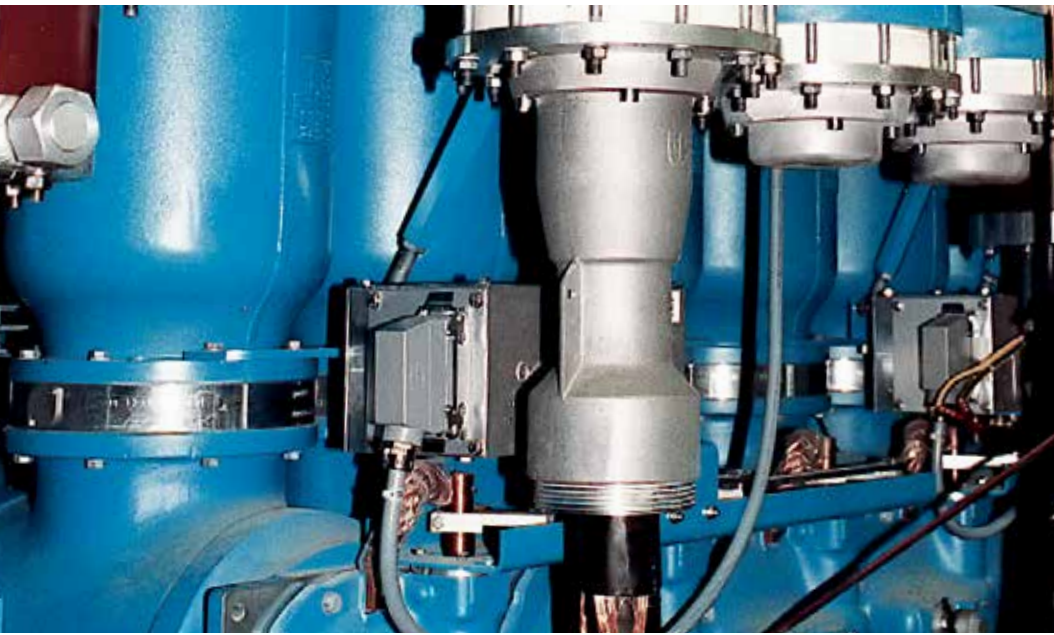


PFISTERER



MV-CONNEX, HV-CONNEX, IXOSIL Terminations, IXOSIL Slip-on Joints

CABLE SYSTEMS

Accessories and Systems for Medium and High-Voltage Cables up to 300 kV.

THE POWER CONNECTION



Welcome to the **CABLE SYSTEMS** Centre of Competence.

We offer medium and high voltage engineered solutions for cable accessories for virtually all applications up to 300 kV. All accessories use a silicone rubber insulating medium because of its outstanding properties. We offer components and complete systems, installation and advisory services, worldwide.

CONNEX. A Dry, Separable Connector System for Medium and High-Voltage Networks.

CONNEX products provide a universal system of separable connectors: fully insulated with grounded metal housings. It is virtually maintenance free, suitable for indoor and outdoor use, and water resistant. CONNEX can be used even under extreme temperatures, from -25°C up to $+50^{\circ}\text{C}$ (-10° up to $+120^{\circ}\text{F}$).

MV-CONNEX products for medium voltage system (up to 52 kV) include traditional plug and socket combinations, as well as multiple sockets, busbar connectors, surge arresters and voltage detectors.

HV-CONNEX products for high voltage systems up to 245 kV are factory tested, and surprisingly simple to install. Working in difficult oil and gas environments during installation of transformers and gas insulated switchgears is finally a thing of the past.

IXOSIL. Cable Terminations.

The extensive range of terminations will handle almost all applications. The silicone rubber insulating medium enables IXOSIL products to be ideally suited for outdoor use. Self-supporting oil-filled terminations are available with silicone rubber coated or porcelain housings. Special designs for indoor use complete the product range.



IXOSIL. Slip-on Joints.

IXOSIL silicone rubber joints can be used to join all XLPE and EPR insulated cables within the range of 72.5 – 300 kV. Two designs are available: the compact one piece version, and a three piece version for connecting cables with different shielding and cross sections. Joints can be used on either aluminum or copper cables.

IXOLINE. Factory-Assembled Cables Ready-to-Use.

IXOLINE finished cable sections come with IXOSIL and/or CONNEX terminations. No special tools are required for installation. Result: increased efficiency, reduced installation time, lower costs.

Silicone – a Key Material in High-Voltage Engineering.

Silicone rubber is the perfect material for cable terminations. Water, dirt, grease and oil resistant, completely maintenance free, shock resistant and unbreakable; it is far superior to traditional materials such as porcelain. When used as a stress relief device in sealed applications, silicone performs much better than harder materials such as EPDM because it helps to even out temperature variations and unevenness in the cable surface. Silicone helps to prevent air gaps, and therefore dangerous partial discharges are avoided. PFISTERER takes extensive advantage of using advanced LSR (liquid silicone rubber) designs, and special variations are designed using RTV (room temperature vulcanizing silicone).

Worldwide Installation Services.

The installation of high voltage components requires extensive knowledge and care. We share our know-how with our customers in training courses based on practical applications. If requested by the customer, we can perform installations anywhere in the world.

Cable Systems | Medium-Voltage



MV-CONNEX 10 kV – 52 kV

The MV-CONNEX range is ideal for use in high load ring main units, circuit breaker switchgear, high voltage motors, transformers, capacitors, transducers and cable joint boxes. The connectors on the equipment side are designed to meet EN 50180 (bushings for liquid filled transformers up to 52 kV), EN 50181 (plug-in type bushings up to 36 kV for equipment other than filled transformers) and DIN 47637 (separable accessories for power cable for bushing with inside cone). The plug is suitable for most types of insulated plastic cables. In addition to numerous standard versions, customer specific variations are also available for most cable types. CONNEX can be provided in other versions for testing purposes and special applications.

Advantages

- metal-encapsulated
- fully insulated
- touch-proof
- water resistant IP68
- zero-maintenance
- suitable for outdoor use
- free from arcing
- high short circuit resistance
- suitable for underground and offshore applications (special variants)

A Contact system

- 1 contact ring
- 2 tension cone
- 3 thrust piece

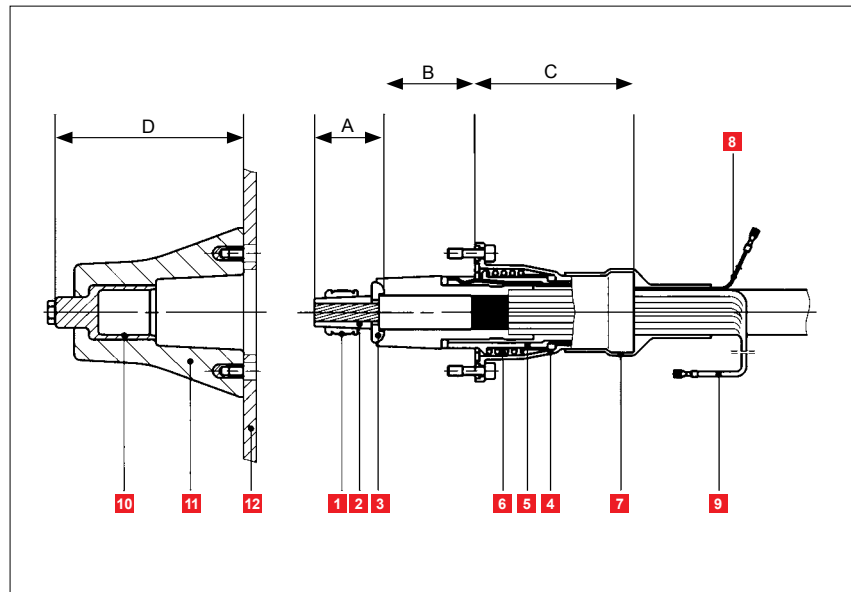
B Insulating and field-control part

C Housing

- 4 bell flange
- 5 pressure sleeve
- 6 pressure spring
- 7 heat-shrink
- 8 test lead (depends on design)
- 9 cable screen

D Bushing

- 10 female contact part
- 11 insulating bushing
- 12 housing



Test standard: DIN VDE 0278 Part 6
high-current design II

CONNEX cable connector system

		CONNEX cable connector system				
		Size 0	1	2	3	3-S
Current rating	I_N (A)	250	630	800	1250	1250
Max. working voltage	U_m (kV)	24	36	42	42	52
AC voltage test	50 Hz/1 min (kV)	50	70	95	95	117
Nominal withstand lightning impulse voltage	1.2/50 μ s (kV)	125	170	200	200	250
Partial discharg	$2 \times U_0$ (pC)	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10
DC voltage test	15 min $6 \times U_0$ (kV)	72	108	125	125	156
Rated short-time withstand current	0.5 sec (kA)	-	50	50	63	63
Rated short-time withstand current	1 sec (kA)	16	31.5	40	50	50
Nominal impulse current	(kA)	40	125	125	150	150

MV-CONNEX Multi-Contact Elbow Bushing 24 kV – 52 kV

Multi-contact elbow bushings are used instead of DIN-standard porcelain versions on the medium-voltage side of power transformers. They distribute the current over two or four cables, thus accommodating higher power loads using more manageable cable cross sections.



MV-CONNEX Surge Arrester 6 kV – 52 kV

CONNEX surge arresters are used to protect metal enclosed switchgears which have cable terminations in accordance with EN 50180/EN 50181. Connected to the switchgear or the transformer, they are particularly effective in limiting surges caused by reflected travelling waves and switching over voltages.



MV-CONNEX Busbar Connectors 24 kV – 42 kV

The busbar connectors allow modular designed SF6 insulated switchgear to be easily expanded, as the gas compartment does not have to be unsealed and opened during installation. Busbar connectors are available in the 24 kV to 42 kV range.



CMA-MV-CONNEX Motor Connector

The CMA-MV-CONNEX motor connector allows a quick and easy connection of high voltage motors as a replacement for the motor connection box. It is fully metal enclosed, and intrinsically safe.



Voltage Detecting Systems

Voltage potential can be detected with the integrated capacitive test point system, which includes both mobile and stationary continuous voltage indicators, as well as phase comparators and testing equipment for the voltage indicators.



Cable Systems | High-Voltage



Cable Systems | High-Voltage

The advantages of the CONNEX system are especially evident for high voltage applications. Simple on-site installation and factory tested, reliable components provide a safe and cost effective solution. Plug-in HV-CONNEX systems eliminate costly oil and gas insulation work during the installation process of transformers and gas insulated switchgear. CONNEX cable joints are more flexible, a big advantage when building or converting electrical systems. The wide range of products includes all the connection components needed to test the system and the attached equipment.

Advantages

- The space required for mounting is approximately half that of conventional systems.
- Flexibility is increased with the availability of horizontal, vertical and angled CONNEX connections to gas insulated switchgear and transformers. This often leads to space saving setups in the substation and reduced installation time.
- Cable shield tests can be made without unplugging the system, further reducing installation time.
- There is no unsealing or opening of the actual cable termination required, eliminating costly oil and insulating gas work during installation.
- Improved safety is assured, using factory pre-assembled and tested components.

A Socket

- 1 contact element
- 2 epoxy socket

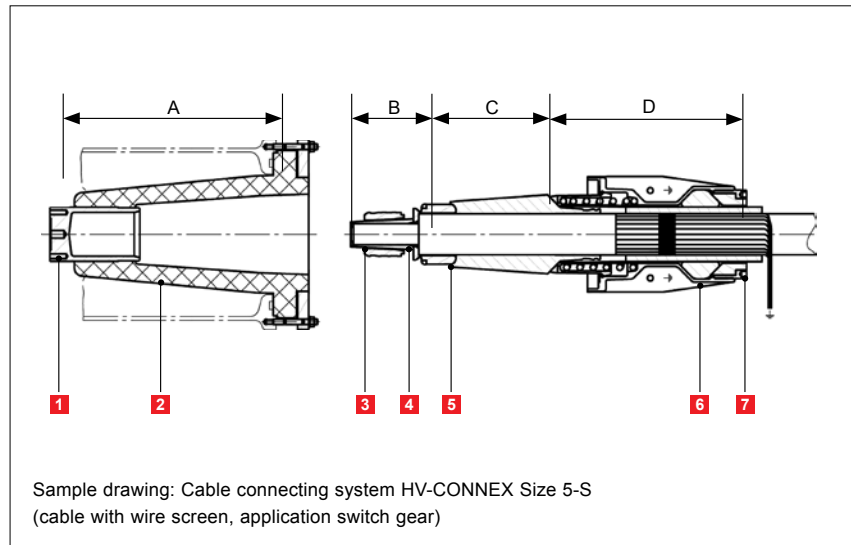
B Contact system

- 3 contact ring
- 4 tension cone
- 5 thrust piece

C Insulating part

D Bell flange

- 6 gasket
- 7 threaded counter ring



Test standard: TNT 10.97

CONNEX cable connection system

		Size			
		4	5-S	6	6-S
Current rating	I_N (A)	2500	2500	2500	2500
Max. working voltage	U_m (kV)	72.5	145	170	245
AC voltage test	50 Hz/1 min (kV)	140	275	325	460
Nominal withstand lightning impulse voltage	1.2/50 μ s (kV)	325	650	750	1050
Partial discharge	$2 \times U_0$ (pC)	≤ 2	≤ 2	≤ 2	≤ 2
DC voltage test	15 min $6 \times U_0$ (kV)	144	304	348	508
Nominal short-time current	0.5 sec (kA)	63	63	63	63
Nominal short-time current	1 sec (kA)	50	50	50	50
Nominal surge current	(kA)	160	160	160	160

Gas Insulated Switchgear (GIS)

HV-CONNEX bushings require less space than conventional type connectors. An extension adapter for conventional cable connector modules is required when HV-CONNEX is used with traditional gas insulated switchgear.



Transformers

The HV-CONNEX system offers the possibility of completely enclosing and testing the transformer at the manufacturing site, shipping it on-site and connecting it by a simple plug-in process. This not only permits a more compact transformer design, but makes handling easier and allows the unit to be completely tested, signed off and accepted before shipment.



Plug-in Joint Boxes

The HV-CONNEX cable connection system allows plug-in joint boxes for various geometric configurations to be assembled with fewer components. The complete joint box is a single unit, and has been fully tested at the factory. There are huge savings when cables need to be moved many times during the installation or conversion phase.



CONNEX 170 kV Plug-in Bushing

The HV plug-in bushing can be used wherever overhead lines need to be connected to high voltage equipment. Using an HV-CONNEX connection, the equipment can be operated immediately after connection, without having to open and test it again at the installation site. Plug-in HV versions can be installed at any angle, and the bushing swapped out for a cable connector at any time.



The conventional Alternative: IXOSIL ESG and IXOSIL ESU

These terminations are used for terminating XLPE insulated high voltage cables in oil (ESU type) or gas insulated equipment (ESG type). Both types are available in vertical, horizontal and overhead configurations, from 72.5 kV to 245 kV.



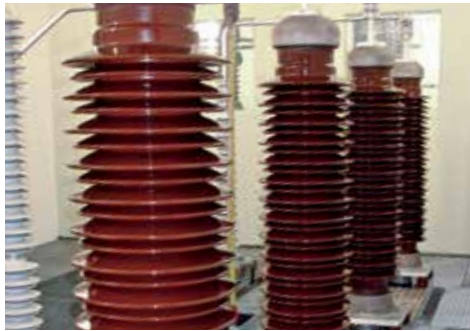
Cable Systems | High-Voltage



IXOSIL ESS Outdoor Cable Termination with Composite

Type ESS terminations are available for voltages from 72.5 kV to 300 kV, with various creepage distances. A resin-glass fiber tube with filling compound equipped with silicone sheds gives the ESS termination extremely high mechanical strength. An easy to fit head fitting completes the ESS to provide a maintenance-free system.

Highest voltage	U _m (kV)	72.5	123	145	170	245	300
Standards		IEC60840	IEC60840	IEC60840	IEC60840	IEC62067	IEC62067
		IEC60815	IEC60815	IEC60815	IEC60815	IEC60815	IEC60815
Rated voltage	U (kV)	60 – 69	110 – 115	132 – 138	150 – 161	220 – 230	275 – 287
Lightning impulse withstand voltage (BIL) (kV)		325	550	650	750	1050	1050



IXOSIL ESP Outdoor Cable Termination with Porcelain

The ESP termination is similar to the composite version, suitable for the same voltage levels, and utilizes the same stress cone.

Highest voltage	U _m (kV)	72.5	123	145	170	245	300
Standards		IEC60840	IEC60840	IEC60840	IEC60840	IEC62067	IEC62067
		IEC60815	IEC60815	IEC60815	IEC60815	IEC60815	IEC60815
Rated voltage	U (kV)	60 – 69	110 – 115	132 – 138	150 – 161	220 – 230	275 – 287
Lightning impulse withstand voltage (BIL) (kV)		325	550	650	750	1050	1050



IXOSIL ESF Flexible Outdoor Cable Termination

Type ESF flexible terminations are dry, slip-on terminations for modular assembly. Using silicone sheds, it is ideally suited for applications in outdoor installations. Type ESF terminations are available for voltages from 52 kV to 170 kV.

Highest voltage	U _m (kV)	52	72.5	123	145	170
Standards		IEC60840	IEC60840	IEC60840	IEC60840	IEC60840
		IEC60815	IEC60815	IEC60815	IEC60815	IEC60815
Rated voltage	U (kV)	45 – 47	60 – 69	110 – 115	132 – 138	150 – 161
Lightning impulse withstand voltage (BIL) (kV)		250	325	550	650	750

IXOSIL EST Outdoor Cable Termination (Dry Type)

Type EST is ideally suited for both indoor and outdoor applications. It is available for voltages from 72.5 kV up to 170 kV. It consists of a flexible ESF type termination and a supporting insulator. The dry type construction of the terminator enables it to be installed on the cable in a short period of time. This can be done in either a horizontal or vertical position prior to lifting. The terminator and cable can be lift up together using a crane and installed directly on the pylon. This mounting procedure permits a quick and economic installation without having to use a special platform.



Highest voltage	U_m (kV)	72.5	123	145	170
Standards		IEC60815	IEC60815	IEC60815	IEC60815
		IEC60840	IEC60840	IEC60840	IEC60840
Rated voltage	U (kV)	60 – 69	110 – 115	132 – 138	150 – 161
Lightning impulse withstand voltage (BIL) (kV)		325	550	650	750

Cable Systems | High-Voltage



IXOSIL Slip-on Joints

IXOSIL slip-on joints consist almost entirely of pre-molded slip-on silicone parts. This enables the secure and efficient connection of two polymeric-insulated cables (XLPE, EPR). The proven slip-on technique ensures minimum installation time and a maximum operational reliability. The tested and applied materials comply with all electrical, mechanical and thermal requirements for rebuilding the cable insulation. IXOSIL slip-on joints are available in both one piece and three piece set up and may be used for connecting either copper or aluminum conductors. Both slip-on joints are available with many variants.









IXOSIL One-Piece Slip-on Joints

The one-piece slip-on joints are available for voltages from 72.5 kV to 300 kV. Due to the one-piece construction the joints are extremely compact in size. The space required in a joint bay therefore is reduced to a minimum. Each size of the silicone body covers a range of different insulation diameters. Up to 5 different outlets are available for efficiently sealing of fibre optic cable and/or PD sensor cables.

IXOSIL three-part Slip-on Joint

The three-part slip-on joint is available for voltages from 72.5 kV to 170 kV. The well-tried three-part construction of this joint enables cables of different types and dimensions to be connected. For example a 630 mm² EPR cable can be connected to a 500 mm² XLPE cable. This slip-on joint is also available with an outlet for a fibre optic cable.

Screen treatment		Protective housing	
XL, XK, DE  XL, XK: Screen version with bonding cable DE: Screen version with earthing tap on one side	S or R  S: Heat-shrinkable sleeve R: Fibre-glass reinforced heat-shrinkable sleeve	MS or MR  MS: Copper tube with heat-shrinkable sleeve and filling compound MR: Copper tube with fibre-glass reinforced heat-shrinkable sleeve and filling compound	
DO  Screen transition	G  Plastic housing and filling compound	MG  Copper tube with plastic housing and filling compound	

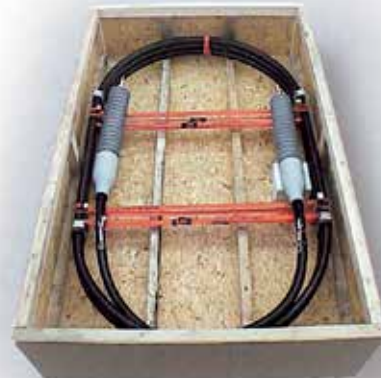
Maximum voltage U _m (kV)	Standards	Rated voltage U (kV)	Lightning impulse withstand voltage (BIL), (kV)	Partial discharge measurement (pC)	Conductor cross section		Diameter over cable insulation (prepared)	
					(mm ²)	(AWG)	(mm)	(inch)
72,5	IEC60840	60 – 69	325	< 5	150-1200	300 MCM – 4000 MCM	37 – 87	1.46 – 3.43
123	IEC60840	110 – 115	550	< 5	240-2500	500 MCM – 5000 MCM	45 – 122	1.77 – 4.8
145	IEC60840	132 – 138	650	< 5	240-2500	500 MCM – 5000 MCM	45 – 122	1.77 – 4.8
170	IEC60840	150 – 161	750	< 5	240-2500	500 MCM – 5000 MCM	45 – 122	1.77 – 4.8
245	IEC62067	220 – 230	1050	< 5	240-2500	500 MCM – 5000 MCM	69 – 122	2.719 – 4.8
300	IEC62067	275 – 287	1050	< 5	240-2500	500 MCM – 5000 MCM	69 – 122	2.719 – 4.8

Installation and Accessories

IXOLINE – Ready-Made Cable Systems

A PFISTERER specialty: IXOLINE – ready-made cables with dry IXOSIL or CONNEX connectors. IXOLINE components make it very easy to assemble short cable connections. The applications are endless:

- for turn key substations
- for emergency cable connections
- for cables under roads and rail lines
- for short connections between GIS and/or transformers
- for connecting overhead switchgear
- for high-voltage test cables



Installation Made Easy

The installation of high voltage components requires know-how and care. Our team of technicians carries out the installation of cable equipment, cable runs, substation cabling, and testing throughout the world for medium and high voltage. We offer practical training courses and on-site supervision to provide needed know-how.



Tools

We have available all the tools and components needed for the installation and testing of high voltage connections. We can also provide accessories for improving grounding characteristics.



High-Voltage Lab

High voltage lab is completely equipped for both inside and outside testing. All tests are carried out in accordance with the relevant standards for the application. Testing for fittings and cable systems are also provided. A considerable amount of time is spent in doing R&D work to continually upgrade products to meet the latest market requirements. The facilities consist of:

- AC test equipment up to 1,000 kV
- Impulse voltage generator up to 1,600 kV
- Induced current system for heat cycle testing
- Artificial rain equipment
- Fully shielded partial discharge measurement room



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