

HIGH VOLTAGE CABLE ACCESSORIES

for 72 kV up to 170 kV



Completing the picture

BASED ON EXPERIENCE IS THE **FUTURE**

nkt cables GmbH

NKT was established in 1891 as cable manufacturer. In 1999 NKT A/S Denmark merged with Felten & Guillaume Kabelwerke GmbH in Germany to form **nkt cables group GmbH** with headquarters in Cologne. **nkt cables group GmbH** is owned by NKT Holding A/S, an industrial group of companies employing 9.110 people.

nkt cables group GmbH bundles the expertise of around 2.500 employees in 10 production and development facilities spread over five European countries and P.R. China.

Manufacturing and developing power cable accessories up to 400 kV is one of the core businesses of **nkt cables group GmbH**. Since more than 50 years **nkt cables group GmbH** Nordenham, Germany (formerly F&G Kabelgarnituren GmbH) is one of the world market leaders in power cable accessories.

As the first company introducing silicone rubber terminations already in the sixties, **nkt cables GmbH**, Nordenham is specialized in production of silicone rubber power cable accessories.

The product range covers cable joints, cable connectors for SF6-switchgears and transformers as well as indoor- and outdoor terminations. These types of cable accessories are used for single- and 3-core cables as well as for paper insulated cables.



GENERAL

Silicone rubber	5
Stress control	5

INDOOR AND OUTDOOR TERMINATIONS

THV 72	Dry type push-on technique without supporting function	6
KFEV-V	Dry type composite insulator without insulating liquid	7
FEV-V	Composite insulator oil filled	8
FEV-P	Porcelain insulator oil filled	9

SWITCHGEAR AND TRANSFORMER TERMINATIONS

KSEV/KTEV	Dry type plug-in termination	10-11
SEV/TEV	Epoxy insulator termination	12

STRAIGHT JOINTS

SM 72-170	Premoulded straight joint	13
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MORE ACCESSORIES FOR DIFFERENT APPLICATIONS

Screen separation	14
Link box	14
Tools	14

REQUESTED CABLE INFORMATION

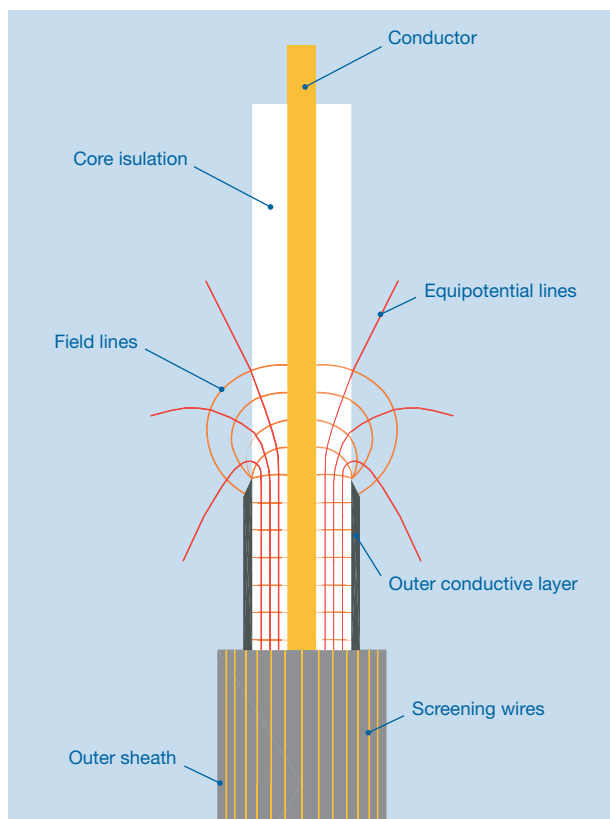
Cable data	15
Certificates	16
Contact	16



Stress control

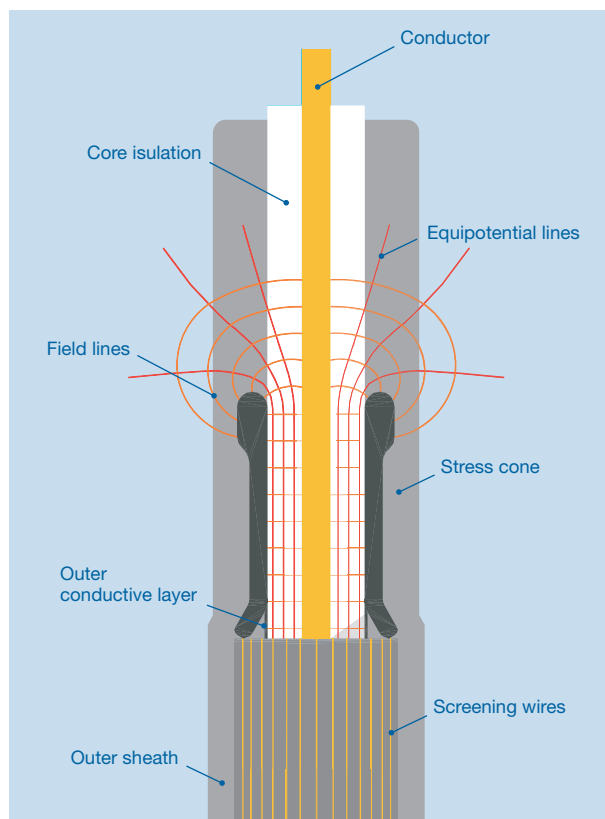
The specific electrical problems of the cable termination are found at the point between the high-grade solid electrical insulation of the cable and the gaseous insulation air which has a significantly lower dielectric strength.

In order to achieve sufficient insulating clearance, the outer conductive layer of the cable must be stripped to below the end of the core. This causes unacceptably high field intensities at the end of the outer conductive layer (figure 1) which must be eliminated by means of special measures.



Electrical field without stress control (Figure 1)

Figure 2 shows the field of the cable termination controlled capacitively by a funnel shaped electrode. It is dimensioned in such a way that field intensities do not exceed at any point. This prevents harmful corona or partial discharge.



Electrical field with capacitive stress control (Figure 2)

Silicone rubber

Silicone rubber is a preferred material for cable accessories due to its excellent mechanical and electrical properties.

For more than 40 years silicone has been used successfully as high-quality electrical insulation for voltages up to 400 kV. Silicone rubber features high quality electrical insulation, superior corona and tracking resistance, combined with high elasticity.

It facilitates multi range application, where one silicone rubber body can be used for various conductor cross sections. Optimal flexibility ensures easy assembly of the accessories.

Outstanding features of the silicone rubber insulation material are:

- ✓ UV and ozone resistance
- ✓ durable water rejection
- ✓ weather and aging resistance
- ✓ non-flammable, self-extinguishing, heat resistant
- ✓ applicable for use at temperatures between -50° C and +180° C
- ✓ high elasticity
- ✓ high tracking resistance
- ✓ unlimited storage life
- ✓ friendly to the environment

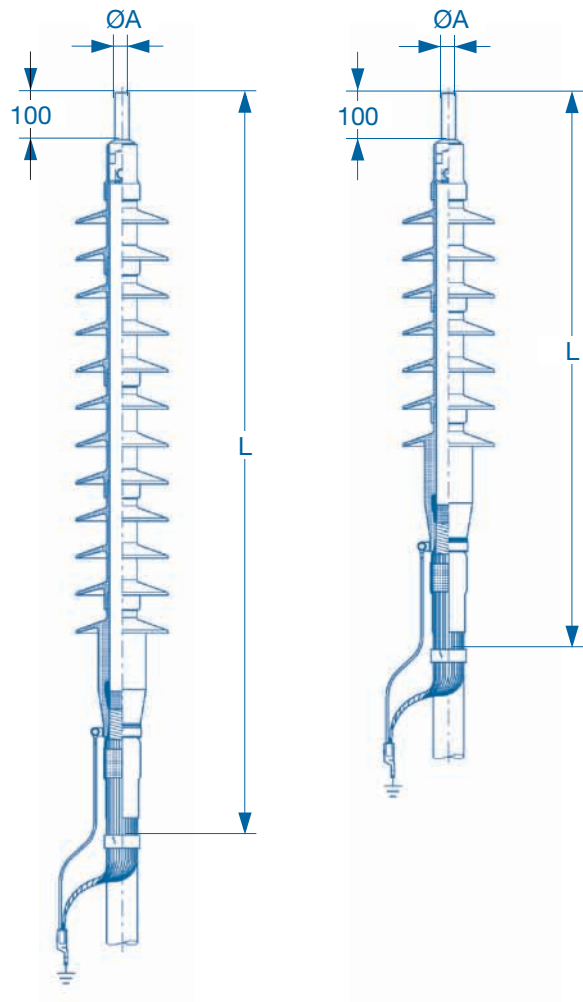
Indoor and outdoor termination

THV 72 kV dry type without supporting function

This two versions of silicone rubber terminations are designed for indoor and outdoor conditions. Main components of the termination are the pretested push-on silicone components with integrated stress cone for electrical field control.

- ✓ Integrated capacitive stress control system
- ✓ Piece tested silicone components
- ✓ Screw type top bolt, no special tools are required
- ✓ Top bolt covered by top part of silicone rubber
- ✓ Quick and easy assembly
- ✓ Long creepage distance due to optimised shed design
- ✓ Type test certificate in accordance with IEC 60840 available

Operation voltage Um (kV)	72					
	THV 72 II Size 36	THV 72 IV Size 36	THV 72 II Size 46	THV 72 IV Size 46	THV 72 II Size 56	THV 72 IV Size 56
Conductor Cu/Al max. (mm ²)	...800	... 800	... 1200	... 1200	... 1600	... 1600
Diameter over dielectric min. - max. (mm)	40.0 - 54.0	40.0 - 54.0	51.5 - 65.0	51.5 - 65.0	63.0- 78.0	63.0- 78.0
Diameter over sheath max. (mm)	approx. 80-190	approx. 80-190	approx. 100-200	approx. 100-200	approx. 110-210	approx. 110-210
Screw / Press Connection S/P	S	S	S	S	S	S
Length L (mm)	1100 - 1160	1450 - 1540	1000 - 1040	1250 - 1280	1250 - 1280	1250 - 1280
Pollution level	II	IV	II	IV	II	IV
Creepage distance min. (mm)	> 1450	> 2248	> 1450	> 2248	> 1450	> 2248
Diameter A (mm)	30	30	30/50	30/50	50	50
No. of sheds	8	11	8	11	8	11



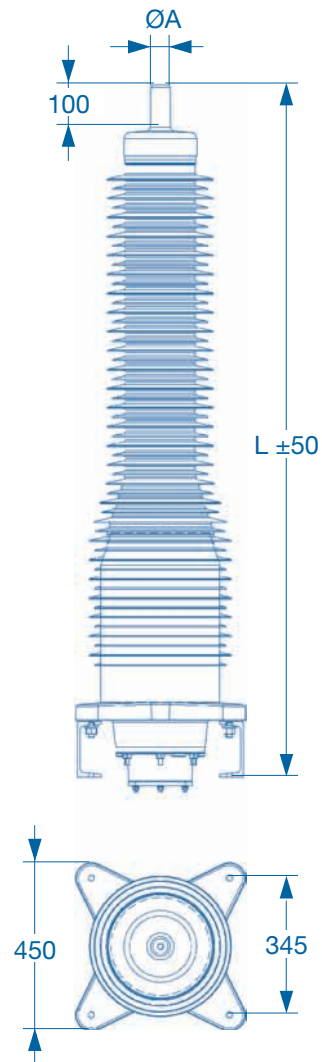
Dry type outdoor termination

KFEV 145-V dry type outdoor termination

This new generation of dry type termination is free of any liquid and gaseous insulation medium. Main components of the termination are the push-on silicone components with integrated stress cone for electrical field control and the liquid free epoxy resin insulator with silicone sheds.

- ✓ Free of insulation liquid, no filling procedure
- ✓ Less parts to be assembled therefore faster installation
- ✓ Prefabricated capacitive silicone stress control system
- ✓ Plug-in part comprising four components (stress cone made of silicone rubber, cable gland, connection bolt, spring loaded compression device)
- ✓ Easy to fit screw type conductor connector
- ✓ All metal work made of corrosion resistant aluminium alloy
- ✓ Type test certificate in accordance with IEC 60840 available

Operation voltage Um (kV)	145
Typ	KFEV 145-V
Conductor Cu/Al max. (mm ²)	... 1200
Diameter over dielectric min. - max. (mm)	42.0 - 74.0
Diameter over sheath max. (mm)	... 99
Screw / Press Connection S/P	S
Length L (mm)	1750
Pollution level	IV
Creepage distance min. (mm)	> 4495
Diameter A (mm)	50



Outdoor termination

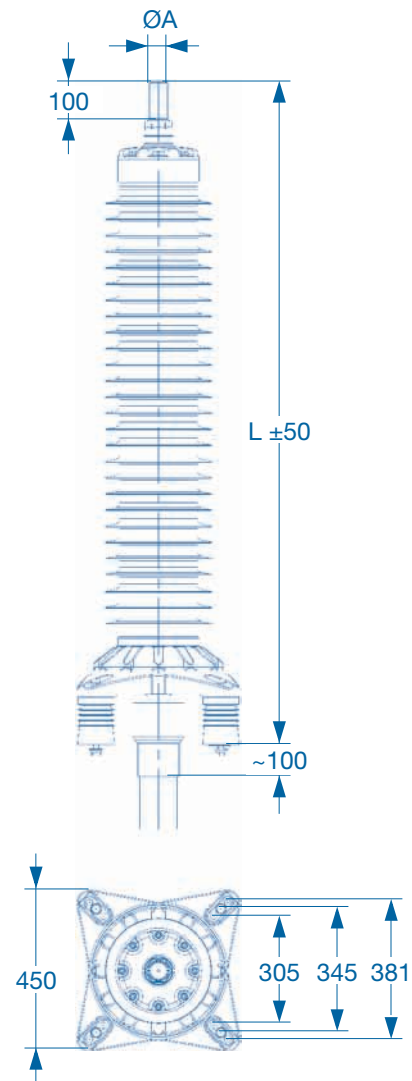
FEV-V with composite insulator

The different versions of this outdoor termination type FEV-V are designed for operation under severe outdoor conditions. Main components of the termination are the composite insulator with upper metal work, metal base plate with supporting insulators and premoulded stress cone for electrical field control.

- ✓ Integrated premoulded stress control system made of silicone rubber
- ✓ All metal work made of corrosion resistant aluminum alloy
- ✓ Termination is standing on supporting pedestal insulators, so that the cable screen can be isolated from earth
- ✓ Top bolt available in two versions, screw type or press type
- ✓ Different top bolt diameter available suiting to the cable dimensions
- ✓ Type test certificate in accordance with IEC 60840 available

Operation voltage Um (kV)	72	145	170
Typ	FEV 72-V	FEV 145-V	FEV 170-V
Conductor Cu/Al max. (mm ²)	... 1200 ¹	... 1200 ¹	... 1200 ¹
Diameter over dielectric min. - max. (mm)	34.5 - 97.0	34.5 - 84.0	34.5 - 108.0
Diameter over sheath max. (mm)	... 105	... 105	... 105
Screw / Press Connection S/P	S / P	S / P	S / P
Length L (mm)	1400	1900 / 2100	2100
Pollution level	III	II / IV	IV
Creepage distance min. (mm)	> 1813	> 3075 > 5270	> 5270
Diameter A (mm)	30 / 50	30 / 50	30 / 50

¹ >1200 up to 2500 mm² special crimping tool is required



Outdoor termination

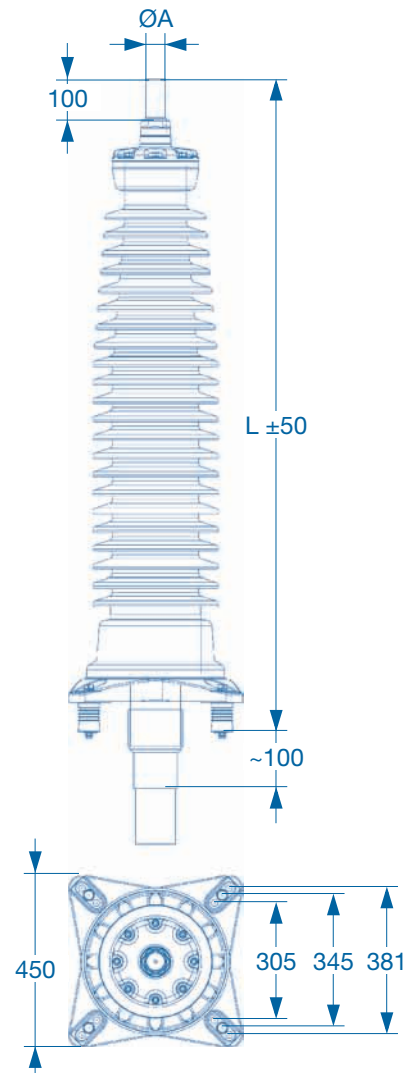
FEV-P with porcelain insulator

The different versions of outdoor termination type FEV-P are designed for operation under severe outdoor conditions. Main components of the termination are the porcelain insulator with upper metal work, metal base plate with supporting insulators and premoulded stress cone for electrical field control.

- ✓ Integrated premoulded stress control system made of silicone rubber
- ✓ All metal work made of corrosion resistant aluminum alloy
- ✓ Termination is standing on supporting pedestal insulators, so that the cable screen can be isolated from earth
- ✓ Top bolt available in two versions, screw type or press type
- ✓ Different top bolt diameter available suiting to the cable dimensions
- ✓ Type test certificate in accordance with IEC 60840 available

Operation voltage Um (kV)	72	145	170
Typ	FEV 72-P	FEV 145-P	FEV 170-P
Conductor Cu/Al max. (mm ²)	... 1200 ¹	... 1200 ¹	... 1200 ¹
Diameter over dielectric min. - max. (mm)	34.5 - 84,0	34.5 - 97,0	34.5 - 108,0
Diameter over sheath max. (mm)	... 105	... 105	... 105
Screw / Press Connection S/P	S / P	S / P	S / P
Length L (mm)	1500	1950	2150
Pollution level	IV	IV	III
Creepage di- stance min. (mm)	> 2248	> 4495	> 4250
Diameter A (mm)	30 / 50	30 / 50	30 / 50

¹ >1200 up to 2500 mm² special crimping tool is required



Switchgear and transformer termination

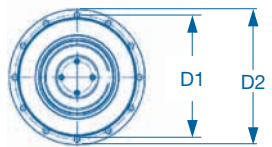
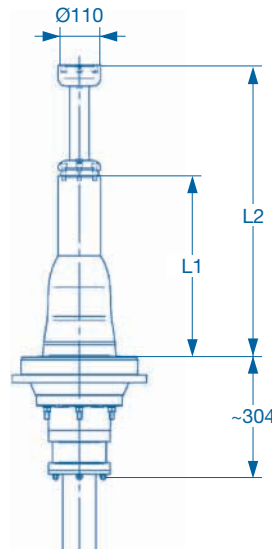
KSEV / KTEV dry type plug-in termination up to 145 kV

All versions of dry-type termination are designed for installation in SF6 gas insulated switchgear (GIS) or for installation in the oil filled cable box of the transformer. The complete termination consists of epoxy resin insulator with embedded electrode, fixing ring which is fitting to the cable, comprising metal cable gland, compression device and premoulded plug-in stress cone for electrical field control.

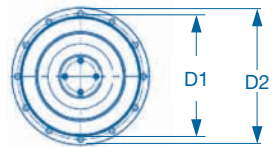
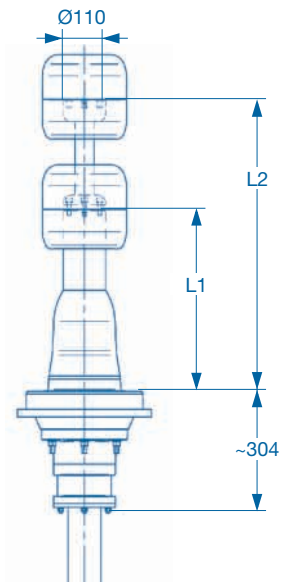
- ✓ Plug-in part comprising four components (stress cone made of silicone rubber, cable gland, connection bolt, spring loaded compression device)
- ✓ Insulator according with IEC 62271-209 for GIS and DIN EN 50299 for transformer termination
- ✓ Conductor connection bolt designed as mechanical screw type connector
- ✓ Combination with different adapter and additional electrodes are available to fulfil the requirements from IEC 60859 Part 1 and 2 and older switchgear housings
- ✓ Type test certificate in accordance with IEC 60840 available
- ✓ Dead-end plug available (see page 14)

Operation voltage Um (kV)	72	123 ... 145
Typ Switchgear Transformer	KSEV 72 KTEV 72	KSEV 145 KTEV 145
Conductor Cu/Al max. (mm ²)	... 1000	... 1200
Diameter over dielectric min. - max. (mm)	38.5 - 74.0	38.5 - 74.0
Diameter over sheath max. (mm)	... 99	... 99
Screw / Press Connection S/P	S	S
L1 (mm)	310 ±0.5	470 ±0.5
L2 (mm)	583 ±0.5	757 ±0.5
D1 (mm)	270 ±0.5	320 ±0.5
D2 (mm)	300	350

GIS KSEV



Transformer KTEV



Switchgear and transformer termination

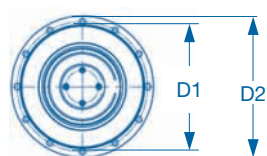
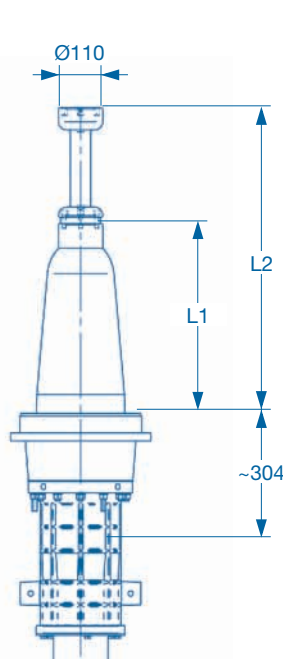
KSEV / KTEV dry type plug-in termination up to 170 kV

The new version of dry-type plug-in termination is designed for the voltage level up to $U_m=170$ kV and to the biggest conductor cross-section up to 2500 mm². With this large application range the termination still fulfils the dimensions according to the IEC standards. The termination is also applicable in the 145 kV voltage level with conductor cross section above 1200 mm².

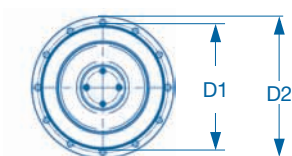
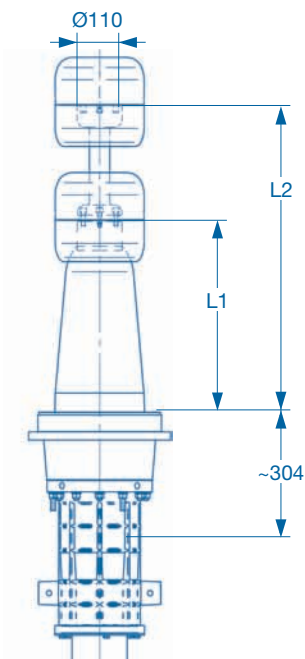
- ✓ Very large application range for conductor cross sections up to 2500 mm²
- ✓ Insulator according with IEC 62271-209 for GIS and DIN EN 50299 for transformer termination
- ✓ Conductor connection bolt designed as mechanical screw type connector.
- ✓ Combination with different adapter and additional electrodes are available to fulfil the requirements of IEC 60859 Part 1 and 2 and older switchgear housings
- ✓ Type test certificate in accordance with IEC 60840 available
- ✓ Dead-end plug available (see page 14)

Operation voltage U_m (kV)	123 ... 170
Typ Switchgear Transformer	KSEV 170 KTEV 170
Conductor Cu/Al max. (mm ²)	... 2500
Diameter over dielectric min. - max. (mm)	65.0 - 97.0
Diameter over sheath max. (mm)	... 135
Screw / Press Connection S/P	S
L1 (mm)	470 ± 0.5
L2 (mm)	757 ± 0.5
D1 (mm)	320 ± 0.5
D1 (mm)	350

GIS KSEV



Transformer KTEV



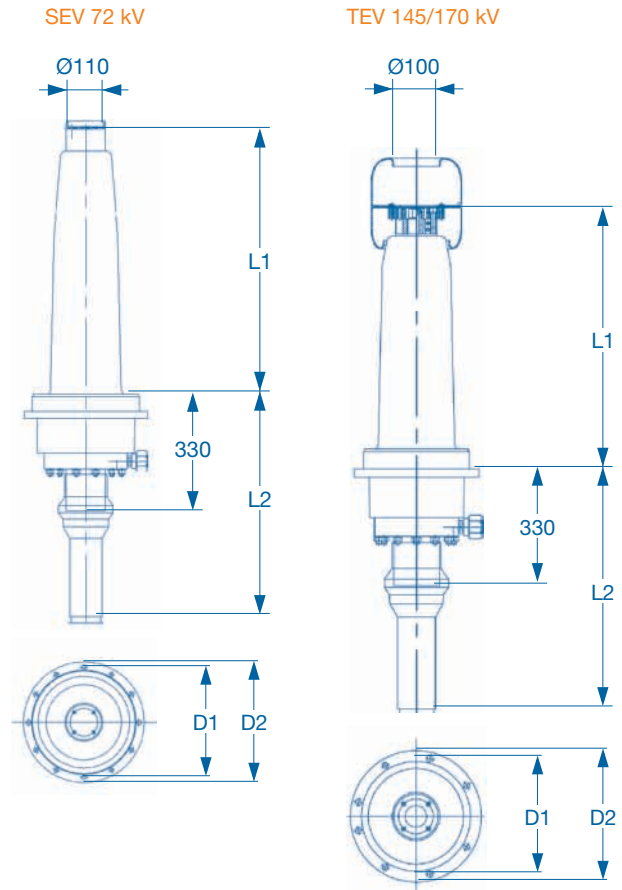
Switchgear and transformer termination

SEV / TEV epoxy insulator termination

The termination is designed for direct installation in SF6 gas insulated switchgear (GIS) or in the oil filled cables box of the transformer. Major components of the termination are the pressure tight epoxy resin insulator with embedded electrode, metal fixing ring, metal cable gland and prefabricated stress cone for electrical field control.

- ✓ Integrated prefabricated stress control system with silicon rubber
- ✓ Pressure tight epoxy resin insulator is cast in one piece with integrated insulation ring at the bottom allowing to separate the cable screen from earth.
- ✓ Cable gland made of corrosion resistant aluminium alloy
- ✓ Possible installation position vertical up to 45° then up to 90° oil expansion vessel required
- ✓ Type test according to IEC 60840 is available

Operation voltage Um (kV)	72	145	170
Typ Switchgear Transformer	SEV 72 TEV 72	SEV 145 TEV 145	SEV 170 TEV 170
Conductor Cu/Al max. (mm ²)	... 1000	... 1200	... 1200
Diameter over dielectric min. - max. (mm)	34.4 - 74.0	41.6 - 84.0	41.6 - 84.0
Diameter over sheath max. (mm)	... 85	... 105	... 105
Screw / Press Connection S/P	S / P	S / P	S / P
Creepage distance (mm)	500	650	750
L1 (mm)	583 ±1	757 ±1	757 ±1
L2 (mm)	~ 630	~ 630	~ 630
D1 (mm)	270 ±0.5	320 ±0.5	320 ±0.5
D2 (mm)	300	350	350



Straight joint

SM 72 – SM 170 premoulded straight joint

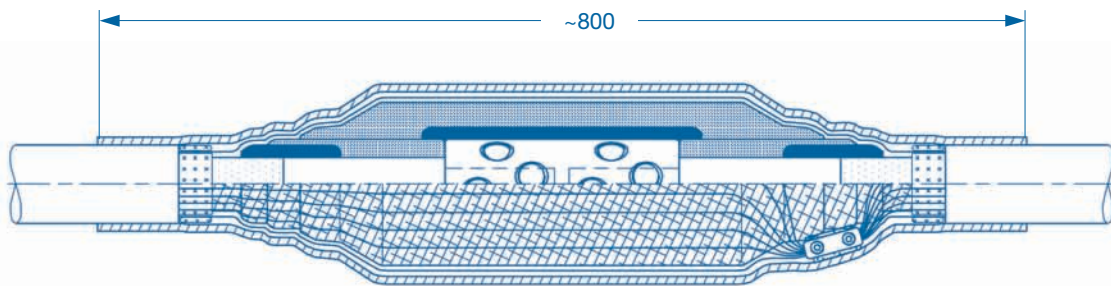
This premoulded straight joint in three piece design with compact dimensions is made of silicone rubber. Main components of the standard straight joint are conductor connection sleeve, cable adapters, main joint sleeve and outer protective covering.

- ✓ Integrated premoulded stress control system with silicone rubber
- ✓ Three piece design with compact dimensions
- ✓ Screw type conductor connector
- ✓ Minimum tool requirement
- ✓ Version with screen separation available
- ✓ Type test certificate in accordance with IEC 60840 available

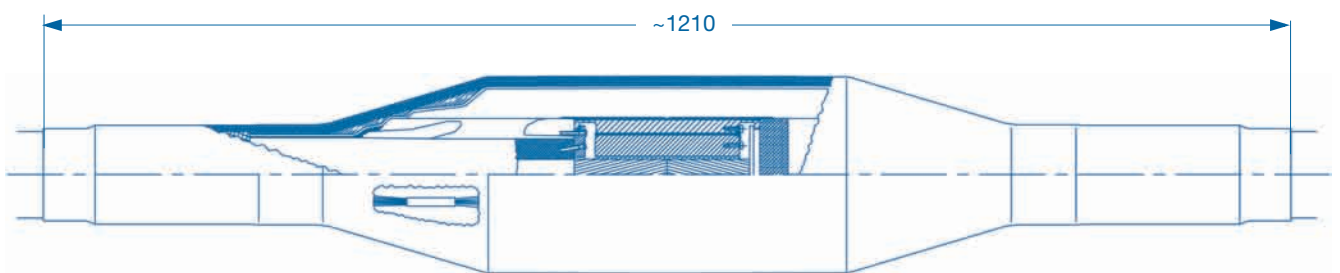
Operation voltage Um (kV)	Type	Conductor Cu / Al max. (mm ²)	Diameter over dielectric min. - max. (mm)	Diameter Joint approx. (mm)	Connection Type Screw / Press
72	SM 72 Size 36	...630	40.0 - 54.0	150	S
72	SM 72 Size 46	...1000	51.5 - 65.0	150	S
72	SM 72 Size 56	...1600	63.0 - 78.0	150	S
145	SM 145-1	...1200 ^{*1}	34.5 - 75.0	180	S/P
145	SM 145-2	...1200 ^{*1}	72.0 - 84.0	195	S/P
145	SM 145-3	...1200 ^{*1}	81.5 - 108.0	230	S/P
170	SM 170-1	...1200 ^{*1}	50.0 - 84.0	225	S/P
170	SM 170-2	...1200 ^{*1}	81.5 - 108.0	230	S/P

^{*1} >1200 up to 2500 mm² special crimping tool is required

SM 72



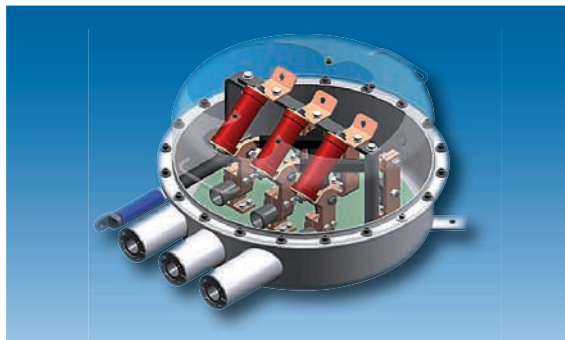
SM 145



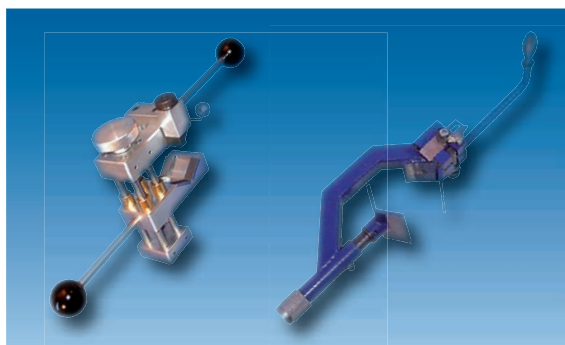
Accessories

More accessories for different applications

- ✓ Link Box for special bonded or earthed cable systems available
 - Indoor and outdoor gantry mounted
 - Outdoor within concrete pit in horizontal position
 - With 3 zinc oxide sheath voltage limiters
 - All metal work in stainless steel
- ✓ All joints are available with screen separation for special bonded or earthed cable systems
- ✓ Tools for cable preparation
 - Sheath stripper
 - Cable peeling tool to remove outer conductive layer
- ✓ Training course and supervision to guarantee perfect installation in our assembly department or on site are possible

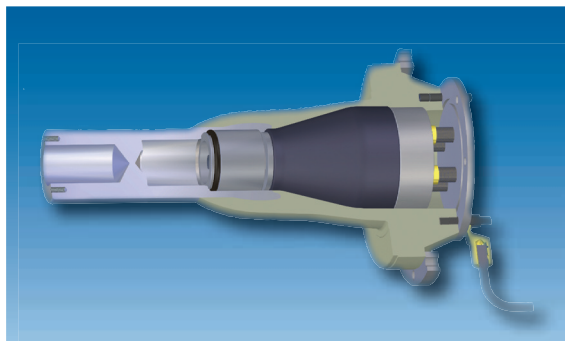


Link box with voltage limiters

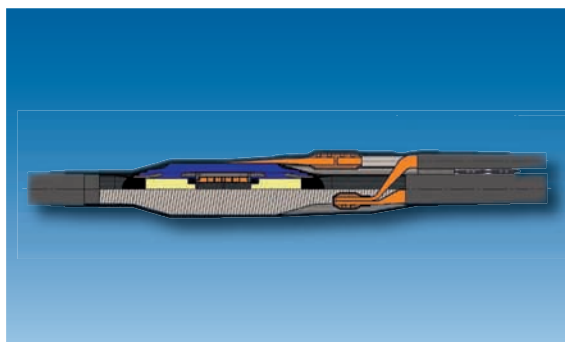


Cable peeling tool

Sheath stripper



Dead-end plug for KSEV/KTEV 72/145/170



Straight joint with screen separation

Cable data

Requested cable information

To supply the optimal accessories solution detailed cable data are required. Please send the completed cable data form with your inquiry.

Remarks

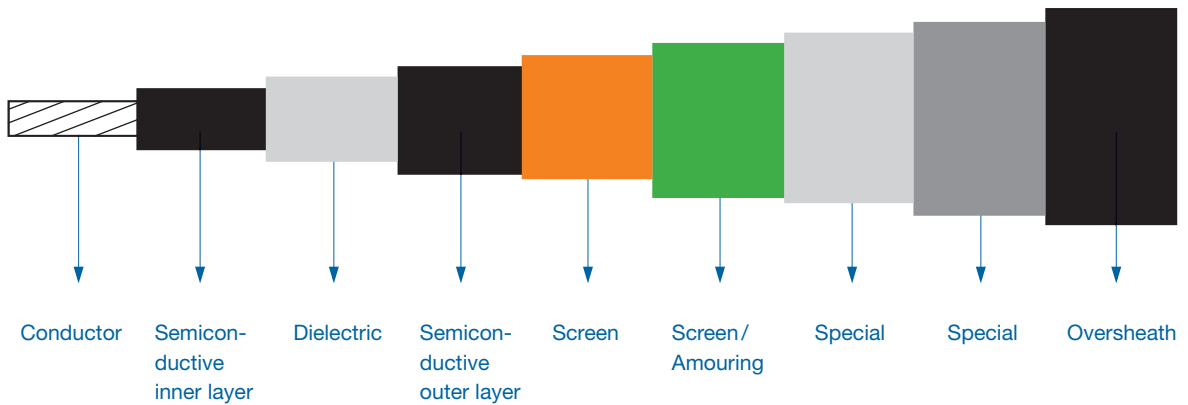
Customer Name/Project Name:

Offer No.:

Order No.:

Date:

Name:



	Conductor	Semicon- ductive inner layer	Dielectric	Semicon- ductive outer layer	Screen	Screen/ Armouring	Special	Special	Oversheath
Diameter (mm)	_____	_____	_____	_____	_____	_____	_____	_____	_____
Diameter (mm) min.	_____		_____						_____
Diameter (mm) max.	_____		_____						_____
Cross section (mm ²)	_____		_____						_____
Thickness (mm)	_____	_____	_____	_____	_____	_____	_____	_____	_____

- Al
- Cu
- Solid round
- Solid sector
- Stranded
- Circular
- Milliken
- Keystone

- XLPE
- EPR
- Rubber
- Paper

- Cu wires
- Cu tapes
- Lead
- Al screen
- Al wire
- Al tape
- Steel wire
- Steel tape
- Corrug. Al
- Corrug. Cu

- Cu wires
- Cu tapes
- Lead
- Al screen
- Al wire
- Al tape
- Steel wire
- Steel tape
- Corrug. Al
- Corrug. Cu
- Filler
- Laminated foil Al
- Laminated foil Cu

- Cu wires
- Cu tapes
- Lead
- Al screen
- Al wire
- Al tape
- Steel wire
- Steel tape
- Corrug. Al
- Corrug. Cu
- Filler
- Laminated foil Al
- Laminated foil Cu

- Cu wires
- Cu tapes
- Lead
- Al screen
- Al wire
- Al tape
- Steel wire
- Steel tape
- Corrug. Al
- Corrug. Cu
- Filler
- Laminated foil Al
- Laminated foil Cu

- PE
- PVC
- Laminated foil Al
- Laminated foil Cu

Network Data:

Operation voltage _____ kV

Basic impulse level _____ kV

Short circuit current (conductor) _____ kA

Short circuit current (shield) _____ kA

System grounding

- solid isolated resonant

CERTIFICATE **TUVNORD**

Management system as per
DIN EN ISO 9001 : 2008
DIN EN ISO 14001 : 2005

In accordance with TÜV NORD CERT procedures, it is hereby certified that

nkt cables GmbH
Kabelgarnituren
Helgoländer Damm 75
26954 Nordenham
Germany

applies a management system in line with the above standards for the following scope

**Sales, development and production of high, low and medium voltage
cable accessories and cabinets at location Nordenham**

Certificate Registration No. 78 100 993990
Certificate Registration No. 78 104 993990
Audit Report No. 3503 9526 / 3503 9527

Valid until 2012-02-14
Initial certification 1999


Certification Body
at TÜV NORD CERT GmbH

Essen, 2009-03-27

This certification was conducted in accordance with the TÜV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.

TÜV NORD CERT GmbH

Langemarckstrasse 20

45141 Essen

www.tuev-nord-cert.com



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Completing the picture