PLUG-IN TERMINATIONS FOR XLPE-INSULATED
12 – 52 kV MEDIUM VOLTAGE CABLES
Südkabel has set many milestones with its cable accessories for energy transmission. The company has done pioneering work, particularly in the field of silicone rubber technology. The first one-piece medium voltage accessories were already being used back in the seventies. The company is therefore the trailblazer of a technology that did not take long to become a standard for medium voltage accessories and that is used today in accessories for up to 550 kV.

The properties of silicone rubber make it the ideal material for cable accessories:

- Good dielectric properties
- High degree of elasticity (for perfect adaption to stripped cable insulations)
- Ozone and UV resistance
- Long-term hydrophobicity
- High leakage current and arc resistance
- Usable in a wide range of temperatures
- Carbon-free material

At Südkabel, different types of silicone rubber are used. On the one hand, this enables the cost-efficient production of standard accessories on a large scale. On the other hand, small batches can also be manufactured at a reasonable expense.

The Südkabel standard range of medium voltage accessories includes:

- Multi-range terminations for indoor and outdoor applications
- Multi-range straight-through and transition joints
- Plug-type connectors (cable plugs) for metal-enclosed switchgears with inner or outer cone

All accessories are type tested to the DIN VDE 0278-629-1 revision valid at the time of market launch.
Plug-in terminations (cable plugs) for metal-enclosed switchgears

Since their introduction to the market in the 1980s, metal-enclosed SF₆-insulated medium voltage switchgears have become increasingly important due to their undisputed benefits. Amongst others, the compact design enabled by this technology lead to reduction of phase spacings which meant, however, that traditional terminations in an uninsulated connection technique used up until then could no longer be allowed. Other advantages such as shock-proof conditions, independence from ambient conditions and no maintenance requirements could no longer be realised with these terminations. It was therefore necessary to develop a new generation of terminations: metal-enclosed cable terminations.

Unlike conventional terminations, the switchgear interface of metal-enclosed terminations has to be defined more precisely. In this case, it consists of cone-shaped bushings according to the European standards DIN EN 50180 “Bushings above 1 kV to 36 kV and 250 A to 3150 A for liquid-immersed transformers” and DIN EN 50181 “Plug-in bushings above 1 kV to 36 kV and 250 A to 1.25 kA for equipment other than liquid-immersed transformers”.

Today, two systems with different application areas are established: a system with inner cone and a system with outer cone.
All plug-in terminations are type tested to the DIN VDE 0278-629-1 revision valid at the time of market launch. Please refer to the following table for the current test values.

<table>
<thead>
<tr>
<th>Test to DIN VDE 0278-629-1 (Testing methods according to DIN VDE 0278-628)</th>
<th>EN 61442 Section</th>
<th>Test values for rated voltage</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>U₀/U</td>
<td>6/10</td>
</tr>
<tr>
<td>DC withstand voltage 15 min</td>
<td>5</td>
<td>kV</td>
<td>36</td>
</tr>
<tr>
<td>AC withstand voltage 5 min</td>
<td>4</td>
<td>kV</td>
<td>27</td>
</tr>
<tr>
<td>Partial discharge at ambient temperature</td>
<td>7</td>
<td>kV</td>
<td>12</td>
</tr>
<tr>
<td>Impulse at elevated temperature (10 impulses with pos. and neg. polarity)</td>
<td>6</td>
<td>kV</td>
<td>75</td>
</tr>
<tr>
<td>Load cycles in air (63 cycles)</td>
<td>9</td>
<td>kV</td>
<td>15</td>
</tr>
<tr>
<td>Load cycles under water (63 cycles)</td>
<td>9</td>
<td>kV</td>
<td>15</td>
</tr>
<tr>
<td>Partial discharge at ambient and elevated temperature</td>
<td>7</td>
<td>kV</td>
<td>12</td>
</tr>
<tr>
<td>Thermal short circuit (screen)</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal short circuit (conductor)</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic short circuit</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disconnect/Connect</td>
<td>5 times</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial discharge at ambient and elevated temperature</td>
<td>7</td>
<td>kV</td>
<td>12</td>
</tr>
<tr>
<td>Impulse at elevated temperature (10 impulses with pos. and neg. polarity)</td>
<td>6</td>
<td>kV</td>
<td>75</td>
</tr>
<tr>
<td>AC withstand voltage 15 min</td>
<td>4</td>
<td>kV</td>
<td>15</td>
</tr>
</tbody>
</table>
| Operating eye | 19 | | | | | | Axial force: 1.3 kN for 1 min  
Torque: 14 Nm |
| Partial discharge at ambient temperature | 7 | kV | 12 | 24 | 36 | 45 | max. 10 pC at XLPE/EPR cables |
| Screen resistance | 17 | | | | | | max 5,000 Ohm  
max 0.5 mA at Uₘ |
| Fault current ignition | 18 | | | | | | Fault ignition must occur within 3 s (solidly earthed system); fault current to flow continuously (unearthed/impedance earthed system) |
| Operating force | | | | | | | Force less than 900 Nm |
| Capacitive test point performance | | | | | | CTₑ < 1 pF, CT₀/CTₑ < 12 |

* According to DIN VDE 0278-629-1
OUTER CONE SYSTEM

BUSHINGS

As a result of the different models of bushings and the varying field requirements, different versions of plug-in terminations with outer cones are available. Südkabel offers plug-in terminations that are elbow-shaped, straight or T-shaped. In many cases, the insulation bodies made of silicone rubber are multi-ranged and can be combined with hexagonal compression cable lugs or with mechanical cable lugs with shear-off bolts. A conductive coating makes these plug-in terminations independent of ambient conditions, maintenance-free and submersible.

All plug-in terminations are available with an additional metal housing for electric shock protection.

The standards EN 50180 and EN 50181 define six types of bushings for the outer cone system up to 36 kV, of which only 3 are relevant in practice:

### Bushing type A (Rated current 250 A)
- Bushing type A with a rated current of 250 A are suitable for a maximum operating voltage of 24 kV.
- The contact element is dimensioned for contact pins of 7.9 mm in diameter.
- They are generally used on distribution transformers, motor junction boxes and at transformer feeders of switch disconnector substations up to 24 kV in distributor stations for local networks.

For these bushings, elbow-shaped and straight plug-in terminations are available (e.g. SEW 24 and SEHDG 21.1).

### Bushing type B (Rated current 250 – 400 A)
- Bushing type B with a rated current of 250 to 400 A are suitable for a maximum operating voltage of 36 kV.
- The contact element is dimensioned for contact pins of 14 mm in diameter.
- They are generally used on distribution transformers, motor junction boxes and on transformer feeders of switch disconnector substations up to 36 kV in distributor stations for local networks.

For these bushings, T-shaped and straight plug-in terminations are available (e.g. SET 24-B and SEHDG 22).

### Bushing type C (Rated current 630 – 1250 A)
- Bushing type C with a rated current of 630 to 1250 A are appropriate for a maximum operating voltage of 36 kV.
- The contact element is dimensioned for M16x2 threaded pins.
- They are generally used on ring-main systems of substations in local networks but also in switch disconnector substations of transformer stations.

For these bushings, T-shaped and straight plug-in terminations are available (e.g. SET and SEHDG 23).

<table>
<thead>
<tr>
<th>Rated current</th>
<th>Maximum operating voltage</th>
<th>Designation</th>
<th>Contact element</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 A</td>
<td>24 kV</td>
<td>Interface type A</td>
<td>Contact pin Ø 7.9 mm</td>
</tr>
<tr>
<td>250 – 400 A</td>
<td>36 kV</td>
<td>Interface type B</td>
<td>Contact pin Ø 14 mm</td>
</tr>
<tr>
<td>630 – 1250 A</td>
<td>36 kV</td>
<td>Interface type C</td>
<td>M16 threaded pin</td>
</tr>
</tbody>
</table>
ACCESSORIES FOR OUTER CONE SYSTEMS
INTERFACE TYPE A

Elbow and straight plug-in terminations of type A are suitable for bushings according to DIN EN 50180 and DIN EN 50181, interface type A, rated current 250 A.

Elbow plug-in terminations SEW and SEHDW, $U_m$ up to 24 kV
- Conductor and screen connection for compression and mechanical connections (shear-off bolts).
- Available with conductive coating only.
- Optionally with additional metal housing.
- Cover of five cable cross-sections with one insulating body size and a stress controlling adapter (SEW).
- Fixation with two extension springs (SEW) or one fixing ring and hooks.

Straight plug-in termination SEHDG, $U_m$ up to 24 kV
- Conductor and screen connection for compression and mechanical connections (shear-off bolts).
- Available with conductive coating only.
- Optionally with additional metal housing.
- Each cross-section is assigned an insulating body size.
- Fixation with fixing ring and hooks.

<table>
<thead>
<tr>
<th>Voltage $U_m$</th>
<th>Type</th>
<th>Admissible outer diameter (mm)</th>
<th>Conductor cross section of the insulating body (mm²)</th>
<th>Measure D (mm)</th>
<th>Measure $L_1$ (mm)</th>
<th>Measure $L_2$ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>SEW 12</td>
<td>12.2 – 18.6 1)</td>
<td>25 – 70 (95)</td>
<td>58/74 4)</td>
<td>105/108 4)</td>
<td>245/245 4)</td>
</tr>
<tr>
<td>12</td>
<td>SEW 12</td>
<td>17.3 – 25.0</td>
<td>(70) 95 – 150</td>
<td>58/74 4)</td>
<td>105/108 4)</td>
<td>245/245 4)</td>
</tr>
<tr>
<td>12</td>
<td>SEHDG 11.1</td>
<td>12.7 – 24.3 3)</td>
<td>25 – 150</td>
<td>58/68 4)</td>
<td>-</td>
<td>275/285 4)</td>
</tr>
<tr>
<td>24</td>
<td>SEW 24</td>
<td>17.3 – 25.0 2)</td>
<td>(25) 35 – 95</td>
<td>58/74 4)</td>
<td>105/108 4)</td>
<td>245/245 4)</td>
</tr>
<tr>
<td>24</td>
<td>SEHD 21</td>
<td>17.0 – 28.5 3)</td>
<td>25 – 150</td>
<td>64/74 4)</td>
<td>118/134 4)</td>
<td>235/265 4)</td>
</tr>
<tr>
<td>24</td>
<td>SEHDG 21.1</td>
<td>17.0 – 24.3 3)</td>
<td>25 – 70</td>
<td>58/68 4)</td>
<td>-</td>
<td>275/285 6)</td>
</tr>
<tr>
<td>24</td>
<td>SEHDG 21</td>
<td>17.0 – 28.5 3)</td>
<td>25 – 150</td>
<td>71/92 4)</td>
<td>-</td>
<td>280/310 4)</td>
</tr>
</tbody>
</table>

1) For cables acc. to DIN VDE 0276-620 (cross sections in brackets are only partly covered)
2) With stress controlling adapter
3) Each cross section is assigned a separate insulating body
4) Data without metal housing
T-shaped and straight plug-in terminations of type B are suitable for bushings according to DIN EN 50180 and DIN EN 50181, interface type B, rated current 250/400 A.

### T-shaped plug-in terminations SET-B, \( U_m \) up to 36 kV
- Conductor and screen connection for compression and mechanical connections (shear-off bolts).
- Available with conductive coating only.
- Optionally with additional metal housing.
- Cover up to eight cable cross-sections with one insulating body size and a stress controlling adapter.
- Fixation with one fixing ring and two extension springs or alternatively with fixing ring and claws.
- Capacitive voltage tap.

### Straight plug-in termination SEHDG, \( U_m \) up to 24 kV
- Conductor connection for a special clamping bolt suitable for Al and Cu conductors.
- Available with conductive coating only.
- Optionally with additional metal enclosure.
- Each cross-section is assigned an insulating body size.
- Fixation with fixing ring and claws.

<table>
<thead>
<tr>
<th>Voltage ( U_m )</th>
<th>Type</th>
<th>Admissible outer diameter ( \text{mm} )</th>
<th>Conductor cross section of the insulating body ( \text{mm}^2 )</th>
<th>Measure ( D_1 ) ( \text{mm} )</th>
<th>Measure ( D_2 ) ( \text{mm} )</th>
<th>Measure ( L_1 ) ( \text{mm} )</th>
<th>Measure ( L_2 ) ( \text{mm} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>SET 12-B</td>
<td>15.0 – 23.5</td>
<td>50 – 150</td>
<td>74/88 ( 3 )</td>
<td>53/71 ( 3 )</td>
<td>188/188 ( 3 )</td>
<td>275/275 ( 3 )</td>
</tr>
<tr>
<td>12</td>
<td>SET 12-B</td>
<td>21.8 – 32.6</td>
<td>185 – 300</td>
<td>74/88 ( 3 )</td>
<td>53/71 ( 3 )</td>
<td>188/188 ( 3 )</td>
<td>275/275 ( 3 )</td>
</tr>
<tr>
<td>12</td>
<td>SEHDG 12</td>
<td>15.0 – 28.4 ( 3 )</td>
<td>50 – 240</td>
<td>79/89 ( 3 )</td>
<td>-</td>
<td>-</td>
<td>317/347 ( 3 )</td>
</tr>
<tr>
<td>24</td>
<td>SET 24-B</td>
<td>15.0 – 23.5</td>
<td>25 – 70</td>
<td>74/88 ( 3 )</td>
<td>53/71 ( 3 )</td>
<td>188/188 ( 3 )</td>
<td>275/275 ( 3 )</td>
</tr>
<tr>
<td>24</td>
<td>SET 24-B</td>
<td>21.8 – 32.6</td>
<td>95 – 240</td>
<td>74/88 ( 3 )</td>
<td>53/71 ( 3 )</td>
<td>188/188 ( 3 )</td>
<td>275/275 ( 3 )</td>
</tr>
<tr>
<td>24</td>
<td>SEHDG 22</td>
<td>15.0 – 32.6 ( 3 )</td>
<td>25 – 240</td>
<td>79/89 ( 4 )</td>
<td>-</td>
<td>-</td>
<td>317/347 ( 4 )</td>
</tr>
<tr>
<td>36</td>
<td>SET 36-B</td>
<td>26.2 – 32.0</td>
<td>70 – 120</td>
<td>74/- ( 4 )</td>
<td>85/- ( 4 )</td>
<td>188/- ( 4 )</td>
<td>290/- ( 4 )</td>
</tr>
<tr>
<td>36</td>
<td>SET 36-B</td>
<td>30.8 – 39.6</td>
<td>150 – 300</td>
<td>74/- ( 4 )</td>
<td>85/- ( 4 )</td>
<td>188/- ( 4 )</td>
<td>290/- ( 4 )</td>
</tr>
</tbody>
</table>

1) For cables acc. to DIN VDE 0276-6-20
2) With stress controlling adapter
3) Data without/with metal housing
4) Data without/with metal housing on request
5) Each cross section is assigned a separate insulating body
6) Data with/without metal housing, metal housing is flattened on the side for 85 mm phase spacing
ACCESSORIES FOR OUTER CONE SYSTEMS
INTERFACE TYPE C

The T-shaped termination of type C is suitable for bushings according to DIN EN 50180 and DIN EN 50181, interface type C, rated current 630/1250 A.

The coupling termination SEHDK can be used to expand a T-shaped termination connected to the system to a space-saving and convenient parallel connection without a coupling element.

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**T-shaped plug-in terminations SET and SAT, U_m up to 36 (42) kV / coupling termination SEHDK, U_m up to 36 (42) kV (optional with additional metal housing)**

- Conductor and screen connection for compression and mechanical connections (shear-off bolts).
- Available with conductive coating only.
- Cover up to eight cable cross-sections with one insulating body size and a stress controlling adapter.
- Capacitive voltage tap.

<table>
<thead>
<tr>
<th>Voltage U_m (kV)</th>
<th>Type</th>
<th>Admissible outer diameter (mm)</th>
<th>Conductor cross section of the insulating body (mm²)</th>
<th>Measure D₁ (mm)</th>
<th>Measure D₂ (mm)</th>
<th>Measure L₁ (mm)</th>
<th>Measure L₂ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>SET 12</td>
<td>15.0 – 23.5</td>
<td>50 – 150</td>
<td>53/71 ³</td>
<td>80/88 ³</td>
<td>188/188 ³</td>
<td>275/275 ³</td>
</tr>
<tr>
<td>12</td>
<td>SET 12</td>
<td>21.8 – 32.6</td>
<td>185 – 300</td>
<td>53/71 ³</td>
<td>80/88 ³</td>
<td>188/188 ³</td>
<td>275/275 ³</td>
</tr>
<tr>
<td>12</td>
<td>SAT 12</td>
<td>22.1 – 34.6</td>
<td>185 – 300</td>
<td>60/- ⁴</td>
<td>80/- ⁴</td>
<td>189/- ⁴</td>
<td>285/- ⁴</td>
</tr>
<tr>
<td>12</td>
<td>SEHDK 13.1 ²</td>
<td>15.0 – 23.5</td>
<td>50 – 150</td>
<td>74/- ⁴</td>
<td>53/- ⁴</td>
<td>200/- ⁴</td>
<td>275/- ⁴</td>
</tr>
<tr>
<td>12</td>
<td>SEHDK 13.1 ²</td>
<td>21.8 – 32.6</td>
<td>185 – 300</td>
<td>74/- ⁴</td>
<td>53/- ⁴</td>
<td>200/- ⁴</td>
<td>275/- ⁴</td>
</tr>
<tr>
<td>24</td>
<td>SET 24</td>
<td>15.0 – 23.5</td>
<td>25 – 70</td>
<td>53/71 ³</td>
<td>80/88 ³</td>
<td>188/188 ³</td>
<td>275/275 ³</td>
</tr>
<tr>
<td>24</td>
<td>SET 24</td>
<td>21.8 – 32.6</td>
<td>95 – 240</td>
<td>53/71 ³</td>
<td>80/88 ³</td>
<td>188/188 ³</td>
<td>275/275 ³</td>
</tr>
<tr>
<td>24</td>
<td>SEHDT 23.1</td>
<td>31.6 – 34.6</td>
<td>300</td>
<td>60/- ⁴</td>
<td>80/- ⁴</td>
<td>189/- ⁴</td>
<td>285/- ⁴</td>
</tr>
<tr>
<td>24</td>
<td>SAT 24</td>
<td>22.1 – 34.6</td>
<td>95 – 300</td>
<td>60/- ⁴</td>
<td>80/- ⁴</td>
<td>189/- ⁴</td>
<td>285/- ⁴</td>
</tr>
<tr>
<td>24</td>
<td>SEHDK 23.1 ³</td>
<td>15.0 – 23.5</td>
<td>25 – 70</td>
<td>74/- ⁴</td>
<td>53/- ⁴</td>
<td>200/- ⁴</td>
<td>275/- ⁴</td>
</tr>
<tr>
<td>24</td>
<td>SEHDK 23.1 ³</td>
<td>21.8 – 32.6</td>
<td>95 – 240</td>
<td>74/- ⁴</td>
<td>53/- ⁴</td>
<td>200/- ⁴</td>
<td>275/- ⁴</td>
</tr>
<tr>
<td>36 (42)</td>
<td>SET 36 (42)</td>
<td>26.2 – 32.0</td>
<td>70 – 120</td>
<td>81/- ⁴</td>
<td>90/- ⁴</td>
<td>196/- ⁴</td>
<td>290/- ⁴</td>
</tr>
<tr>
<td>36 (42)</td>
<td>SET 36 (42)</td>
<td>30.8 – 39.6</td>
<td>150 – 300</td>
<td>81/- ⁴</td>
<td>90/- ⁴</td>
<td>196/- ⁴</td>
<td>290/- ⁴</td>
</tr>
<tr>
<td>36 (42)</td>
<td>SAT 36</td>
<td>35.0 – 59.4 ⁴</td>
<td>300 – 1000</td>
<td>110/- ⁴</td>
<td>90/- ⁴</td>
<td>201/- ⁴</td>
<td>425/- ⁴</td>
</tr>
<tr>
<td>36 (42)</td>
<td>SEHDK 36 (42)</td>
<td>25.2 – 32.0</td>
<td>70 – 120</td>
<td>90/- ⁶</td>
<td>81/- ⁴</td>
<td>≤ 296/- ⁴</td>
<td>290/- ⁴</td>
</tr>
<tr>
<td>36 (42)</td>
<td>SEHDK 36 (42)</td>
<td>29.8 – 39.6</td>
<td>150 – 300</td>
<td>90/- ⁶</td>
<td>81/- ⁴</td>
<td>206/- ⁴</td>
<td>290/- ⁴</td>
</tr>
</tbody>
</table>

1) For cables acc. to DIN VDE 0276-620
2) With stress controlling adapter
3) Data without/with metal housing
4) Data without/with metal housing on request
5) Each cross section is assigned a separate insulating body
ACCESSORIES FOR OUTER CONE SYSTEMS
INTERFACE TYPE C

The T-shaped and the straight termination of type C is suitable for bushings according to DIN EN 50180 and DIN EN 50181, interface type C, rated current 630/1250 A.

T-shaped plug-in termination SEHDT, $U_m$ up to 36 kV

- Conductor connection for compression connections.
- Available with conductive coating only.
- Optionally with additional metal housing.
- Each cross section is assigned an insulating body size.
- Suitable for double connection for a total current of 1250 A, whereas each individual plug may have a maximum current of 630 A.
- Capacitive voltage tap.

Straight plug-in termination SEHDG, $U_m$ up to 24 kV

- Conductor connection for a special clamping bolt suitable for Al and Cu conductors.
- Available with conductive coating only.
- Optionally with additional metal housing.
- Each cross-section is assigned an insulating body size.

Depending on the design, a maximum current load of 400 A is permissible.

<table>
<thead>
<tr>
<th>Voltage $U_m$</th>
<th>Type</th>
<th>Admissible outer diameter $mm$</th>
<th>Conductor cross section of the insulating body $^{1)}$ $mm^2$</th>
<th>Measure $D_1$ $mm$</th>
<th>Measure $D_2$ $mm$</th>
<th>Measure $L_1$ $mm$</th>
<th>Measure $L_2$ $mm$</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 $kV$</td>
<td>SEHDT 13</td>
<td>22.0 – 40.6 $^2)$</td>
<td>185 – 500</td>
<td>78/89 $^3)$</td>
<td>67/78 $^3)$</td>
<td>265/278 $^3)$</td>
<td>260/290 $^3)$</td>
</tr>
<tr>
<td>12 $kV$</td>
<td>SEHDG 13</td>
<td>15.0 – 28.4 $^2)$</td>
<td>50 – 240</td>
<td>-</td>
<td>79/89 $^3)$</td>
<td>-</td>
<td>317/347 $^3)$</td>
</tr>
<tr>
<td>24 $kV$</td>
<td>SEHDT 23</td>
<td>26.3 – 45.6 $^2)$</td>
<td>185 – 630</td>
<td>78/89 $^3)$</td>
<td>67/78 $^3)$</td>
<td>265/278 $^3)$</td>
<td>260/290 $^3)$</td>
</tr>
<tr>
<td>24 $kV$</td>
<td>SEHDG 23</td>
<td>18.0 – 32.6 $^2)$</td>
<td>35 – 240</td>
<td>-</td>
<td>79/89 $^3)$</td>
<td>-</td>
<td>317/347 $^3)$</td>
</tr>
<tr>
<td>36 $kV$</td>
<td>SEHDT 33</td>
<td>22.8 – 45.6 $^2)$</td>
<td>35 – 500</td>
<td>78/89 $^3)$</td>
<td>78/89 $^3)$</td>
<td>265/278 $^3)$</td>
<td>260/290 $^3)$</td>
</tr>
</tbody>
</table>

1) For cables acc. to DIN VDE 0276-620
2) Each cross section is assigned a separate insulating body
3) Data with/without metal enclosure, metal enclosure is flattened on the side for 85 mm phase spacing
ACCESSORIES FOR OUTER CONE SYSTEMS
INTERFACE TYPE C

Surge arrester MUT, $U_m$ up to 36 kV

Südkabel has developed a comprehensive range of accessories to take optimal use of all the advantages of plug-in terminations for metal-enclosed switch-gears. The wide range of products offers solutions for any requirements regarding plug-in terminations. Metal-enclosed surge arresters protect switchgears against power-frequency and atmospheric overvoltage. The arresters can be connected directly to T-shaped plug-in terminations or to bushing type C.

- Available with conductive coating only or with additional metal housing.
- Contact assembly: metal-oxide arrester.
- Meets the specifications of IEC 99-4, 11/91, protection level based on VDE recommendation DIN VDE 0675 part 5.
- Overload performance verification by tests in accordance with IEC and ANSI C6211-1987.

MUT 23 / MUT 23.1

- T-shaped surge arrester for application in combination with SEHDT 23.1 (SEHDT 13.1) and SET 24 (SET 12) T-shaped plug-in terminations.
- Compact solution for overvoltage protection directly at the connection of the pole-mounted feeder cable to the substation.

MUT 33

- T-shaped surge arrester for direct connection to outer cone bushing according to DIN EN 50180 and DIN EN 50181, interface type C, as well as for parallel connection to T-shaped plug-in terminations via appropriate coupling pieces.

<table>
<thead>
<tr>
<th>Voltage $U_m$ (kV)</th>
<th>Type</th>
<th>Measure $L_1$ (mm)</th>
<th>Measure $L_2$ (mm)</th>
<th>Measure $L_3$ (mm)</th>
<th>Measure $D_1$ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>MUT 23</td>
<td>301/301 1)</td>
<td>415/415 1)</td>
<td>108/108 3)</td>
<td>86/86 3)</td>
</tr>
<tr>
<td>24</td>
<td>MUT 23.1</td>
<td>290/290 1)</td>
<td>445/445 3)</td>
<td>108/108 3)</td>
<td>86/86 3)</td>
</tr>
<tr>
<td>36</td>
<td>MUT 33</td>
<td>240/240 1)</td>
<td>481/481 1)</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

1) Data without/with metal enclosure
## Technical data of the contact assemblies MKVT in surge arresters MUT 23 / MUT 23.1 / MUT 33

<table>
<thead>
<tr>
<th>Metal-oxide surge arrester MKTV contact assembly</th>
<th>MUT 23 / MUT 23.1 (^2) / MUT 33 (^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous load voltage (U_C) (kV RMS)</td>
<td>6 12 18 20 22 24 30 36</td>
</tr>
<tr>
<td>Rated Voltage (kV RMS)</td>
<td>7.5 15 22.5 25 27.5 30 37.5 45</td>
</tr>
<tr>
<td>Rated discharge current (I_{A_dm})</td>
<td>10 10 10 10 10 10 10 10</td>
</tr>
<tr>
<td>Maximum discharge current (I_{A_dm})</td>
<td>65 65 65 65 65 65 65 65</td>
</tr>
<tr>
<td>Rect. wave strength, 2000 µsec A pv</td>
<td>250 250 250 250 250 250 250 250</td>
</tr>
<tr>
<td>Energy absorption capacity at rect. wave strength (kJ/kV U_C)</td>
<td>1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5</td>
</tr>
<tr>
<td>Energy absorption capacity at high impulse current (kJ/kV U_C)</td>
<td>2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6</td>
</tr>
<tr>
<td>Short circuit current up to kA</td>
<td>16 16 16 16 16 16 16 16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discharge voltage (U_p) (peak value)</th>
<th>MUT 23 / MUT 23.1 (^2) / MUT 33 (^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>with 1/10 µsec wave at 5 kA (kV pv)</td>
<td>21.8 43.6 65.3 72.6 79.8 87.1 108.9 130.6</td>
</tr>
<tr>
<td>with 1/10 µsec wave at 10 kA (kV pv)</td>
<td>24.0 48.0 72.0 80.0 88.0 96.0 120.0 144.0</td>
</tr>
<tr>
<td>with 8/20 µsec wave at 1 kA (kV pv)</td>
<td>17.4 34.8 52.1 57.9 63.7 69.5 86.8 104.2</td>
</tr>
<tr>
<td>with 8/20 µsec wave at 2.5 kA (kV pv)</td>
<td>18.6 37.1 55.6 61.8 68.0 74.1 92.7 111.2</td>
</tr>
<tr>
<td>with 8/20 µsec wave at 5 kA (kV pv)</td>
<td>19.5 39.0 58.5 65.0 71.5 78.0 97.5 117.0</td>
</tr>
<tr>
<td>with 8/20 µsec wave at 10 kA (kV pv)</td>
<td>21.5 42.9 64.4 71.5 78.7 85.8 107.3 128.7</td>
</tr>
<tr>
<td>with 8/20 µsec wave at 20 kA (kV pv)</td>
<td>23.8 47.6 71.4 79.3 87.3 95.2 119.0 142.8</td>
</tr>
<tr>
<td>mit Welle 30/60 µs bei 100 A (kV sw)</td>
<td>14.9 29.7 44.5 49.4 54.4 59.3 74.1 89.0</td>
</tr>
<tr>
<td>with 30/60 µsec wave at 250 A (kV pv)</td>
<td>15.5 30.9 46.3 51.4 56.5 61.7 77.1 92.5</td>
</tr>
<tr>
<td>with 30/60 µsec wave at 500 A (kV pv)</td>
<td>16.0 32.0 48.0 53.3 58.7 64.0 80.0 96.0</td>
</tr>
<tr>
<td>with 30/60 µsec wave at 1000 A (kV pv)</td>
<td>16.8 33.6 50.4 55.9 61.5 67.1 83.9 100.7</td>
</tr>
</tbody>
</table>

### Definitions

The maximum permissible continuous operating voltage \(U_C\) (MCOV) is the highest power-frequency voltage the arrester can withstand on a continual basis. This value is specified in kV as an r.m.s. value.

The energy absorption capacity \(E\) is the maximum permissible electrical energy expressed in kJ per kV \(U_C\) that the surge arrester can absorb in total without its thermal stability being endangered.

The energy absorption capacity is temperature-dependent and is specified for an ambient temperature of 45 °C.

### Explanation of the protection characteristics

**Gap-free arresters** have no sparkover voltage but only a discharge voltage \(U_p\). This represents the voltage between the arrester terminals while a power pulse current passes through.

The 1/10 µsec current wave at a rated discharge current of 10 kA represents very steep overvoltage waves. The associated discharge voltage is comparable to the front sparkover voltage of conventional arresters with spark gaps.

The 8/20 µsec pulse wave at a peak value of 10 kA results in a discharge voltage approximately corresponding to the protection level in case of lightning impulses.

The 30/60 µsec current wave corresponds to a steep switching impulse voltage. With this waveform, the discharge voltage at 1 kA results in approximately the protection level for switching impulse voltage stress.

The protection characteristics are sufficiently described with these three current waves.

---

1) Further operating voltages on request
2) MUT 23 / MUT 23.1 for voltages up to 24 kV
3) MUT 33 for voltages up to 36 kV
ACCESSORIES FOR OUTER CONE SYSTEMS

Surge-proof insulating terminations IS $U_m$ up to 36 kV

Surge-proof insulating terminations are used for surge-proof and shock-proof insulation of plug-in terminations which are disconnected from the switchgear or the transformer.

Earthing accessories ER

Earthing accessories are used for short circuit-proof earthing of plug-in terminations.

1. Contact tube
2. Cast resin terminating element
3. Mounting plate with bores for fastening the insulating termination to plug-in terminations

1. Earthing pin with contact tube for plug-in or screwed contact
2. Polyamide body
3. Mounting plate with bores for fastening the earthing accessories to plug-in terminations with plug-in contacts
4. Copper compression cable lug, tin-plated
5. ESBY earthing cable (50 mm² for bushing type A, 95 mm² for bushing type B and C), cable length 500 mm, counterpart with copper compression cable lug with strap boring (10.5 mm for bushing type A and 13 mm for bushing type B and C). Alternatively available with ball pin Ø 20 mm.

Insulating termination IS 21
- For plug-in termination type A.
- Suitable for up to 24 kV.

Insulating termination IS 23.1
- For plug-in termination type B and C.
- Suitable for up to 36 kV.

Earthing accessory ER 21
- For plug-in termination type A.

Earthing accessory ER 22/ER 23
- For plug-in termination type B and C.
Coupling pieces KU
Uₘ up to 36 kV

Coupling pieces are used in combination with shaped plug-in terminations for surge-proof and shock-proof connection of components such as parallel cables or surge arresters. It is also possible to provide cable connections or highly-flexible cable connections in the form of detachable sections using coupling pieces and appropriate plug-in terminations. Special coupling pieces are available for connecting plug-in terminations for different connection types.

Coupling piece KU 21
- Insulating material: cast resin.
- For interconnecting plug-in terminations of interface type A up to 24 kV.

Coupling piece KU 23.2/23
- Insulating material: silicone rubber.
- For connecting SET 12/24 (SEHDT 13.1/23.1) plug-in terminations to plug-in terminations of interface type C with at least one combined type SET plug-in termination.

Coupling piece KU 33
- Insulating material: silicone rubber.
- For interconnecting plug-in terminations of interface type C up to 36 kV.
**ACCESSORIES FOR OUTER CONE SYSTEMS**

**Test bushing PR**

**U_m up to 36 kV**

Test bushings are used to perform voltage tests (cable tests, fault locating) on cables that are connected with plug-in terminations.

**Post insulator STF 21**

**U_m up to 24 kV**

The post insulator STF 21 is used to connect single-core XLPE cables to outer cone bushing type A via conventional terminations.

---

**Test bushing PR 23.1**

- For T-shaped SET and SEHDT plug-in terminations of interface type C up to 24 kV.
- T-shaped plug-in terminations can remain connected to the system.
- Assembly of the test bushing on the rear cast resin terminating element of the T-shaped plug-in termination.

**Test bushing PR 23.1 with extension**

- For T-shaped SET and SEHDT plug-in terminations of interface type C up to 36 kV.
- T-shaped plug-in terminations can remain connected to the system.
- Assembly of the test bushing on the rear cast resin terminating element of the T-shaped plug-in termination.

**Wall bushing WA 23**

**U_m up to 24 kV**

The wall bushing WA 23 enables the transition from medium voltage overhead lines to metal-enclosed termination systems up to 24 kV inside masonry-enclosed substations.

- On the outside: outdoor insulator made of epoxy cast resin.
- Inside the station: outer cone bushing according to EN 50180 and DIN EN 50181 with screw-type contact.
- Metal-enclosed through insulator for wall thickness of up to 25 cm.
- For plug-in terminations of interface type C.
Surge-proof terminating caps SP
$U_m$ up to 36 kV

Terminating caps are used for surge-proof and shock-proof insulation of bushings on distribution transformers and metal-enclosed switchgears.

1. Bushings
2. Insulating body
3. Metal housing
4. Cast resin terminating element
5. Conductive coating
6. Earthing cap
7. Earthing connection

Terminating cap SP 21
- For bushings type A up to 24 kV.
- Connector bail holder according to DIN EN 50180 and DIN EN 50181 required.

Terminating cap SP 23.1
- For bushings type B and C up to 24 kV.
- Connector bail holder according to DIN EN 50180 and DIN EN 50181 required.

Terminating cap SP 33
- For bushings type C up to 36 kV.
- Connector bail holder according to DIN EN 50180 and DIN EN 50181 required.

Terminating cap AD 23.1 SP
- For bushings type C up to 24 kV.
- No connector bail holder required.
- Includes the adapter AD 23.1 *), threaded pin, cast resin terminating element and earthing cap.

*) For direct switchgear connection of accessory parts that can only be assembled on SET.
INNER CONE SYSTEM
CABLE TERMINALS

For the inner cone system too, particularly used in power switchgears and power transformers, Südkabel has developed a designated compatible product range for flexible application.

The basic designs of all inner cone plug-in terminations can be compared. The size of the insulator and the design of the individual plug-in contacts, however, vary according to the size of the respective bushing. The plug-in contact consists of a lamellated contact that is connected to the conductor with a cone clamp. A pressure spring between insulating body and mounting flange ensures compensation of the expansion of the silicone components during operation. It also provides sufficient contact pressure at the interface between the silicone component and cast resin bushing.

### Bushings
The standards EN 50180 and EN 50181 define four types of interfaces for the inner cone system up to 52 kV of which only three are relevant in practice.

Its bushings type 1, type 2 and type 3 mainly vary in dimensions:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Rated current</th>
<th>Max. operating voltage</th>
<th>Contact element</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Interface 1</td>
<td>400 – 630 A</td>
<td>36 kV</td>
<td>Lamellated contact</td>
<td>137 mm</td>
</tr>
<tr>
<td>Interface 2</td>
<td>800 A</td>
<td>42 kV</td>
<td>Lamellated contact</td>
<td>137 mm</td>
</tr>
<tr>
<td>Interface 3</td>
<td>1250 A</td>
<td>52 kV</td>
<td>Lamellated contact</td>
<td>185 mm</td>
</tr>
</tbody>
</table>
ACCESSORIES FOR INNER CONE SYSTEMS
INTERFACE TYPE 1 – 3

The SEIK inner cone plug-in terminations serve for bushings according to DIN EN 50180 and DIN EN 50181, interface types 1, 2 and 3.

The product range ISIK offers different variations of insulating seals for all sizes of bushings. The inner cone insulating seal ISIK can be installed on all bushings according to DIN EN 50180 and DIN EN 50181, interface types 1, 2 and 3.

Inner cone plug-in termination SEIK
U_m up to 52 kV

- Straight plug-in terminations for connection of XPLE cables 12 – 52 kV to metal-enclosed switchgears and transformers.
- Capacitive voltage tap-off on request.
- Enclosure test available with optional insulating wrap.
- The insulating seals type ISIK serve for surge-proof and shock-proof termination of bushings for inner cone systems.

<table>
<thead>
<tr>
<th>Type</th>
<th>Interface type</th>
<th>Rated current load of the bushing</th>
<th>Permissible wire diameter</th>
<th>Voltage</th>
<th>Conductor diameter assignment of the insulator</th>
<th>Measure L</th>
<th>Measure D1</th>
<th>Measure D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEIK</td>
<td>13/23/33</td>
<td>1</td>
<td>630</td>
<td>13.0 – 33.6</td>
<td>12/24/36</td>
<td>35 – 240/25 – 240/35 – 150</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>ISIK</td>
<td>13/23/33</td>
<td>1</td>
<td>-</td>
<td>13.0 – 41.4</td>
<td>12/24/36</td>
<td>-</td>
<td>-</td>
<td>95</td>
</tr>
<tr>
<td>SEIK</td>
<td>14/24/34</td>
<td>2</td>
<td>800</td>
<td>13.0 – 41.4</td>
<td>12/24/36</td>
<td>35 – 300/25 – 300/35 – 300</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>ISIK</td>
<td>14/24/34</td>
<td>2</td>
<td>-</td>
<td>18.9 – 52.0</td>
<td>12/24/36</td>
<td>-</td>
<td>-</td>
<td>102</td>
</tr>
<tr>
<td>SEIK</td>
<td>15/25/35/55</td>
<td>3</td>
<td>1250</td>
<td>18.9 – 52.0</td>
<td>12/24/36</td>
<td>150 – 630/50 – 630/35 – 630</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>ISIK</td>
<td>15/25/35</td>
<td>3</td>
<td>-</td>
<td>12/24/36</td>
<td>12/24/36/52</td>
<td>-</td>
<td>-</td>
<td>130</td>
</tr>
</tbody>
</table>

1) For cables according to DIN VDE 0276-620
2) On request
**ACCESSORIES FOR OUTER AND INNER CONE PLUG-IN TERMINATIONS**

Preassembled links are XLPE cables or flexible EPR-insulated trailing cables that are factory-equipped with terminations. They are primarily used for connections between transformers and switchgears.

---

**Preassembled cable and high flexible cable-links 12 – 36 kV**

- The minimum bending radius of flexible trailing cables is ideal for installation in narrow areas.
- Rationalization of substation assembly as no installation on site is necessary.
- The accessory equipment of the links can be freely chosen as any type of termination and plug-in connectors admissible for cables or flexible cable links can be combined.
- Output check on request.

---

**Sheath cutter WM 20.1**
Sheath cutter to remove PE over-sheaths and XLPE insulations from medium voltage cables.

**Cable stripper WL 20.1**
Cable stripper for removal of the fix-bonded outer insulation screen of XLPE-insulated medium voltage cables.

**Indicator unit for capacitive voltage tap**
The indicator unit enables long-term use of the voltage tap for safe and reliable display that the plug-in termination is de-energised. The indicator unit can be adapted to different designs by means of designated adjustment kits.

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**Further accessories**
Products for cable installation and laying:

- Earthing material for cables with copper tape screens.
- Shrinkable cable breakout for three-core XLPE cables.
- Cable bundling tape for short circuit-proof bundling of single-core cables.
- RUK 500 cleaning tissue impregnated with cable cleaning agent for cable sheaths and insulations.

---

**Type** | Admissible current carrying capacity **1)** A | Short circuit current 1s KA | Outer diameter mm | Minimum bending radius mm
---|---|---|---|---
Trailing cable 24 kV **2)** | | | | |
NTMCWOEU 1x 35 mm² | 240 | 5.0 | 29.5 | 145
NTMCWOEU 1x 50 mm² | 300 | 7.2 | 31.5 | 155
Cable 24 kV **2)** | | | | |
N2XSY 1x 35 mm² | 235 | 5.0 | 30 | 450
N2XSY 1x 50 mm² | 282 | 7.2 | 34 | 550

1) Air installation at an ambient temperature of 30 °C
2) Further diameters on request
Glass fibre reinforced polyamide fixing clamps for safe mounting of cables on poles, in stations and cable ducts.

**Type K**
(mechanical short-circuit stability 10.000 N) for fixing of single and multi-core cables.

**Type KP**
(mechanical short-circuit stability 25.000 N) for fixing of single-core cables in trefoil formation for high short-circuit stress levels.

**Type KS**
(mechanical short-circuit stability 12.500 N) for fixing of single-core cables in trefoil formation.

**Type KR**
(mechanical short-circuit stability 20.000 N) for fixing of single and multi-core cables (individual fixing).

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure L₁</td>
<td>90</td>
<td>105</td>
<td>126</td>
<td>158</td>
<td>172</td>
<td>190</td>
<td>150</td>
<td>170</td>
<td>180</td>
<td>210</td>
<td>250</td>
</tr>
<tr>
<td>Measure L₂</td>
<td>60</td>
<td>75</td>
<td>95</td>
<td>120</td>
<td>125</td>
<td>145</td>
<td>110</td>
<td>130</td>
<td>150</td>
<td>175</td>
<td>210</td>
</tr>
<tr>
<td>Measure B</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>77</td>
<td>97</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>Measure d</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
OUR OFFER

Cables

- XLPE-insulated cables from 6 kV to 500 kV

Cable systems

- Turnkey XLPE-insulated cable systems up to 500 kV

Accessories for medium, high and extra-high voltage cables

- Outdoor terminations
- Conventional and plug-in terminations for SF₆ switchgears and transformers
- Cable Joints
- Plug-in terminations for outer and inner cone systems
- Medium voltage cable links
- Accessories for electrostatic precipitator cables

Services

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

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