 moulds life to allow an average of 75 joints, 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 must be ordered separately according to the type and size of joint required.



#### Cable cleaner

Designed for cleaning circular conductors such as rods and cables.



#### Standard tool kit

The tool kit comprises:

- File card brush for cleaning conductors
- Flint igniter for the starting powder
- 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**

**Thermite welding**

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German Cathodic Protection



**Equipment for copper conductors to steel pipe connections**

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

## CABLE CONNECTIONS

### Electronic pin brazing unit S30 XC

Document No.: 09-500-R1

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German Cathodic Protection



For use when a cathodic protection system is to be applied to steel, ductile or cast-iron pipelines, vessels, tanks or reinforcement bars. Pin brazing is a simple, maintenance free alternative to thermite welding.



#### The advantages of pin brazing

- Works in any weather condition
- Very fast method, the pin brazing process takes only a second
- Does not affect internal coatings
- Economical
- Safe for the operator
- Uses lower temperature than thermite welding

#### Electronic Pin Brazing Unit S30 XC

S30 XC is a small handheld pin brazing unit made specially for cathodic protection and grounding installations. S30 XC is electronically controlled, powered by 3 pcs of 12 V batteries which are easily exchangeable using a cassette system. The power (36V DC) comes from sealed high power batteries located in a separate battery box for easy replacement.

Supplied as standard with patented automatic S4 brazing gun, uses brazing pins without fuse wire.

#### Technical Specifications

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

#### Unit S30XC SAFE 9307 is supplied with:

Braze S4 Automatic gun	SAFE 9102
Electronic unit	SAFE 9627
Batteries, sealed, high power 16 Ah, 3 pcs.	SAFE 8093
Grinder 36 V DC	SAFE 8005
Earthing device	SAFE 8067
Carrying harness	SAFE 9523
Tool case	SAFE 9524

#### Brazing pins

The Pin brazing system use a special, patented brazing pin with silver content for a melting temperature of less than 700°C (1300°F). The special pin brazing technique ensures that only the solder material melts. The steel structure is never damaged.



#### Ferrules

Ferrules are used in pin brazing to prevent the brazing gun from sticking to the work piece and for better distribution of the oxygen during the process.

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

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 36 V DC	SAFE 8005
Grinding Pin/Stone	SAFE 8025
Tool case	SAFE 9524
Carrying harness	SAFE 9523
Battery Charger, stationary use	SAFE 8049
Battery charger, for car use	SAFE 8055
High power batteries, sealed 13 Ah	SAFE 8092
High power batteries, sealed 16 Ah	SAFE 8093
Carbide burr	SAFE 8014
S4-Automatic gun, self adjusted	SAFE 9102
Extension cable 5 m (to extend existing gun)	SAFE 9235
Extension cable 5 m (to extend existing ground)	SAFE 9237
Extension cable 5 m (to extend existing grinder)	SAFE 9338
Rail transport wagon HANDY	SAFE 9361
Extra battery box for 16 Ah excl. batteries. With lid and handle.	SAFE 9320
Extra battery box for 13 Ah excl. 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

To obtain a perfect bond, it is essential that only lugs are used which have been specially manufactured for pin brazing.

The lug is crimped to the cable using a crimping tool. Lugs are supplied in kits with brazing pins and ferrules so there is no risk of mixing the materials.



Cable lug SAFE No.	Cable area	D inner	D outer	Qty. pack	Complete kit incl. Brazing pin
6056CP	10 mm <sup>2</sup>	6	9	100	SAFE 10051
6057Cp	16 mm <sup>2</sup>	6.5	9	100	SAFE10051
6080CP	25 mm <sup>2</sup>	8	12	100	SAFE10301
6091CP	Ø 8 mm	8.5	12	100	SAFE10301
6081CP	35 mm <sup>2</sup>	9	12	100	SAFE10301
6079CP	50 mm <sup>2</sup>	11	14	100	SAFE10301

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

2.5 mm<sup>2</sup>, use sleeve SAFE 6700 + lug SAFE 6056  
 4.0 mm<sup>2</sup>, use sleeve SAFE 6701 + lug SAFE 6056  
 6.0 mm<sup>2</sup>, use sleeve SAFE 6702 + lug SAFE 6056

## CABLE CONNECTIONS

### Electronic pin brazing unit ECONECT

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German Cathodic Protection



For use when a cathodic protection system is to be applied to steel, ductile or cast-iron pipelines, vessels, tanks or reinforcement bars. Pin brazing is a simple, maintenance free alternative to thermite welding.



#### The advantages of pin brazing

- Works in any weather condition
- Very fast method, the pin brazing process takes only a second
- Does not affect internal coatings
- Economical
- Safe for the operator
- Uses lower temperature than thermite welding
- Does not melt the work material
- No need for special moulds
- The whole preparation takes less than 1 minute

#### Electronic digitised Pin Brazing Unit ECONECT

The new lightweight and digitized pin brazing unit ECONECT reaches a whole new level of performance.

It has a higher brazing capacity than previous models but at 60 % less unit weight, making it ideal for maintenance works. Which not only makes it ideal for maintenance works. ECONECT is powered by a revolutionary new nano-battery with longer life than previous batteries. Supplied as standard with patented automatic S4 brazing gun, uses brazing pins without fuse wire.

#### Technical Specifications

Voltage	36 V DC	Width	150 mm
Number of brazes	50	Height	280 mm
Weight incl. batteries	9.8 kg	Length	320 mm

#### ECONECT SAFE 94360 is supplied with:

Braze S15 Automatic gun	SAFE 91016
Pinholder 8-9.5 mm	SAFE 9211
Ringholder 8-9.5 mm	SAFE 9202
Battery (1 pc. required)	SAFE 80982
Grinding machine	SAFE 8007
Ground super magnet	SAFE 8069
Tool case	SAFE 9524
Shoulder strap	SAFE 9523

#### Add Battery Charger (not included)

Stationary Battery Charger 230 V	SAFE 8048
Battery charger for car use 12 V	SAFE 80561

#### Brazing pins

The Pin brazing system use a special, patented brazing pin with silver content for a melting temperature of less than 700°C (1300°F). The special pin brazing technique ensures that only the solder material melts. The steel structure is never damaged.

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



#### Accessories

Ground Grip	SAFE 8071
Grinding wheel, silicon free	SAFE 8025
Carbide burr, type C	SAFE 8014
Carbide burr, type C extended	SAFE 8014XL
Pin holder 8-9.5 (A)	SAFE 9211
Pin holder M8 (B)	SAFE 9213
Pin holder M10 (C)	SAFE 9215
Pin holder M12 (D)	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

Ground grip SAFE 8071



#### Ferrules

Ferrules are used in pin brazing to prevent the brazing gun from sticking to the work piece and for better distribution of the oxygen during the process.

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

#### Cable Lugs - Field made bonds

To obtain a perfect bond, it is essential that only lugs are used which have been specially manufactured for pin brazing.

The lug is crimped to the cable using a crimping tool. Lugs are supplied in kits with brazing pins and ferrules so there is no risk of mixing the materials.



Cable lug SAFE No.	Cable area	D inner	D outer	Qty. pack	Complete kit incl. Brazing pin
6056CP	10 mm <sup>2</sup>	6	9	100	SAFE 10051
6057Cp	16 mm <sup>2</sup>	6.5	9	100	SAFE10051
6080CP	25 mm <sup>2</sup>	8	12	100	SAFE10301
6091CP	Ø 8 mm	8.5	12	100	SAFE10301
6081CP	35 mm <sup>2</sup>	9	12	100	SAFE10301
6079CP	50 mm <sup>2</sup>	11	14	100	SAFE10301

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

2.5 mm<sup>2</sup>, use sleeve SAFE 6700 + lug SAFE 6056

4.0 mm<sup>2</sup>, use sleeve SAFE 6701 + lug SAFE 6056

6.0 mm<sup>2</sup>, use sleeve SAFE 6702 + lug SAFE 6056



**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 such as mild steel, stainless steel, brass, copper, etc. The process uses a powerful bank of capacitors to store energy at a specific voltage as required by stud size and material. When welding begins, this energy is discharged through a special ignition tip at the base of the stud. This creates an instantaneous arc which melts both the base of the stud and the adjoining surface onto the workpiece. At the same time, the welding gun forces the stud into the workpiece, 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**

- thermally controlled ventilation
- compact construction, low weight
- robust, powder-coated metal housing
- front plate with screenprint (scratch resistant)
- 50 mm<sup>2</sup> welding cable sockets
- automatic function test after switching on unit
- 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 $\mu$ 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	<b>PKM-1B</b> , PKM-101, PHM-1A, PHM-101, PIM-1B

## CABLE CONNECTIONS

### Capacitor discharge stud welding unit

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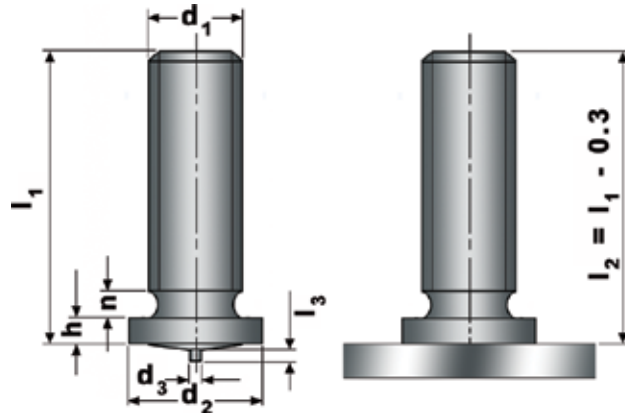
### Compact stud welding gun PKM-1B

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 easy to use
- very well suited for welding on problematic surfaces (e.g. zinc, tinder)
- all stud types weldable (special chuck might be required)
- short re-tooling 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 <sup>2</sup>
Dimensions (WxHxL)	40x130x183 mm
Weight	0.7 kg

d <sub>1</sub>	l <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	l <sub>3</sub>	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	-	

#### Characteristics

- spring pressure adjustable
- indication of adjusted spring pressure in sight window
- low weight and easy handling
- CE conformity

**CABLE CONNECTIONS**

**Cable sealing set**

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**Cable sealing set for airtight cable connection**

Economical and reliable sealing of cable-to-pipe connections.

**Pipe Diameter 80 to 1600 mm**

Cable sealing set is suitable for use with pipelines with nominal diameters from 80 to 1600 mm.

**Housing**

Five different housing sizes cover the space requirement for 1 to 4 welding points (contacts) as well as all cable diameters from 9 to 17 mm.



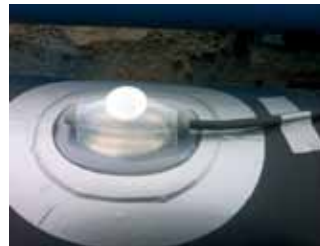
**Welding Clip**

Type WG with 70 mm height adapter for use with welding clips on pipelines.



**Resin**

Easy to use and environmentally friendly 2 component sealing resin. Suitable for use with PE and bituminous coatings.



		Order number	
<p><b>Cable Sealing Set</b></p> <ul style="list-style-type: none"> <li>- housing with cap</li> <li>- sealing material</li> <li>- emery cloth</li> <li>- disposable gloves</li> <li>- templates for removal of PE jacket</li> <li>- 2 adhesive strips for resealing the cable sleeves</li> </ul>			
Type 1	housing size 130 mm - 2 weld points		GHS 100 10
Type 2	housing size 230 mm - 3 weld points		GHS 100 12
Type 3	housing size 340 mm - 4 weld points		GHS 100 14
Type 10	housing size 110 mm - 1 weld point		GHS 100 16
Type WG	housing size 250 mm - for weld clip		GHS 100 15

**CABLE CONNECTIONS**  
**ROYSTON Handy Cap™ IP**

Document No.: 09-600-R1

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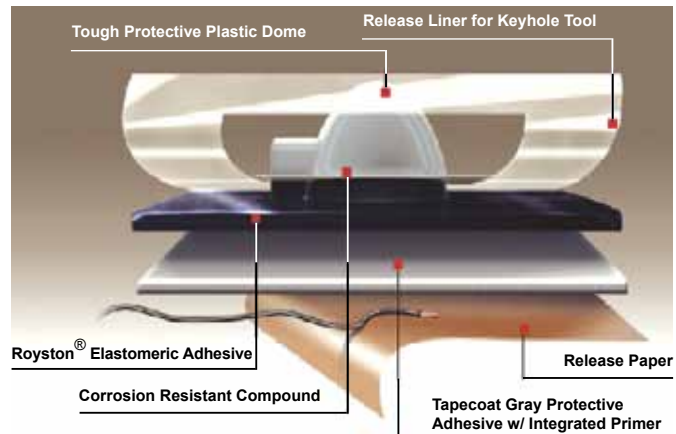


Passive corrosion protection for exothermic cable connections

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



New Handy Cap™ IP now adds the innovative technology of Tapecoat® Gray Adhesive to its unique design. The integration of a primer in Tapecoat® Gray makes field application of Handy Cap™ IP easier and more economical.



**Easy Field-Applied Corrosion Protection**

- No liquid primer needed
- Ideal for keyhole applications
- Dome and tunnel provide easy access
- Tapecoat 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 Tapecoat® 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 primerless Tapecoat® or Royston® tapes. Remove the narrow plastic release film to accommodate tool use for keyhole applications.

**NO LIQUID PRIMER REQUIRED**

Tapecoat® Gray Adhesive bonds the tough outer shell of the Handy Cap™ IP to the bare metal weld area and surrounding plant applied coating. Innovative Tapecoat® 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 moulds itself over the irregular welded profile and encases the exothermic connection.

**Typical Properties**

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

## CABLE CONNECTIONS

### Cable route markers

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#### Model 700

Upright cable route markers are used to indicate the location of buried cables as well as anode groundbeds, water, gas and oil pipelines. They provide visible above ground, indication of the position of underground service lines located below.

The stake marker can be installed either as a temporary sign during construction and removed after completion or as a permanent upright in areas where it will not obstruct traffic and where it is advantageous to see the marker from a distance.

#### Materials

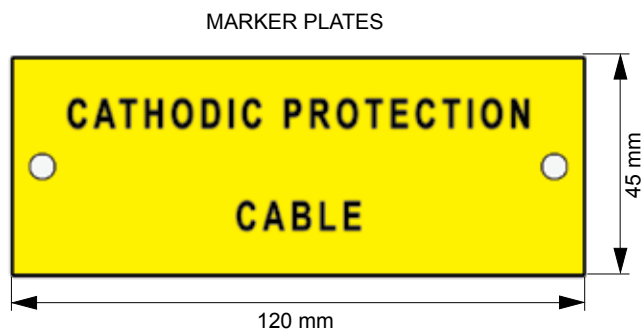
Cableroute markers are made of a hot-dip galvanised profile steel 50 x 50 x 5 mm angle section.

The length above ground is 1.00 m, upright installation with a route marker plate on top and an identification plate at the bottom.

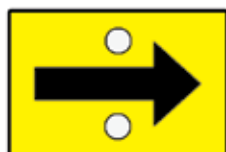
The marker plates are made of laminated plastic sheet (Trademark: ASTRALON A™) in three (3) layers (yellow, black, yellow) and two (2) mm thickness.

Yellow (RAL 1021) marker plates and black (RAL 9005) engraved letters.

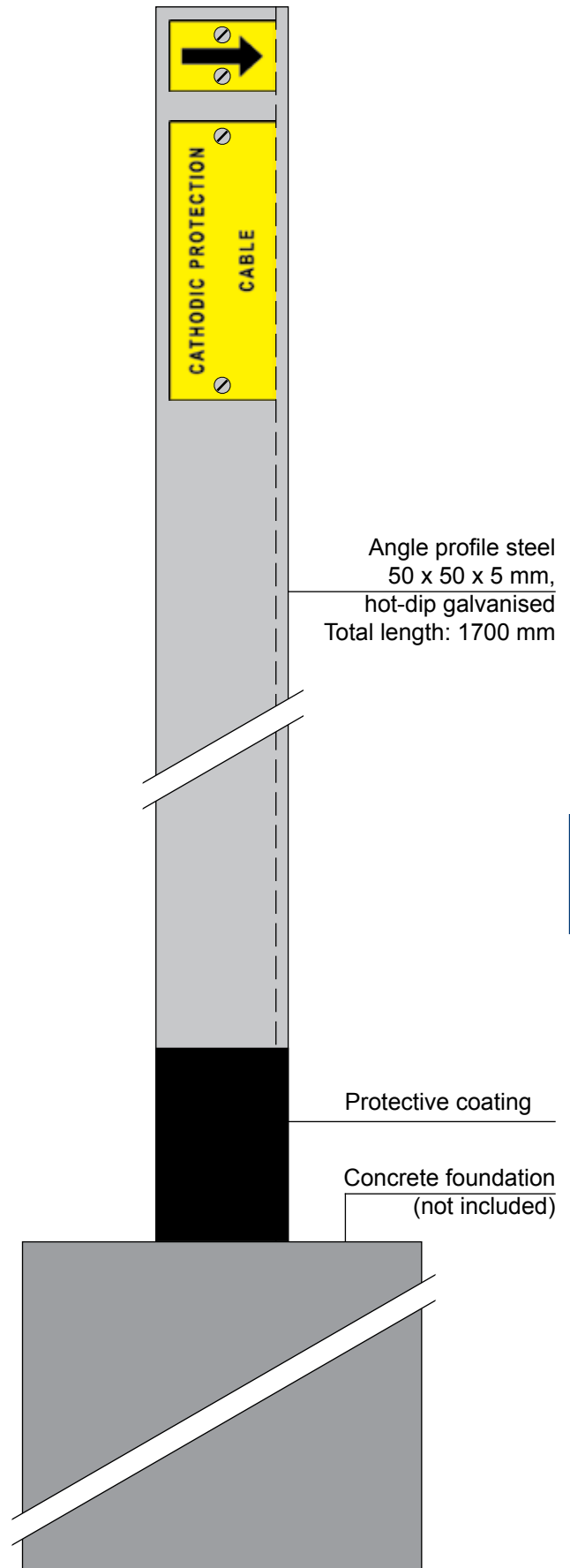
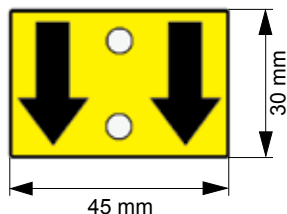
Supplied with galvanised fixing bolts, nuts and washers.



DIRECTIONAL SIGN FOR CABLE



DIRECTIONAL SIGN FOR CABLE JOINT



**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, showing the presence of utility cables during excavation work. The majority of damage is caused by excavators.

Until now, the warning principle used was based on the 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. Advances in technology, especially with modern lifting speeds of up to 300 mm/second have reduced this system's effectiveness. 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. They comply with safety and production specifications in accordance with EN 12613, developed in association with the Institut for Bauschadensforschung Hannover<sup>1</sup>, FH Mainz and Deutsche Telekom AG. The outdated warning principle of elongated tapes is replaced by the new principle of extreme tensile strength. In combination with the perforated rated break point, underground warning tape Type 94 guarantees a perfect warning function.

<sup>1</sup> Institute of Damage Investigation



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. Its specifications guarantee a reliable warning effect. High visibility colours make it impossible to oversee the warning tape. The imprint (tape legend) immediately identifies type and ownership of the pipe or cable below. The tapes age properties ensures permanent warning effect, and it is colourfast even in aggressive ground environment.

Underground warning tape Type 94 made of polyethylene which is not harmful to the environment.

**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**

**Co-extruded PE, temperature and ageing resistant, colourfast, free of PVC and heavy metals, with film lamination for permanent readability.**

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 also available on request



**WCSM**

**Heat-shrinkable heavy wall insulating tubing**

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

WCSM material is halogen free. On heating, WCSM shrinks to fit tightly over a wide range of cable diameters. At the same time, the tubing's inner adhesive wall provides reliable moisture sealing of even the most irregular shapes.

WCSM tubing's mechanical strength allows 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/R 1183 Method A	1.0 - 1.2 g/cm <sup>3</sup>
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 <sup>12</sup> Ωcm min
Dielectric Constant	IEC 60250	5.0 max
Water Absorption	ISO/R 62 Procedure A	* 0.2 % max
Weathering	The material contains carbon black for protection against UV radiation	

\* after 14 days at 23° C ± 2° C

Tubing Size	Application Range (diameter)	Diameter of Tube		Wall Thickness	
		min. delivered	max. shrunked	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 is only available without adhesive

**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 standard lengths of 1000 mm and 1500 mm.

Also available on spools and in other lengths.

All lengths subject to standard cutting tolerances.

**Adhesive**

WCSM tubing is available with or without an inner adhesive wall. The adhesive has 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 \_\_\_\_\_

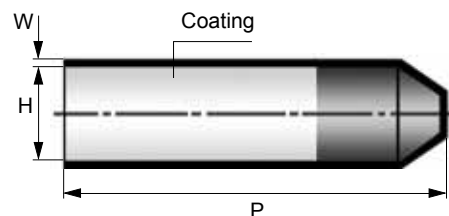
## Heat-shrinkable cable caps

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

However, even the most tried and tested engineering practices can suddenly be rendered obsolete by new technological advances. Cable caps made of heat-shrinkable materials provide a simple and reliable solution to the problem of protecting and sealing cable ends.

During the application of heat shrinking, a special adhesive is released which bonds to the cable providing a high integrity moisture seal.

Cable caps, however, are far more than just an exceptionally effective sealing system. The materials used ensure that these crosslinked 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 <sup>3</sup>
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 contains carbon black for protection against UV radiation.		

### Ordering Information

Cap Type	Diameter H		Length P +15/-10%	Thickness W ± 20%
	min. delivered	max. shrunked		
102L011/S	10	4.0	38	2.0
102L022/S	20	7.5	55	2.8
102L027/S	29	13.0	93	2.5
102L033/S	35	15.0	90	3.2
102L044/S	55	25.0	143	3.9
102L048/S	75	32.0	150	3.3
102L050/S	93	38.0	142	4.4
102L055/S	100	45.0	162	3.8
102L066/S	120	70.0	145	3.8

Notes : Dimensions in millimeters

### Material

Cable caps are made from materials specially designed for sealing applications for all commonly used cable types and cable sheath materials.

### Coating

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