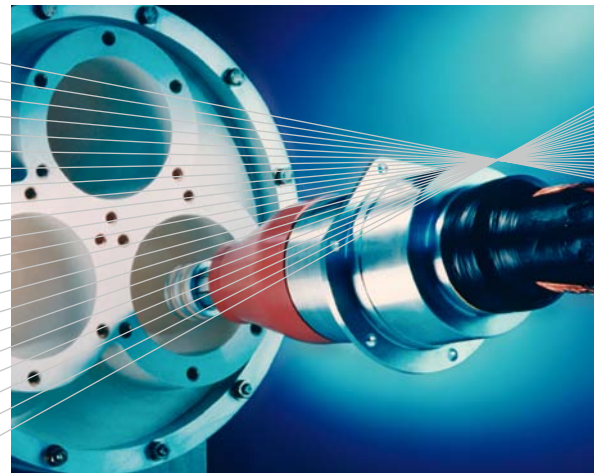


ACCESSORIES FOR XLPE-INSULATED HIGH AND EXTRA-HIGH VOLTAGE CABLES



THE POWER OF INNOVATION: A TRADITION OF THINKING OUTSIDE THE BOX



The Achievement Principle

A pioneering spirit and the will to achieve – these are qualities that drive a history of success stretching back more than 100 years. Superior products, comprehensive service, and careful project management are what define us – and what underlies our long-standing partnerships with energy providers and the electrical engineering industry. Our primary focus – then as now – is on the individual requirements of every one of our customers. Whether as a pioneer in XLPE technology or as developer of cutting-edge manufacturing techniques – it is only through close dialog with you the customer that we can succeed in bringing to market the innovations that have impacted energy transmission and distribution so decisively. And we will continue to focus on developing even better solutions, more advanced manufacturing techniques, and more comprehensive services, without ever sacrificing quality. To achieve this, we use the very latest technologies: our entire portfolio is being developed, manufactured and tested in our headquarters in Mannheim with modern techniques like computerised systems.



Inquiring Minds and the Power of Innovation

Maintaining and improving our knowledge and know-how are important parts of the entrepreneurial culture at Südkabel. The drive to innovate is one of our traditions. Our company is known worldwide as a pioneering specialist for cutting-edge products and technology. Our teams are always on the lookout for new materials, manufacturing or assembly processes that promise better utility and safety. We work hard toward further improving our user-friendly solutions – solutions that meet all our customers' requirements.

Pioneers in XLPE Cable Technology

Ever since the company was founded, our goal has been to provide new solutions that guarantee our customers greater safety and improved procedures. Südkabel established its reputation as a pioneer in XLPE technology when Germany's polymeric-insulated medium-voltage cables were laid in the 1960s. And many more trailblazing innovations followed: the planning and construction of the first 110 kV XLPE cable system in Germany, the first 400 kV XLPE cable system in the European transmission network, and last but not least, the manufacture and installation of many 500 kV XLPE cable systems in Russia, Asia, Africa, and South America with conductor cross-sections of up to 2500 mm².

High-performance technology: Accessories for complex projects

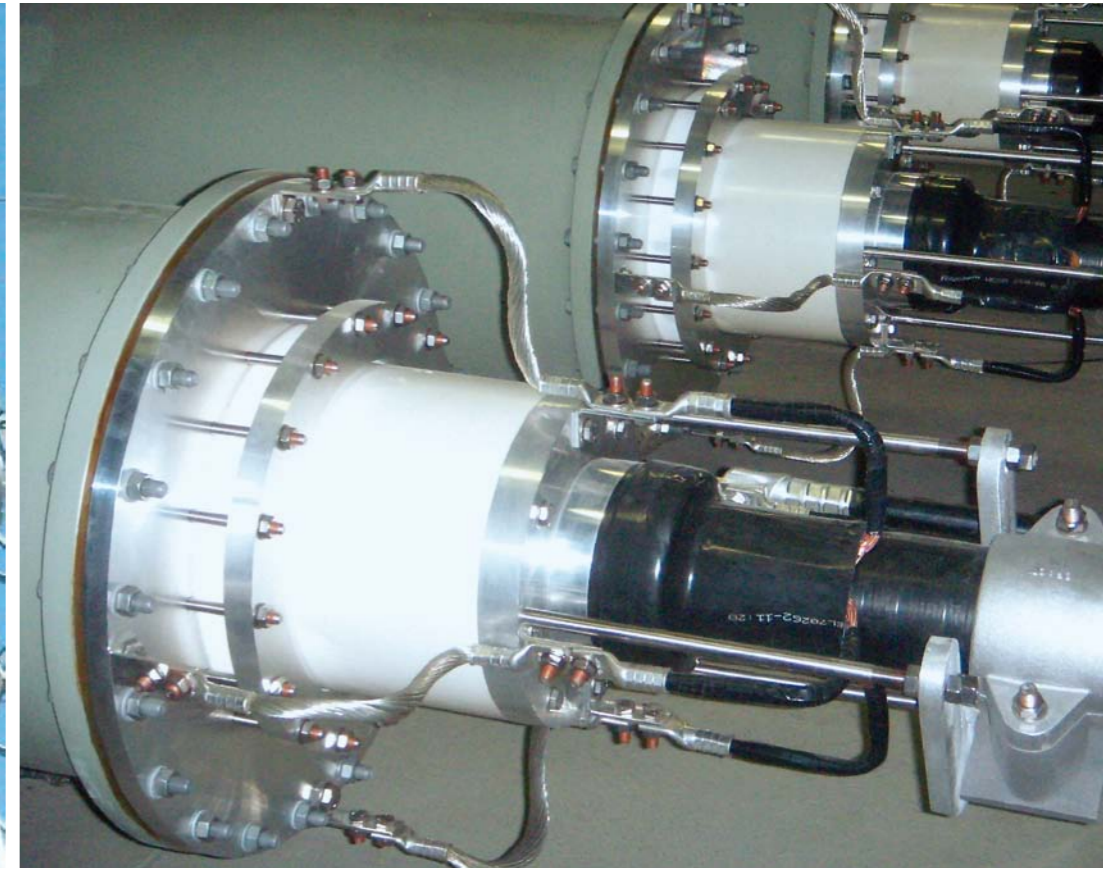
Südkabel accessories are important components for XLPE-insulated high and extra-high voltage cables. Here, too, the development of new products were path-breaking, such as joints for 400 kV XLPE-insulated cables, which in 1995 succeeded in the first world-wide prequalification according to CIGRE (International Council on Large Electric Systems). Our compact terminations are based on this advanced technology. They are excellent examples of how we enhance safe and easy to-install accessories for XLPE-insulated high and extra-high voltage cables. They can be used for almost all types of XLPE-insulated cables with vastly different conductors, screens, sheaths, and armouring. Südkabel accessories can also be installed on EPR insulation up to 170 kV. The optical fibres in screens can be decoupled in all accessories. Accessories for extra-high voltage applications can be supplied with integrated sensors for partial discharge detection. All cable accessories are designed for a long life, the same as expected for energy cables themselves.

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A WIDE RANGE OF HIGH PERFORMERS: ACCESSORIES FOR XLPE-INSULATED HIGH AND EXTRA-HIGH VOLTAGE CABLES

Over the years, experience with built-in terminations for gas-insulated switchgears and transformers has proved just how valuable they are. The dry, compact terminations EHSVS (in SF₆-enclosure) or EHTVS (for oil-filled transformer) have been established in the market since 1995.



Performance at a glance

- Compact terminations are completely maintenance-free and can be installed quickly and safely
- They are also environmentally friendly as the solid insulation contains no gaseous or liquid components
- The epoxy resin insulator is short enough to allow for compact design of the cable enclosure
- Assembly is quick and easy: Since the insulator can be pre-installed as a socket, the cable can be installed separately from switchgear or transformer equipment. The compact termination is then simply inserted into the pressure-tight insulator socket
- The compact termination can be installed at any position since no balancing volume has to be included to allow for liquid expansion
- Custom variants can accommodate almost any installation length or diameter
- Cables can be tested on-site for voltages up to 170 kV at the switchgear without the need for any additional equipment since for the compact termination a necessary test adapter is available
- Relevant dimensions for compact terminations can be found in the following publications: IEC 62271-209 (for gas-insulated metal-enclosed switchgear) and EN 50299 (for oil-immersed cable termination for transformers and reactors)

Tests and Test Specifications

- Test specifications for XLPE-insulated high and extra-high voltage cables up to 170 kV are published in DIN VDE 0276-632 and IEC 60840 respectively, and for operating voltages higher than 170 kV in IEC 62067. The compact terminations EHSVS and EHTVS comply with all relevant test specifications
- The values shown in Table 1 (page 7), 'Data sheet for compact terminations', were derived from type and prequalification tests for each compact termination in a single-phase arrangement
- Compact terminations for voltages up to 170 kV were tested in a three-phase enclosure together with the pluggable conductor connection for resistance to lightning impulses (also under reduced operating pressure) and short circuits

For **outdoor terminations**, Südkabel distinguishes between terminations filled with liquid insulation (EHFV and EHFVC series) and the dry, gas-filled type EHFVCS. The EHFVC is a light-weight, slim-line outdoor termination with a rigid-type composite insulator. We can also produce a variant with a porcelain insulator (EHFV type) for all voltage levels upon request. In both types, the electric field is controlled by means of prefabricated stress cones made of silicone rubber. A balancing volume in the top part of the insulator compensates for temperature-related volume changes in the insulating compound, making for a pressure- and maintenance-free system.

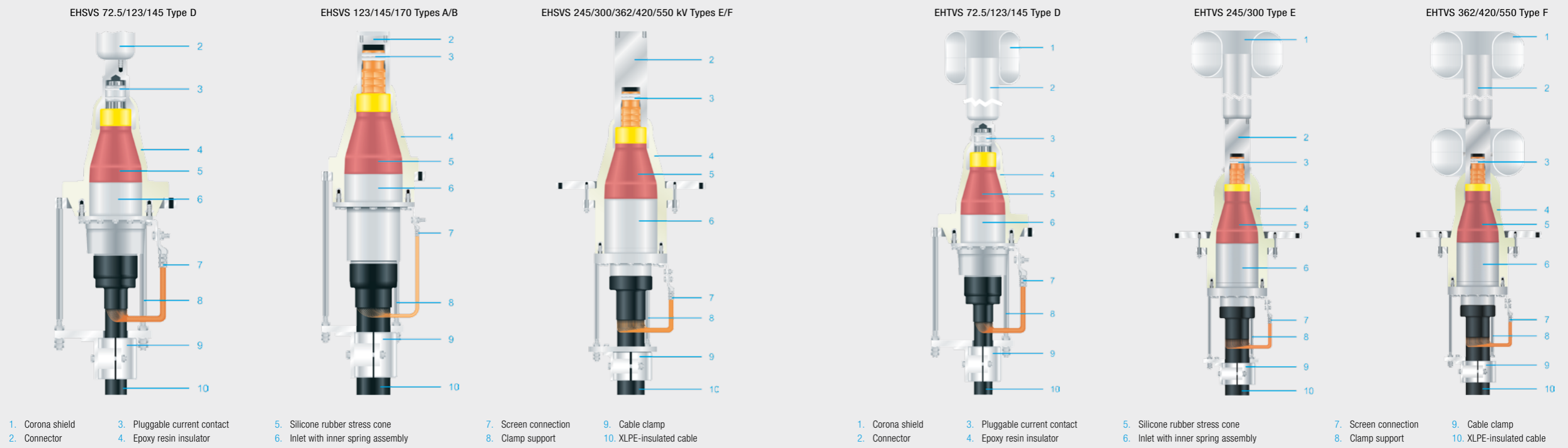
In addition to the composite insulator, the most important component of the dry, gas-filled EHFVCS type is a complete compact termination for controlling the electrical field. This helps shorten on-site installation time since the composite insulator can be supplied pre-assembled.

The Südkabel accessories portfolio also includes **joints** for voltage levels from 72.5 kV to 550 kV. In 1993, Südkabel was the first manufacturer to provide prefabricated and pre-tested joints for extra-high voltage levels from 245 kV to 550 kV.

All joint types are basically maintenance-free as they contain no gaseous or liquid components. The SEHDV slip-on joint is used to through-connect the screens, while the SEHDVCB sectionalising joint functions as isolation for both sides of the screens. Sectionalising joints are used for cross-bonding of cable screens, or for single-sheath bonding in subsections.

The joints comply with relevant test specifications (e.g. IEC 60840, IEC 62067). A three-part VMEV(CB) joint is available as an alternative for voltage levels from 245 to 420 kV. It consists of an epoxy resin body and two field control elements made of silicone rubber and can also be used to connect two cables with completely different constructions.

COMPACT TERMINATIONS: EHSVS (IN SF₆-ENCLOSURE) AND EHTVS (FOR OIL-FILLED TRANSFORMER)



Type G

- For voltages up to 72.5 kV
- In accordance with IEC 62271-209, for use in cable enclosures at voltage level 72.5 kV

Types A/B

- For voltages from 123 kV to 170 kV
- Single-phase insulator design in accordance with the interface dimensions of IEC 62271-209
- Outer geometry and dimensions for Types A/B are identical, but are different at the plug end
- Consists of a pre-assembled stress cone made of silicone rubber for permanent elastic connection to the insulator via spring assemblies
- Current contact via custom contact springs
- Type B, which has a larger inner diameter, can generally be used for conductor cross-sections of 630 mm² up to max. 2500 mm²

Type C

- For voltages from 72.5 kV to 145 kV
- Special compact cable entry uses a common three-phase epoxy resin insulator
- Stress cone made of silicone rubber, with inner spring assembly and pluggable current contact
- For use in SF₆-enclosure only

Type D

- For voltages from 72.5 kV to 145 kV
- Interface dimensions comply with IEC 62271-209 for voltages from 123 kV to 145 kV
- Like Types A/B, uses a single-phase epoxy resin insulator
- Stress cone made of silicone rubber, with inner spring assembly and pluggable current contact

Types E/F

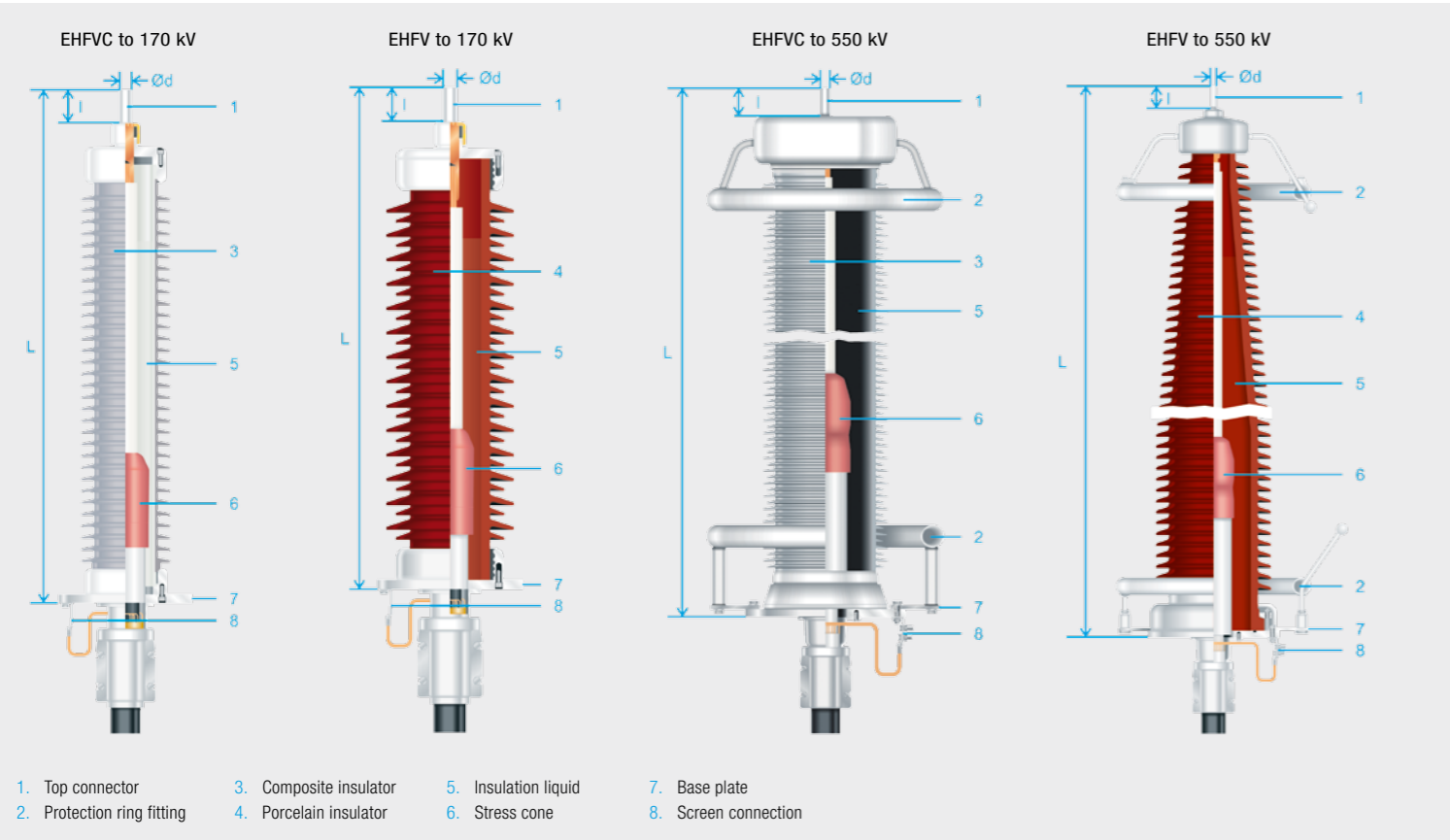
- For voltages from 245 to 300 kV (Type E) and from 362 to 550 kV (Type F)
- Both variants consist of a pre-assembled stress cone made of silicone rubber for permanent elastic connection with the insulator via spring assemblies
- Design essentially the same as Types A/B
- Single-phase insulator in accordance with the interface dimensions of IEC 62271-209

All insulators for the above-mentioned compact terminations – with the exception of Type C – can be used for the cable enclosures in both SF₆ enclosures as well as in oil-filled transformer enclosures in compliance with EN 50299 (or similar) using the same pluggable parts. The compact terminations for transformers are labelled EHTVS, the only technical difference being one or two additional corona shield(s).

Highest voltage U _m	kV	72.5	123	123	145	145	170	245	300	362	420	550
Insulator type	-	G	D/C	A/B	D/C	A/B	A/B	E	E	F	F	F
In SF ₆ -enclosure	-	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS	EHSVS
In oil-transformer enclosure	-	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS	EHTVS
Impulse lightning voltage	kV	350	550	550	650	650	750	1050	1050	1175	1425	1675
Switching impulse voltage	kV	-	-	-	-	-	-	-	850	950	1050	1240
Normative document	IEC	60840	60840	60840	60840	60840	60840	62067	62067	62067	62067	62067
Cu/Al conductor (min.)	mm ²	95	150	150	240	240	240	400	400	500	630	800
Cu/Al conductor (max.)	mm ²	800	800	2500	800	2500	2500	2500	2500	2500	2500	2500
Rated current (max.) *	A	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
Rated peak current *	kA	100	100	170	100	170	170	170	170	170	170	170
Rated short-time withstand current *	kA/s	40/3	40/3	50/3 63/1	40/3	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1
Max. radial force effect	kN	5	5	5	5	5	5	5	5	5	5	5
Max. longitudinal force effect	kN	10	10	10	10	10	10	10	10	10	10	10

* Subject to cable conductor cross section

Table 1: Data sheet for compact terminations



Variants EHFVC (with composite insulator) and EHFV (with porcelain insulator)

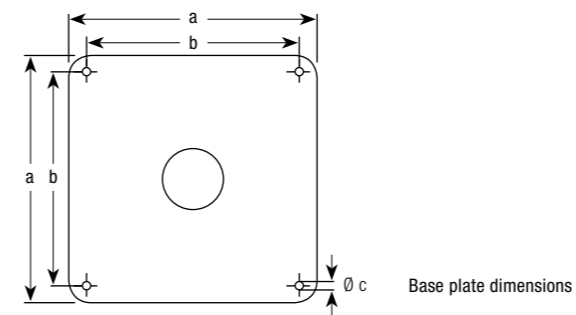
- Primary component: composite insulator made of fibreglass-reinforced plastic support tubing with integrally cast sheds of high-grade silicone rubber, or with porcelain insulator
- Field control by means of a push-on stress cone made of silicone rubber that also seals the base of the termination
- Filled with a synthetic insulating liquid (polyisobutylene)
- Optional equipment: flashover protective fittings (arcing horns)
- Also available: insulated installation with special cast-resin post insulators

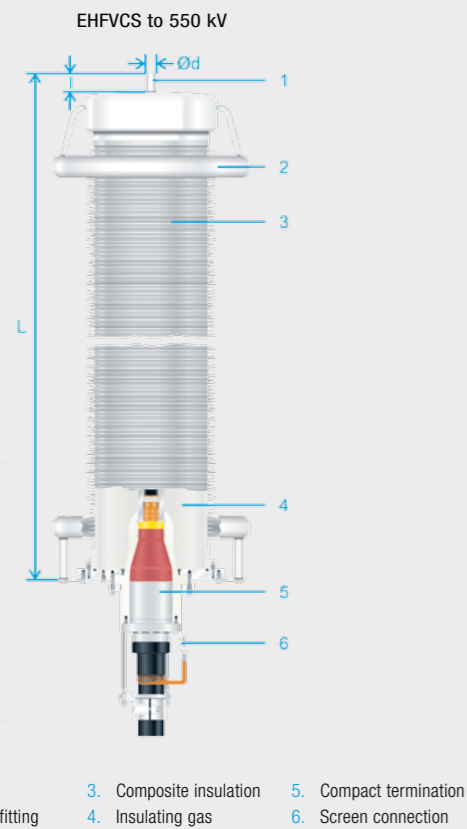
- Meets the requirements of relevant test specifications (e.g. IEC 60840, IEC 62067, IEC 60815)
- Insulators with extended creepage paths for use in highly polluted areas are available
- Cantilever load at conductor bolt dependent on type and length of insulator
- Possible modification of external insulation to correct for atmospheric conditions (for installations at altitudes > 1000 m) by increasing the arcing distance with longer insulators or by using accessories with a higher voltage level
- Short overall height insulator up to a maximum of 30° inclination

Highest voltage U_m	kV	72.5	123	145	170	245	300	362	420	550
Variant with composite insulator	-	EHFVC	EHFVC	EHFVC	EHFVC	EHFVC	EHFVC	EHFVC	EHFVC	EHFVC
Variant with porcelain insulator	-	EHFV	EHFV	EHFV	EHFV	EHFV	EHFV	EHFV	EHFV	EHFV
Impulse lightning voltage	kV	350	550	650	750	1050	1050	1175	1425	1550
Switching impulse voltage	kV	-	-	-	-	-	850	950	1050	1175
Normative document	IEC	60840 60815	60840 60815	60840 60815	60840 60815	62067 60815	62067 60815	62067 60815	62067 60815	62067 60815
Cu/Al conductor (min.)	mm ²	95	150	240	240	400	400	500	630	800
Cu/Al conductor (max.)	mm ²	2500	2500	2500	2500	2500	2500	2500	2500	2500
Rated current (max.) *	A	3150	3150	3150	3150	3150	3150	3150	3150	3150
Rated peak current *	kA	170	170	170	170	170	170	170	170	170
Rated short-time withstand current *	kA/s	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1
Standard pollution class	-	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy
Length with class d/III (approx.) EHFVC/EHFV [L]	mm	1350/ 1020	1710/ 1490	1980/ 1700	2290/ 1950	2590/ 2540	3070/ 3040	3580/ -	4100/ -	5020/ 5130
Weight with class d/III (approx.) EHFVC/EHFV **	kg	80/ -	90/ 175	95/ 195	105/ 235	370/ 470	390/ 570	780/ -	960/ -	1100/ 1400
Base plate dimensions [a]	mm	420	420	420	420	600	600	700	700	700
Hole distance [b]	mm	345	345	345	345	500	500	600	600	600
Hole diameter [Ø c]	mm	18	18	18	18	23	23	23	23	23
Bolt diameter [Ø d] (≤1000 mm ² />1000 mm ²)	mm	30/50	30/50	30/50	30/50	30/50	30/50	30/50	30/50	30/50
Bolt length [l]	mm	100	100	100	100	100	100	100	100	100

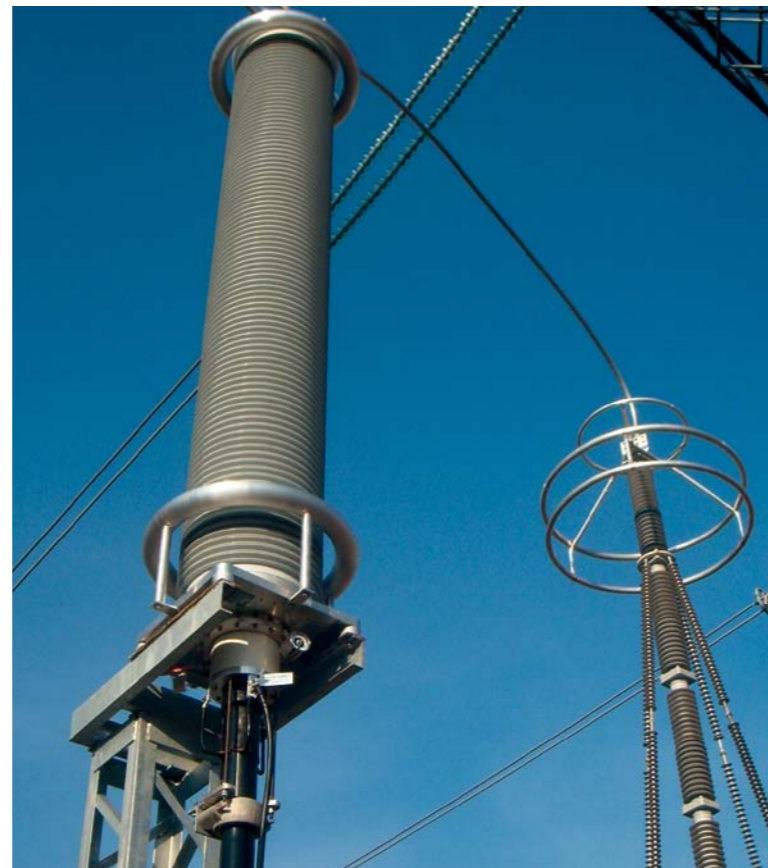
* Depending on cable conductor cross-section; ** Without cable

Table 2: Data sheet for outdoor terminations filled with liquid plate





1. Top connector 2. Protection ring fitting 3. Composite insulation 4. Insulating gas 5. Compact termination 6. Screen connection



Advantages

- Considerably shorter on-site assembly time compared with terminations filled with liquid insulation
- Very short cable length to work with
- Can be installed at any position depending on shed alignment
- Plug-in system allows for insulated assembly

Properties

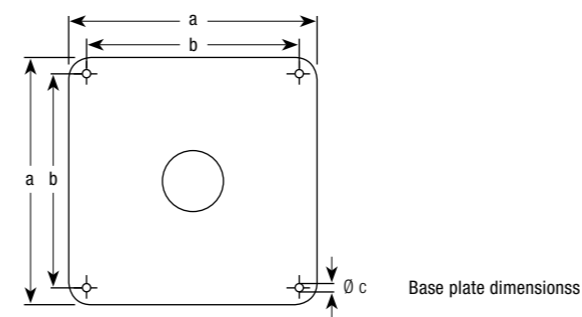
- Composite insulation of fibreglass-reinforced plastic support tubing with integrally cast sheds of high-grade silicone rubber
- Integrated compact termination as a component of the electric field control
- The socket-type epoxy-resin insulator is fastened to the base plate of the termination
- Permanent elastic field control made of silicone rubber connected to the insulator via spring assemblies

- Filled with high-grade insulating gas
- Optional equipment: flashover protective fittings (arcing horns)
- Meets the requirements of relevant test specifications (e.g. IEC 62067, IEC 60815)
- Insulators with extended creepage paths for use in highly polluted areas
- Cantilever load at conductor bolt dependent on type and length of insulator being used
- Possible modification of external insulation to correct for atmospheric conditions (for installations at altitudes > 1000 m) by increasing the arcing distance with longer insulators or by using higher-voltage accessories
- Also available with optional heating system for use in very low-temperature environments

Highest voltage U_m	kV	245	300	362	420	550
Variant with composite insulator	-	EHFVCS	EHFVCS	EHFVCS	EHFVCS	EHFVCS
Impulse lightning voltage	kV	1050	1050	1175	1425	1675
Switching impulse voltage	kV	-	850	950	1050	1240
Normative document	IEC	62067 60815	62067 60815	62067 60815	62067 60815	62067 60815
Cu/Al conductor (min.)	mm ²	400	400	500	630	800
Cu/Al conductor (max.)	mm ²	2500	2500	2500	2500	2500
Rated current (max.) *	A	3150	3150	3150	3150	3150
Rated peak current *	kA	170	170	170	170	170
Rated short-time withstand current *	kA/s	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1
Standard pollution class	-	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy	≥ d/III heavy
Length with class d/III (approx.) [L]	mm	3120	3120	3650	5240	5240
Weight with class d/III (approx.) **	kg	350	350	650	800	800
Max. longitudinal power effect	kN	2	2	2	2	2
Base plate dimensions [a]	mm	600	600	800	800	800
Hole distance [b]	mm	500	500	700	700	700
Hole diameter [Ø c]	mm	23	23	23	23	23
Bolt diameter [Ø d]	mm	60	60	60	60	60
Bolt length [l]	mm	100	100	100	100	100

* Depending on cable conductor cross-section; ** Without cable

Table 3: Data sheet for gas-filled outdoor terminations

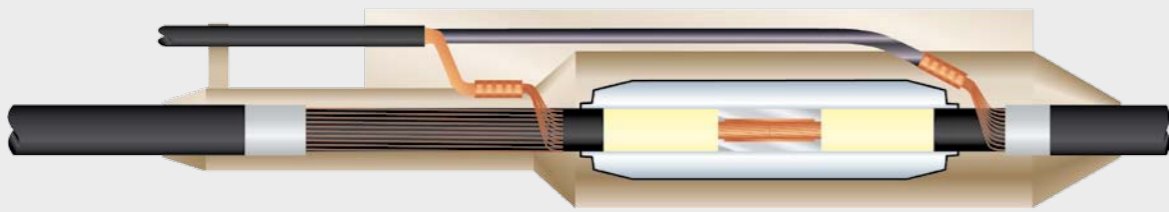


Base plate dimensions

SEHDV 72.5 kV – 170 kV



SEHDVCB 245 kV – 550 kV



Properties

- The slim-line, one piece design of the silicone-rubber joint allows for easy assembly
- Integrated metallic water barrier
- Allows for connection of conductors with different cross-sections and materials
- Corrosion protection for standard-variant with one or more heat-shrinkable tubing for voltage levels up to 170 kV; from 245 kV to 550 kV only for installations in air
- Meets the requirements of relevant test specifications (e.g. IEC 60840, IEC 60840 Annex G, IEC 62067, IEC 62067 Annex G)
- Optional up to 170 kV: corrosion protection with a cast-resin filling in PVC tubing as well as variants with metal coating (for lead- and aluminium-coated cables) and fibreglass protective housing
- Corrosion protection with a cast-resin filling in a fibreglass protective housing for all in-ground applications from 245 kV to 550 kV
- Corrosion protection variants with metal coating (for lead- and aluminium-sheathed cables)

Alternative for 245 kV – 420 kV

The three-part VMEV(CB) joint can be used as an alternative for voltages from 245 to 420 kV. This joint consists of an epoxy-resin body and two field control elements made of silicone rubber. Südkabel has carried this variation since 1993 in its product range, meaning it can look back on many years of experience with it. This type of joint can also be used to connect cables with two completely different constructions.

Highest voltage U _m	kV	72.5	123	145	170	245	300	362	420	550
Variant	-	SEHDV(CB)	SEHDV(CB)	SEHDV(CB)	SEHDV(CB)	SEHDV(CB)	SEHDV(CB)	SEHDVCB	SEHDVCB	SEHDVCB
Impulse lightning voltage	kV	350	550	650	750	1050	1050	1175	1425	1550
Switching impulse voltage	kV	-	-	-	-	-	850	950	1050	1175
Impulse lightning voltage screen separation	kV	60	75	75	75	95	95	125	125	145
Impulse lightning voltage outer protection	kV	30	37,5	37,5	37,5	47,5	47,5	62,5	62,5	72,5
Direct voltage outer protection	kV	20	20	20	20	20	20	20	20	20
Normative document	IEC	60840	60840	60840	60840	62067	62067	62067	62067	62067
Cu/Al conductor (min.)	mm ²	95	150	240	240	400	400	500	630	800
Cu/Al conductor (max.)	mm ²	2500	2500	2500	2500	2500	2500	2500	2500	2500
Rated current (max.) *	A	2500	2500	2500	2500	2500	2500	2500	2500	2500
Rated peak current *	kA	170	170	170	170	170	170	170	170	170
Rated short-time withstand current *	kA/s	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1	50/3 63/1
Length insulation body (approx.)	mm	540	680	680	680	740	740	900	900	900
Weight of standard-variant (approx.) **	kg	15	30	30	30	50	50	380	380	380
Max. longitudinal force effect (in-air installation)	kN	20	20	20	20	20	20	20	20	20
Max. longitudinal force effect (in-ground installation)	kN	50	50	50	50	50	50	50	50	50

* Depending on cable conductor cross-section; ** Without cable

Table 4: Data sheet for joints, 72.5 – 550 kV



Dead-end flange for insulator compact terminations

- For testing insulators as well as switchgears with compact insulator without cable connection (switchgear test voltage)
- Can be used at reduced test voltages for insulators installed in transformer oil
- The Dilo valve is used to apply necessary SF₆ test pressures within the insulator
- Four different sizes for insulator types A/B, C/D/G, E, and F

Link boxes

Südkabel offers a wide variety of link boxes for cross-bonding or grounding one or both sides of the cable screens. The catalogue features boxes for rack, wall or pedestal mounting (protection degree IP66), as well as for horizontal or vertical installation in subterranean shafts or directly in the ground (protection degree IP68).

- Made of coated stainless steel
- Single-phase or three-phase variants available
- Up to six sheath voltage limiters (SVL) can be installed in boxes for screen cross-bonding and for single-end screen bonding
- Peak withstand and short-time withstand current-resistant design (usually 40 kA/ 1s, in custom variants up to 63 kA/ 1 s rated short-time withstand current)
- Arcing tested (usually 40 kA/ 0.1 s)

Fitting device for compact terminations

- For accurate, effortless mounting of the compact termination top connector

Radio-frequency earthing for GIS terminations

Switching activity in gas-insulated switchgears can lead to radio-frequency voltage transients at the insulator collar in terminations. To counteract this, Südkabel offers short, flexible connectors (usually with a SVL ≤ 1kV) that are mounted radially around the insulator collar.

EHSVSM GIS/transformer dead-ends

- EHSVSM dead-ends for voltage-stable, contact-protected termination of built-in insulators in SF₆ gas-insulated switchgears, or oil-filled transformers without cable connection
- The facility can be operated without pressure monitoring or risk to humans
- Very simple mounting without the need for specialised personnel
- When GIS/transformer dead-ends are removed, the corresponding compact termination can be inserted and the system re-energised
- Suitable for voltages up to max. 2.5 U₀

GIS/transformer connection adapters

In addition to conventional interfaces for compact terminations Südkabel can produce custom variants for almost all types of connector bolts and connector flanges in accordance with IEC 62271-209 and EN 50299.

Installation tools

- Südkabel offers the entire range of specialised installation tools, such as stripping tools, compression tools, cutting tools, etc.

Compact termination insulator

- Adapter to make all available SF₆ gas-insulated switchgears, bushings and transformers compatible with compact terminations from Südkabel
- Installation in all current models, including retroactive installation to use dry compact terminations as a replacement for conventional oil-filled terminations

Bundling tape

- Fibreglass-reinforced black adhesive tape for short circuit-proof bundling of three single-core XLPE-insulated cables into one trefoil arrangement
- Number of bundles determined by short-circuit limitations
- Supplied in 55-metre rolls

MAB Cable Cleaner

- Cable cleaning fluid for removing installation residues such as dust, oil, or grease particles from cable sheathing and insulation
- Supplied in 0.6 litre containers

Plastic cable clamps

- Fibreglass-reinforced polyamide cable clamps for secure, short circuit-proof mounting of single- and multicore XLPE-insulated cables
- Flame retardant polyamide, dyed black for UV resistance
- Two-part clamps consisting of an upper and a lower section
- Obligatory rubber insert
- Consistent resistance values for temperature ranges encountered in the field
- Mechanical short-circuit stability up to 20 kN
- Can be used for light cables in any type of installation; with heavy cables, use only in horizontal sections

Sheath voltage limiter (SVL)

- For cable screen cross bonding and for single-end screen bonding
- Size of metal-oxide arrestors determined by maximum expected failure voltage (generally max. approx. 10 kV)

Test adapter

- For high-voltage testing of an XLPE-insulated cable system prior to mounting the EHSVS or EHTVS compact terminations in the GIS or transformer
- Component usually includes test cable for test voltage supply
- Supplied with appropriate insulator sockets in a metal jacket tube filled with pressurised SF₆ gas

Protective cover with earthing connection for compact terminations

Protective covers are recommended for EHSVS and EHTVS compact terminations.

- Protects terminations that are already installed on cables, but not yet connected, from mechanical damage
- Earthing point included

Silumin cable clamps

- Made of non-magnetic aluminium alloy
- For safe, short circuit-proof support of single-core XLPE-insulated cables
- Available in five basic sizes, each with different interior diameters
- Adaptable to outer cable end diameters by means of a rubber insert
- Fixing material included
- At least 2 clamps in the central termination axis recommended to ensure correct termination functionality. A third solid clamp recommended for heavier cables

Voltage-proof dead-ends for compact terminations

- SF₆ gas-filled, voltage-proof dead-end for EHSVS and EHTVS compact terminations
- Can be used to test cables not yet connected to the switchgear or transformer; voltage supplied from the opposite end

OUR OFFER

Cables

- XLPE-insulated cables from 10 kV to 500 kV

Accessories for medium, high, and extra-high voltage

- Outdoor terminations
- Conventional and compact terminations for SF₆ switchgears and transformers
- Cable joints
- Compact terminations for outer and inner cone systems
- Cable links for medium voltage
- Accessories for electrostatic precipitator cables

Cable systems

- Turnkey XLPE-insulated cable systems up to 500 kV

Overhead line conductors

- Aluminium
- Copper
- Aluminium steel

Services

- Consulting for application-related questions
- Training for installation personnel
- Cable laying and supervision of laying
- Installation of accessories
- Commissioning
- After-sales services

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