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

CABLE SYSTEMS
Accessories and Systems for Medium and High-Voltage Cables up to 300 kV.
Our range of cable terminations and general connectors offers solutions for virtually all applications in the area of medium and high-voltage engineering up to 300 kV. All connectors use silicone as an insulating medium because of its outstanding properties. We offer components and complete systems, as well as worldwide installation and advisory services.

**CONNEX.** A Dry, Plug-in Connector System for Medium and High-Voltage Networks.

CONNEX meets all your requirements of a universal connector system: full insulation, metal housings and protection against electric shocks. It is maintenance-free, suitable for outdoor use and deckwater-proof. This means CONNEX can be used even in the most extreme conditions.

MV-CONNEX for medium voltage systems comes in a wide range of variations. It includes traditional plug and socket combinations, multiple sockets, busbar connectors, surge arresters and voltage detectors. HV-CONNEX components for high-voltage systems up to 245 kV are tested at the factory and are surprisingly simple to install. Complex oil and gas work during installation and commissioning of transformers is finally a thing of the past.

**IXOSIL Cable Terminations.**

The comprehensive range of terminations suits all applications: the use of silicone as the insulating medium means they are ideally suited to outdoor use, and special designs for indoor use are available as well. In addition, oil-filled and dry models are also available. Standard components with porcelain insulators complete the range.
IXOSIL MSA Slip-on Joints.
IXOSIL MSA silicone-rubber joints can be used to join all XLPE and EPR insulated cables within the 72.5 kV to 300 kV voltage range. There are two designs: the compact, one-piece version and a three-piece version for connecting cables of different types and cross sections.

IXOLINE. Ready-Made Cables.
IXOLINE cables are supplied with IXOSIL or CONNEX connectors. No special tools are required for installation. Result: increased efficiency in less time and at lower cost.

Silicone – a Key Material in High-Voltage Engineering.
Water, dirt, grease and oil-resistant, completely maintenance-free, shock-resistant and unbreakable: silicone is the perfect material for cable terminations and far superior to traditional materials such as porcelain. When used as a stress-relief device in sealed applications, silicone evens out temperature variations and unevenness in the cable surface much better than do harder materials such as EPDM. Dangerous partial discharges caused by air gaps are safely avoided. PFISTERER makes silicone products primarily using advanced LSR (Liquid Silicone Rubber) designs; special variations are designed using RTV (room-temperature vulcanising silicone).

Worldwide Installation Services.
The installation of high-voltage components requires knowledge and care. We share our know-how in practical applications training courses. If requested we can of course carry out the installation ourselves for you, wherever in the world you may be.
The MV-CONNEX range is ideal for use in ring main units, circuit-breaker switchgear, high-voltage motors, transformers, capacitors, transducers and sealing boxes. The connectors on the equipment-side are designed to meet EN 50180, 50181, and DIN 47637. The plug is suitable for all kinds of insulated plastic cables. As well as a wide range of standard types there are also customer-specific versions for every cable type. The MV-CONNEX system features numerous variations: in addition to the standard plug and socket combination, there are many other versions for testing purposes and special applications.

Advantages
- no liquid insulating medium
- no need to open the cable termination at the installation site
- deckwater-proof
- suitable for outdoor use
- thorough transformer and GIS testing by manufacturer possible

### MV-CONNEX 10 kV – 52 kV

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- thorough transformer and GIS testing by manufacturer possible

### Test standard: DIN VDE 0278 Part 6

#### High-current design II

<table>
<thead>
<tr>
<th>Test Standard</th>
<th>CONNEX Cable Connector System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>Current rating</strong></td>
<td>$I_n$ (A)</td>
</tr>
<tr>
<td><strong>Max. working voltage</strong></td>
<td>$U_{m}$ (kV)</td>
</tr>
<tr>
<td><strong>AC voltage test</strong></td>
<td>50 Hz/1 min (kV)</td>
</tr>
<tr>
<td><strong>Nominal withstand lightning impulse voltage</strong></td>
<td>1.2/50 μs (kV)</td>
</tr>
<tr>
<td><strong>Partial discharge</strong></td>
<td>$2 \times U_{m}$ (pC)</td>
</tr>
<tr>
<td><strong>DC voltage test</strong></td>
<td>15 min 6 x $U_{m}$ (kV)</td>
</tr>
<tr>
<td><strong>Rated short-time withstand current</strong></td>
<td>0.5 sec (kA)</td>
</tr>
<tr>
<td><strong>Rated short-time withstand current</strong></td>
<td>1 sec (kA)</td>
</tr>
<tr>
<td><strong>Nominal impulse current</strong></td>
<td>(kA)</td>
</tr>
</tbody>
</table>
**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 switchgear fitted with cable terminations in accordance with EN 50180/EN 50181. The surge arresters are connected to the switchgear transformer and prevent the entry of excessively high surges. The surge arresters are particularly effective in limiting surges caused by reflected travelling waves and switching overvoltages.

**MV-CONNEX Busbar Connectors 24 kV – 42 kV**

Busbar connectors facilitate the modular construction and on-site expansion of SF₆ insulated switchgear, because the gas compartment does not have to be opened during installation. The range includes 24 kV to 42 kV versions.

**CMA-MV-CONNEX Motor Connector**

The CMA-MV-CONNEX motor connector allows the quick and easy connection of high-voltage motors, with the connection area being fully metal-enclosed and intrinsically safe. The system is easily installed in place of the motor connection box.

**Voltage Detecting Systems**

The integrated capacitive potential point makes it easy to check the connection for the absence of voltage. The PFISTERER range includes mobile and stationary continuous voltage indicators, as well as phase comparators and performance testing equipment.
The advantages of the CONNEX system come to the fore in particular in the area of high-voltage systems: simple on-site installation and factory-tested components save money and provide additional safety. Plug-in HV-CONNEX systems make costly oil and gas work during the installation and commissioning of transformers and gas-insulated switchgear a thing of the past. Thanks to their plug-in connectors, cable joints from the HV-CONNEX range are much more flexible than traditional solutions when it comes to building and converting electrical systems. Needless to say, the range includes all the connection components needed to test the system and the attached equipment.

Advantages
- approx. 50 % shorter mounting length compared with conventional systems in accordance with IEC 60 859
- no opening of the cable termination and associated costly gas or oil work
- horizontal, vertical and angled versions for connection to GIS and transformers
- considerably reduced installation times
- the use of pre-assembled and tested components means maximum safety and efficiency
- installation errors are minimised
- if a fault does arise, rapid separation of cable and equipment
GIS Equipment

HV-CONNEX bushings require less space than IEC connectors. All well-known manufacturers have since begun to offer equipment which exploits this advantage. An extension adapter for conventional cable connector modules is required when HV-CONNEX is used with traditional GIS equipment.

Transformers

The installation of two connectors on the equipment makes it possible to have one cable connector on the side, facing down. If it is necessary to connect this kind of transformer using an overhead line, an HV-CONNEX plug-in insulator for overhead lines can be installed and the downward facing cable connector then terminated with a dummy connector. This plug-in insulator also makes it very easy to carry out simple voltage tests on transformers fitted with HV-CONNEX equipment connectors, either in the factory or on site.

Plug-in Joint Boxes

The HV-CONNEX cable connection system means plug-in joint boxes for various geometric configurations can be assembled using fewer components. The advantage of these joint boxes is that the joint body is a single unit which is completely manufactured and tested at the factory. Solutions of this kind bring enormous benefits if, for example, cables need to be bent back multiple times during the installation and conversion phase.

CONNEX 170 kV Plug-in Bushing

The HV plug-in bushing can be used wherever high-voltage equipment needs to be connected to overhead lines. A CONNEX plug-in bushing provides the connection to the equipment. If the plug-in bushing is used, the high-voltage equipment can be operated immediately without having to open and test it again at the installation site. In addition, plug-in HV versions can be installed at any angle. And the bushing can, of course, be swapped for a cable connector at any time.

The conventional alternative: IXOSIL ESG and IXOSIL ESU

IXOSIL ESG and IXOSIL ESU also provide conventional terminations in accordance with IEC 60 859-1 for the direct introduction of XLPE insulated high voltage cables in oil- or gas-insulated equipment. For IXOSIL ESU we offer customized adapters. Both types are available in vertical, horizontal or overhead versions from 60 kV to 170 kV.
Cable Systems | High-Voltage

**IXOSIL ESS Termination with Self-Supporting Properties**

Type ESS terminations are available for voltages from 60 kV to 300 kV with various creepage distances. A resin-glass fibre tube equipped with silicone sheds gives the ESS termination the highest mechanical strength. The ESS termination can withstand the effects of high forces – for example in a short circuit. Insulation within the resin-glass fibre tube is ensured by a filling compound. An easy-to-fit head fitting completes the ESS to provide a maintenance-free system.

The range of medium voltage terminations 20 kV and 30 kV are also available upon request.

<table>
<thead>
<tr>
<th>Electrical levels</th>
<th>ESS 72.5</th>
<th>ESS 123</th>
<th>ESS 145</th>
<th>ESS 170</th>
<th>ESS 245</th>
<th>ESS 300</th>
</tr>
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<tr>
<td>Highest voltage $U_{hm}$</td>
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<td>60 – 69 kV</td>
<td>110 – 115 kV</td>
<td>130 – 138 kV</td>
<td>150 – 161 kV</td>
<td>220 – 230 kV</td>
<td>275 kV</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage (BIL)</td>
<td>325 kV</td>
<td>550 kV</td>
<td>650 kV</td>
<td>750 kV</td>
<td>1050 kV</td>
<td>1050 kV</td>
</tr>
<tr>
<td>AC withstand voltage 1 min/dry</td>
<td>175 kV</td>
<td>260 kV</td>
<td>310 kV</td>
<td>365 kV</td>
<td>460 kV</td>
<td>460 kV</td>
</tr>
</tbody>
</table>

**IXOSIL ESP Termination with Porcelain Housing**

The ESP termination can be supplied for voltages from 60 kV to 300 kV. The stress cone of the ESP and the ESS termination is identical. The porcelain housing is available with a DIN or alternating shed as required.

<table>
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<tr>
<th>Electrical levels</th>
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</tr>
</tbody>
</table>

**IXOSIL ESF Termination for Multi-Purposes**

Type ESF flexible terminations are dry, slip-on terminations for modular assembly. The use of silicone sheds makes them ideally suited for applications in outdoor installations. Type ESF terminations are available for voltages from 60 kV to 145 kV.

The range of medium voltage terminations 10 kV, 20 kV and 30 kV are also available upon request.

<table>
<thead>
<tr>
<th>Electrical levels</th>
<th>ESF 45</th>
<th>ESF 60</th>
<th>ESF 123</th>
<th>ESF 145</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest voltage $U_{hm}$</td>
<td>52 kV</td>
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</tr>
<tr>
<td>Rated voltage</td>
<td>45 kV</td>
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<td>110 kV</td>
<td>132 kV</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage (BIL)</td>
<td>250 kV</td>
<td>325 kV</td>
<td>550 kV</td>
<td>550 kV</td>
</tr>
<tr>
<td>AC withstand voltage 1 min/dry</td>
<td>95 kV</td>
<td>140 kV</td>
<td>230 kV</td>
<td>230 kV</td>
</tr>
</tbody>
</table>
IXOSIL EST Termination Dry Insulated

Type EST is ideally suited for out- and indoor. It is available for voltages from 60 kV to 145 kV and consists of one flexible terminator of type ESF and with one or three supporting insulators, depending on the operating voltage. It is free from liquid insulating materials, can be installed in each position and is self-supporting. The EST is built up modular which permits a fast and simple installation. There is no need for a special platform for fitting the terminations, just a protection against wind and weather. The baseplate is designed to fit on several existing support structures without any problems.

<table>
<thead>
<tr>
<th>Electrical levels</th>
<th>EST 72,5</th>
<th>EST 123</th>
<th>EST 145</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest voltage $U_m$</td>
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</tr>
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<td>AC withstand voltage 1 min/dry</td>
<td>140 kV</td>
<td>230 kV</td>
<td>275 kV</td>
</tr>
</tbody>
</table>

IXOSIL ESK Termination

Type ESK terminations are dry, slip-on terminations for modular assembly. The use of silicone sheds makes them ideally suited for applications in indoor installations. Type ESK terminations are available for voltages of 45 kV and 60 kV. The range of medium voltage terminations 10 kV, 20 kV and 30 kV are also available upon request.

<table>
<thead>
<tr>
<th>Electrical levels</th>
<th>ESK 45</th>
<th>ESK 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest voltage $U_m$</td>
<td>52 kV</td>
<td>72.5 kV</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>45 kV</td>
<td>60 kV</td>
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<tr>
<td>Lightning impulse withstand voltage (BIL)</td>
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</tr>
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<td>AC withstand voltage 1 min/dry</td>
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</tr>
</tbody>
</table>
IXOSIL Slip-on Joints

IXOSIL joints essentially consist of premoulded 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 operation reliability. The tested and applied material complies with all electrical, mechanical and thermal requirements of the cable. The one-piece MSA slip-on joint is available in two different types. On the one hand with a solid PE housing, on the other hand with a shrink sleeve construction.

Both types of joints are available with integrated screen insulation. Therefore they can be used for any kind of screen treatment, for example cross bonding.

IXOSIL MSA One-Piece Slip-on Joint

The one-piece MSA slip-on joint is available for voltages from 60 kV to 300 kV. Due to the one-piece construction of this joint it is extremely compact in size. The required space in a joint pit therefore is reduced to a minimum. Every size of the silicone body covers a range of different insulation diameters. This enables the connection of a copper and an aluminium conductor cable.

IXOSIL MSA Three-Piece Slip-on Joint

The three-piece MSA slip-on joint is available for voltages from 60 kV to 170 kV. The well approved three-piece construction of this joint allows the connection of cables with different designs and dimensions. This enables the connection of a copper and an aluminium conductor cable. For example a 630 mm² EPR cable can be connected to a 500 mm² XLPE cable.

<table>
<thead>
<tr>
<th>Joint Types</th>
<th>MSA 170 DO</th>
<th>MSA 170 S</th>
<th>MSA 170 MS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Screen transition</td>
<td>Shrink sleeve</td>
<td>Metal water barrier</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>with shrink sleeve</td>
</tr>
<tr>
<td>Joint Types</td>
<td>MSA 170 XL or XK</td>
<td>MSA 170 G</td>
<td>MSA 170 MG</td>
</tr>
<tr>
<td></td>
<td>Screen interruption</td>
<td>Plastic casing</td>
<td>Metal water barrier</td>
</tr>
<tr>
<td></td>
<td>with screen take out</td>
<td>with filling compound</td>
<td>with plastic casing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical levels</th>
<th>MSA 12.5</th>
<th>MSA 123</th>
<th>MSA 145</th>
<th>MSA 170</th>
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<td>650 kV</td>
<td>750 kV</td>
<td>1050 kV</td>
<td>1050 kV</td>
</tr>
<tr>
<td>AC withstand voltage 30 min</td>
<td>90 kV</td>
<td>160 kV</td>
<td>190 kV</td>
<td>218 kV</td>
<td>318 kV</td>
<td>400 kV</td>
</tr>
<tr>
<td>Heating cycle test voltage</td>
<td>72 kV</td>
<td>128 kV</td>
<td>152 kV</td>
<td>174 kV</td>
<td>254 kV</td>
<td>320 kV</td>
</tr>
<tr>
<td>Partial discharge test &lt; 5 pC at</td>
<td>54 kV</td>
<td>96 kV</td>
<td>114 kV</td>
<td>131 kV</td>
<td>190 kV</td>
<td>240 kV</td>
</tr>
</tbody>
</table>
The installation of high-voltage components requires know-how and care. Our own team of technicians carries out the installation of cable equipment, cable runs, cabling of substations and testing throughout the world in the area of medium and high-voltage. We also use practical oriented training courses and on-site supervision to share the necessary know-how.

**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**

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**Tools**

We can supply all the tools and components needed for the installation and testing of high-voltage connectors. We can also advise on your earthing concept and provide the required accessories.

**High-Voltage Lab**

Our high-voltage lab in Altdorf is equipped for internal and external testing. All tests are carried out in accordance with the relevant standards. Aside from type acceptance and routine tests, we also provide testing of fittings and cable systems. Much of our laboratory resources are dedicated to research and development in order to ensure that our products meet the latest market requirements. The infrastructure consists mainly of:

- AC test equipment up to 1000 kV
- Impulse voltage generator up to 1600 kV
- Current inducing system for heat cycle test
- Artificial rain test equipment
- Fully shielded PD measurement room
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