

distribution: customer, EC/ECG/EQ, KS/KSE/KSH, KSI, QM, VPG

title: General Description and Application Conditions of Accessories 72.5 - 550 kV

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1 Design of Cable Accessories

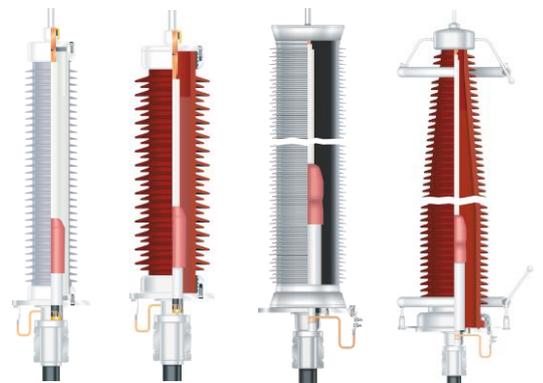
The accessories of Südkabel are the pivotal components of XLPE-insulated high and extra high voltage cables for $U_m = 72.5 - 550$ kV. Südkabel has a complete range of accessories for connecting a cable to an overhead line, inside a gas-insulated switchgear, inside a gas-insulated bushing, inside an oil-filled transformer or for connection of two cable lengths. The dimensions and the details of the interfaces of each accessory are given in the relevant offer drawing. In accordance to CIGRE brochure no. 194 [01] (chapter 2.4.2) the accessory design is described in the following subitems. General reference is made at this point to our technical brochure 'Accessories for XLPE-insulated High and Extra-High Voltage Cables'. In this brochure the electrical characteristics of the accessories are placed in tables. In the separate product-specific technical descriptions of the individual accessories the individual components of the accessory in addition to a detailed functional description are shown.

1.1 Outdoor Terminations Type EHFV(C) 72.5 - 550 (filled with liquid insulation)

Outdoor terminations are used to connect the cable system to air-insulated high voltage components (e.g. overhead line, transformer bushing).

Outdoor terminations consist of a composite insulator made of fibreglass-reinforced plastic support tubing with integrally cast sheds made of silicone rubber or alternatively with a porcelain insulator.

The electric field control is carried out by a push-on stress cone made of silicone rubber. The insulator itself is filled with a synthetic insulating liquid.



[01] CIGRE Technical Brochure 194 - October 2001, Working Group 21.17
Construction, Laying and Installation Techniques for Extruded and Self Contained Fluid Filled Cable Systems

03	rev. 1.3 alternative gases	Weinlein	20.09.2021	Ebert, Peters	20.09.2021	Weinlein	20.09.2021
02	rev. 1.2, 2.1, 2.4	Weinlein	11.03.2019	Ebert, Peters	12.03.2019	Weinlein	12.03.2019
00	recreation in new layout	Weinlein	27.08.2013	Peters	27.08.2013	Weinlein	27.08.2013
rev.	description	editor	date	checked	date	approved	date

1.2 Outdoor Terminations Type EHFV(C)S 72.5 - 550 (gas-filled)

Outdoor terminations are used to connect the cable system to air-insulated high voltage components (e.g. overhead line, transformer bushing).

Gas-filled outdoor terminations consist of a composite insulator made of fibreglass-reinforced plastic support tubing with integrally cast sheds made of silicone rubber or alternatively with a porcelain insulator.

An integrated compact termination as a component of the electric field control is used. The main insulator is filled with high-grade insulating gas. Due to its oil-free design, this type of sealing end is suitable for use in water protection areas. With the included pressure gauge for automatic pressure control two change-over contacts can be used for two alarms.



1.3 Compact Terminations for Gas-Filled Enclosures Type EHSVS 72.5 - 550

Terminations for insulating gas-filled enclosures are used to connect the cable system to a gas insulated switchgear (GIS) or a gas insulated bushing (GIB).

The compact termination uses a completely dry solid insulation without any oil and gas.

The electric field control is carried out by a push-on stress cone made of silicone rubber which has a permanent elastic connection with the insulator by means of spring assemblies. The use of climate-friendly alternative gases instead of SF₆ in the cable connection enclosure is possible.



1.4 Compact Terminations for Oil-Filled Enclosures Type EHTVS 72.5 - 550

Terminations for oil-filled enclosures are used to connect the cable system to an oil-filled transformer or oil-filled reactor.

The compact termination uses a completely dry solid insulation without any oil and gas.

The electric field control is carried out by a push-on stress cone made of silicone rubber which has a permanent elastic connection with the insulator by means of spring assemblies.



1.5 Joints

Joints are used to connect 2 cable lengths or in case of repair works to insert a short cable length.

The main part of the joint is the insulating body made of silicone rubber.

At the joint the cable screen can be lead out for screen earthing or screen cross bonding.

Depending on the application the corrosion protection of the joints is made of heat-shrinkable tubing or a coffin box filled with cast resin.

For all joints of voltage levels $U_m \geq 362$ kV a special metal support for the joint is mandatory.



1.6 Link Boxes and Sheath Voltage Limiters (SVL)

Link boxes serve to connect a cable screen to the earth system for solidly or single side bonding or for cross bonding of cable screens. Depending on installation and earthing concept a single-phase or a three-phase link box is considered for buried or above ground level application.

For cable systems with single side bonding or cross bonding of cable screen sheath voltage limiters have to be applied to protect the outer sheath of cable respectively the screen separation of a sectionalising joint. All sheath voltage limiters are of metal-oxide type.



2 Application Conditions

In principle the use of each cable accessory for cable systems for high and extra high voltage $U_m = 72.5 - 550 \text{ kV}$ is subjected to certain conditions.

2.1 Environmental Conditions

- maximum ambient air temperature: 50 °C 
- minimum ambient air temperature: usually -40 °C 
 - note: on request depending on type and voltage level: down to -60°C*
- maximum installation altitude of standard design outdoor termination: 1000 m (MAMSL) 
 - note: increasing of the outer arcing distance of the outdoor insulator (insulator length) acc. to IEC 60137 [02] (item 5.2) with installation altitudes > 1000 m (MAMSL)*
- installation in non strong salty respectively sulphurous atmosphere
 - note: in strong salty respectively sulphurous atmosphere special additional surface coatings in the design of the accessories to be supplied have to be considered*
- standard pollution class outdoor termination (IEC 60815 [03]): d / III heavy 
 - note: higher pollution classes available on request as special variant*
- interface termination to a SF₆-enclosure: IEC 62271-209 [04]
 - note: other mechanical interfaces available on request as special variant*
- interface termination to a oil-filled enclosure: EN 50299-1 / -2 [05]
 - note: other mechanical interfaces available on request as special variant*
- maximum temperature at connection interface of terminations: 90 °C

2.2 Electric and Thermo-Electric Characteristics

- design rating / type tests for $U_m = 72.5 - 170 \text{ kV}$: IEC 60840 [06]
- design rating / type tests / prequalification tests for $U_m = 245 - 550 \text{ kV}$: IEC 62067 [07]
- maximum temperature at cable conductor: 90 °C
- maximum rated current: 3150 A (terminations), 2500 A (joints)
 - note: increasing possible on request by special variant*
- maximum rated short-time withstand current: 50 kA / 3 s respectively 63 kA / 1 s
 - note 1: increasing possible on request by special variant*
 - note 2: with insulators type C, D, G: 40 kA / 3 s*
- maximum rated peak current: 170 kA
 - note: increasing possible on request by special variant*

2.3 Cable Design

- types of conductor (copper or aluminium): round, compacted, stranded or segmented
note: solid conductor, oxidised or enamelled wires on request by special variant
- maximum and minimum conductor cross section: acc. to indication on offer drawing
- maximum diameter of cable core: acc. to indication on offer drawing
- eccentricity of cable conductor versus cable insulation: < 10%
- roundness cable insulation for $U_m = 72.5 - 170 \text{ kV}$: $t_{\max} - t_{\min} = 0.15 \cdot t_{\max}$ (IEC 60840)
- roundness cable insulation for $U_m = 245 - 550 \text{ kV}$: $t_{\max} - t_{\min} = 0.10 \cdot t_{\max}$ (IEC 62067)
- type of cable core semi-conductive screens: extruded
- application with EPR insulated cables: up to $U_m \leq 170 \text{ kV}$

2.4 Mechanical Characteristics

- installation position of outdoor termination type EHFV/C 72.5 - 170 (liquid insulation): maximum 30° deviation to vertical upright installation
note: for EHFV/C 245-550 usually no deviation allowed
- installation position of outdoor termination type EHFVCS 72.5 - 550 (gas-filled): any
- maximum longitudinal force of cable effect to joint: 20 kN (air inst.), 30 kN (soil inst.)
note 1: cable has to be aligned concentric to joint minimum 1 m at both sides of joint
note 2: cables with corrugated outer sheath: maximum 1 kN
note 3: for $U_m \geq 362 \text{ kV}$ a mandatory joint support has to be engineered
- maximum longitudinal force of cable effect to termination: 10 kN
note 1: EHFV/C 72.5-170: 2 kN, EHFV/C 245-550: 5 kN, with special measures up to 20 kN
note 2: a cable cleat with a maximum distance of 1200 mm to termination has to be engineered
- maximum longitudinal external force at conductor bolt of EHFV/C(S) 72.5-550: 5 kN
- maximum radial force effect to joint: not permissible
- maximum radial force effect to connection interface of terminations for SF₆- or oil-filled-enclosures: 5 kN
- maximum radial force effect at connection bolt of outdoor terminations: acc. to indication of cantilever load on offer drawing

2.5 Characteristics Link Boxes

- IP protection class of link boxes: IP 66 (over ground), IP 68 (under ground)
- rated short time withstand current of link boxes: normally 40 kA / 1 s (rated peak current: 100 kA)
note: up to 63 kA / 1 s on request by special variant
- rated arcing withstand current of link boxes: normally 20 kA / 0.1 s
note: up to 40 kA / 0.5 s on request by special variant

[02]	IEC 60137:	Insulated bushings for alternating voltages above 1 000 V
[03]	IEC 60815:	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1, 2, 3
[04]	IEC 62271-209:	High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid-filled and dry type cable-terminations
[05]	EN 50299-1 / -2:	Oil-immersed cable connection assemblies for transformers and reactors having highest voltage for equipment U_m from 72,5 kV to 550 kV; Part 1: Fluid-filled cable terminations; Part 2: Dry-type cable terminations
[06]	IEC 60840:	Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36 \text{ kV}$) up to 150 kV ($U_m = 170 \text{ kV}$) – Test methods and requirements
[07]	IEC 62067:	Power cables with extruded insulation and their accessories for rated voltages above 150 kV ($U_m = 170 \text{ kV}$) to 500 kV ($U_m = 550 \text{ kV}$) – Test methods and requirements