Wytwórnia Sprzętu Elektroenergetycznego (Electrical Power Equipment Factory) AKTYWIZACJA projects, manufactures, distributes as well as services the safety equipment designed for servicing electrical power installations of low-, medium- and high voltage:

- electric shock protective equipment
  - insulating sticks ○ universal sticks ○ traction earthing and isolator operating sticks ○ sticks for transporting rubber insulated conductors ○ capacitor discharging sticks ○ manipulating sticks for live work ○ telescopic sticks ○ special type sticks
  - insulating platform ○ insulated tongs ○ rescue hooks

- detectors and indicators
  - low voltage detectors ○ single- and two-stick detectors ○ phase order indicators
  - high voltage ○ acoustic-visual ○ diode detectors for bus bars
  - electrical field detectors

- test-unit for voltage detectors

- diode phase comparator

- portable earthing devices ○ one-clamp ○ multi-clamp ○ lightweight ○ stick-type for high, medium and low voltage ○ substation-type ○ power fuse base ○ traction for mines devices ○ for threaded sockets ○ snap lock ○ for metro railway ○ special type

- working elements, auxiliary equipment
  - manipulating grab ○ manipulating catches ○ portable fence ○ capacitor’s dischargers ○ electrostatic dischargers

- We also sell: insulating carpets, mats, overshoes, insulating gloves, safety tags, fire extinguishers, helmets ad other safety equipment.

Note:
The products are provided with “User's Manual”, “Technical Specification” and “Quality Certificate”.

THE PRODUCTS MANUFACTURED BY AKTYWIZACJA MEET THE REQUIREMENTS OF POLISH AND EUROPEAN STANDARDS AS WELL AS DIRECTIVES ACCORDING TO THEIR USE RANGE. IN THE CASE OF A NEW APPROACH, THE PRODUCTS ARE MARKED WITH THE SAFETY SYMBOL “CE”.

Poland, 31-751 Kraków, ul. Stadionowa 24
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UDI-B UNIVERSAL INSULATING STICK

The UDI-B Universal Insulating stick – depending on rated voltage - is designed for servicing electrical power engineering equipment of low-, medium- and high-rated voltages. It is used for protection against electric shock by insulating an operator from the live electrical power equipment. The insulating part of the stick is made of epoxy-glass tube filled with polyurethane foam of high mechanical and electrical resistance. The head and hand limiter of the UDI-B are made of insulating plastic. The plug (of the hole) at the bottom part of the stick is made of high impact resistance rubber. Dependent on the rated voltage, the stick is manufactured as uniform or multi-segmental. Joints of the multi-segmental sticks are made of high mechanical and electrical resistance plastics. Each UDI-B is equipped with the patented UDI system head for clamping any working element or voltage detector in it. The UDI-B universal insulating stick is most commonly used with such products manufactured by Electrical Power Equipment Factory AKTYWIZACJA as:
- Line clamp of the portable earthing device equipped with an end fitting adapted for direct fastening in the stick’s head (e.g. WT-P),
- ZO, ZN manipulating catches designed for servicing the disconnecting switches;
- ZU, ZL manipulating catches designed for installing and removing the portable earthing device,
- ChM manipulating clashell designed for installing and removing fuse cartridges,
- High voltage detector designed for checking the voltage presence,
- Single-stick phase comparators, bipolar phase comparators.

A unit package makes a protective cover made of coated waterproof fabric.

When ordering the UDI-B customer may specify length according to table bellow.

<table>
<thead>
<tr>
<th>Symbol of the stick</th>
<th>max rated voltage of the serviced installation [kV]</th>
<th>Sizes of the sticks</th>
<th>Number of segments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L_{\text{min}} [mm]</td>
<td>L_{\text{max}} [mm]</td>
<td>L_{1\text{min}} [mm]</td>
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<tr>
<td>Uniform sticks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UDI-1-B</td>
<td>1</td>
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<td>Multi-segmental</td>
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<tr>
<td>UDI-10S-B</td>
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<tr>
<td>UDI-20S-B</td>
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<td>UDI-30S-B</td>
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<td>UDI-40S-B</td>
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<td>UDI-110S-B</td>
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<tr>
<td>UDI-400-B</td>
<td>400</td>
<td>5000</td>
<td>6050</td>
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</tbody>
</table>

Reference documents:
- PN-EN 60855:1999   Insulating tubes filled with polyurethane foam and rods for live working.
- WTO-4/01  UDI-B and DU-A insulating sticks.
UDI-B UNIVERSAL INSULATING STICK

I uniform:  UDI-1-B, UDI-10-B, UDI-20-B, UDI-30-B  
UDI-40-B, UDI-110-B

II multi-segmental: UDI-110S-B, UDI-220-B

III multi-segmental: UDI-400-B

1 Insulating tube
2 Head of UDI-B stick
3 Hand limiter
4 Joint
5 Rubber plug

L Total length of the stick: (min, max)  
L1 Length of the insulating element  
D Outside tube diameter  
D1 Outside tube diameter
DU-A INSULATING STICK FOR PORTABLE EARTHING DEVICE MOUNT

The DU-A Insulating Stick – depending on rated voltage - is for mounting portable earthing/short-circuiting devices. Device is designed for low-, medium- and high voltages. The insulating part of the stick is made of epoxy-glass tube, empty inside. The sticks are of green colour. The head and hand limiter of the DU-A are made of insulating plastic. The plug (of the hole) at the bottom part of the stick is made of high impact resistance rubber. Dependent on the rated voltage, the stick is manufactured as uniform or multi-segmental.

Joins of the multi-segmental sticks are made of high mechanical and electrical resistance plastics. Each DU-A is equipped with the patented UDI system head for mounting clamps in it.

The DU-A insulating stick is most commonly used with products for mounting portable earthing/short-circuiting devices, manufactured by Electrical Power Equipment Factory „Aktywizacja” such as:
- Line clamp of the portable earthing device equipped with an end fitting adapted for direct fastening in the stick’s head (e.g. WT-P),
- ZU manipulating catch designed for installing and removing the portable earthing device, the line clamp of which is not directly mounted in the head of the stick and the ZL designed for removing light portable earthing devices.

ATTENTION: DU-A shouldn’t be used during live working (with voltage detectors, manipulating catches designed for servicing the disconnecting switches etc.).

**TECHNICAL SPECIFICATION OF THE DU-A INSULATING STICKS**

<table>
<thead>
<tr>
<th>Symbol of the stick</th>
<th>Rated voltage of the stick and the max rated voltage of the serviced installation [kV]</th>
<th>Sizes of the sticks</th>
<th>Number of segments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L min [mm]</td>
<td>L max [mm]</td>
<td>L1 min. [mm]</td>
</tr>
<tr>
<td>Uniform sticks</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DU-1-A</td>
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<td>500</td>
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<tr>
<td>DU-10-A</td>
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<td>DU-20-A</td>
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<td>DU-40-A</td>
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<td>DU-110-A</td>
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<tr>
<td>DU-150-A</td>
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<tr>
<td>DU-200-A</td>
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<td>DU-300-A</td>
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</tr>
<tr>
<td>DU-400-A</td>
<td>400</td>
<td>5000</td>
<td>5000</td>
</tr>
</tbody>
</table>

Reference Reference documents:
PN-EN 61230:2011
PN-EN 61235:1999
WTO-4/01
DU-A INSULATING STICK FOR PORTABLE EARTHING DEVICE MOUNT

I uniform: UDI-1-A, UDI-10-A, UDI-20-A, UDI-30-A
      UDI-40-A, UDI-110-A

II multi-segmental: UDI-110S-A, UDI-220-A

III multi-segmental: UDI-400-A

1 Insulating tube
2 Head of DU-A stick
3 Hand limiter
4 Joint
5 Rubber plug

L Total length of the stick: (min, max)
L1 Length of the insulating element
D Outside tube diameter
D1 Outside tube diameter
The UDEM Universal Insulating Stick with euro junction – depending on rated voltage - is designed for servicing electrical power engineering equipment of low-, medium- and high-rated voltages up to 400kV. It is used for protection against electric shock by insulating an operator from the live electrical power equipment. The insulating part of the stick is made of epoxy-glass tube filled with polyurethane foam of high mechanical and electrical resistance.

The junction of the UDEM is made of metal, hand limiter is made of insulating plastic. The plug (of the hole) at the bottom part of the stick is made of high impact resistance rubber. Dependent on the rated voltage, the stick is manufactured as uniform or multi-segmental. Joints of the multi-segmental sticks are made of high mechanical and electrical resistance plastics.

A unit package makes a protective cover made of coated waterproof fabric.

The symbols and corresponding parameters of the sticks are given in the table below.

### TECHNICAL SPECIFICATION OF THE UDEM INSULATING STICKS

<table>
<thead>
<tr>
<th>Symbol of the stick</th>
<th>Rated voltage of the stick and the max rated voltage of the serviced installation [kV]</th>
<th>Sizes of the sticks</th>
<th>Number of segments</th>
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</thead>
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<tr>
<td></td>
<td>L min [mm]</td>
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<tr>
<td>Uniform sticks</td>
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<td>UDEM-400S-B</td>
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</table>

Reference documents:
- PN-EN 60855:1999 Insulating tubes filled with polyurethane foam and rods for live working.
- WTO-8/09 UDEM universal insulating stick with Euro junction.
UDEM UNIVERSAL INSULATING STICK WITH EURO JUNCTION

1 Insulating tube
2 U-type head of UDEM stick
3 Hand limiter
4 Joint
5 Rubber plug

L Total length of the stick: (min, max)
L1 Length of the insulating element
D Outside tube diameter
D1 Outside tube diameter

I – uniform: UDEM-1-B, UDEM-10-B, UDEM-20-B, UDEM-30-B, UDEM-40-B, UDEM-110-B
III – multi-segmental: UDEM-400S-B
TDI-B TELESCOPIC INSULATING STICK

The TDI-B telescopic insulating stick can be used for servicing the electrical equipment with a rated voltage up to 400 kV (depending on the number of retracted segments), for lifting and installing auxiliary electrical equipment with weight up to 5 kg. It is designed mainly for installing and removing of latch type earthing devices (U-SM and U-SD type – manufactured by the AKTYWIZACJA) and for working in conjunction with voltage indicators. Its reaching distance makes possible to install the earthing devices from the ground without necessity to climb on to a post. The telescopic insulating stick should be operated vertically, or slightly diverted from the vertical (approx. 15 degrees for lower segment) at no rain weather. The stick segments are extracted subsequently upwards until a distinct stop and then locked by subsequently snapping the joint levers at each extracted tube. The extraction of the following segments means adequate level of insulation has been achieved according to Manual. The segments of the TDI-B telescopic insulating stick are made of empty tubes. The material of these tubes is a composite connection of glass fibre and polyester. TDI-B stick is made with the upper segment filled with insulating foam. Thanks to the application of the UDI system quick clamping head, it is possible to install the AOWN high voltage indicators (for signalling the voltage presence) installed in the head, or the ZU or ZL manipulating catches used for installing and removing above mentioned earthing devices. This broadens significantly the range of applications of TDI-B telescopic insulating stick. Due to safety considerations the producer recommends to use a pedestal under sticks when manipulating with the TDI-B stick. Such pedestals make manipulating the stick easy and one may buy them together with the TDI-B stick. There are four length versions of the TDI-B telescopic insulating sticks: TDI-B with the overall length 7.5 m, TDI/I-B with the overall length 9 m, TDI/II-B with the overall length 4.7 m and TDI/III-B with the overall length 5 m.

Parameters of the TDI-B telescopic insulating sticks:
- Rated voltage from 1 up to 400 kV.
- Length of folded stick approx. 1.85 m.
- Length at all extracted segments approx. 7.5 m.
- Reach of work dependent on the height of an operator approx. 9 m.
- Weighing capacity 5 kg.
- Gross weight is: 4.50 kg.

Parameters of the TDI/I-B telescopic insulating sticks:
- Rated voltage from 1 up to 400 kV.
- Length of folded stick approx. 2.15 m.
- Length at all extracted segments approx. 9 m.
- Reach of work dependent on the height of an operator approx. 10.5 m.
- Weighing capacity 5 kg
- Gross weight is: 5.45 kg.

Parameters of the TDI/II-B telescopic insulating sticks:
- Rated voltage from 1 up to 220 kV.
- Length of folded stick approx. 1.82 m.
- Length at all extracted segments approx. 4.7 m.
- Reach of work dependent on the height of an operator approx. 6.2 m.
- Weighing capacity 5 kg
- Gross weight is: for 3.1 kg

Parameters of the TDI/III-B telescopic insulating sticks:
- Rated voltage from 1 up to 110 kV.
- Length of folded stick approx. 1.6 m.
- Length at all extracted segments approx. 5 m.
- Reach of work dependent on the height of an operator approx. 7 m.
- Weighing capacity 5 kg
- Gross weight is: for 3.5 kg

Above features make the stick especially useful when working in an open field, where they make possible to check the absence of line voltage and to install earthing devices from the ground level. A unit package includes a protective cover made of coated waterproof fabric.

Reference documents:
- PN-EN 60855:1999  Insulating tubes filled with polyurethane foam and rods for live working.
- WTO-1/09  TDI-B Telescopic insulating stick.
DIPS-B INSULATING STICK (STICK)

The DIPS-B insulating stick – depending to rated voltage - is designed for servicing electrical equipment of low-, medium- and high-rated voltages. It is used for protection against electric shock by insulating the operator from live electrical equipment. The insulating and handling part of the stick is made of an epoxy- glass tube filled with polyurethane foam of high mechanical and electrical resistance. The DIPS-B sticks are of orange colour.

The head of the DIPS-B stick is made of metal covered with a protective layer. The handle limiter and joint limiter of the stick are made of high mechanical and electrical resistance plastic. The plug of the hole at the bottom part of the stick is made of high impact resistance rubber. Dependent on the rated voltage, the stick is manufactured as uniform or multi-segmental. The types of the DIPS-B sticks and technical parameters are given in the table below. When ordering the DIPS-B one should write the designation of the rated voltage (e.g. DIPS-B-110). A unit package includes a protective cover made of coated waterproof fabric.

<table>
<thead>
<tr>
<th>Stick symbol</th>
<th>Rated voltage [kV]</th>
<th>Max rated voltage of equipment [kV]</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length L [mm]</td>
</tr>
<tr>
<td>Uniform stick</td>
<td>DIPS-110-B</td>
<td>110</td>
<td>2100</td>
</tr>
<tr>
<td>Multi-segmental sticks</td>
<td>DIPS-110-B/II</td>
<td>110</td>
<td>4100</td>
</tr>
<tr>
<td></td>
<td>DIPS-220-B</td>
<td>220</td>
<td>4100</td>
</tr>
<tr>
<td></td>
<td>DIPS-400-B</td>
<td>400</td>
<td>5200</td>
</tr>
</tbody>
</table>

Reference documents:
PN-EN 60832-1:2010 Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks.
PN-EN 60855:1999 Insulating tubes filled with polyurethane foam and rods for live working.
WTO-6/01 UI-PS earthing device and DIPS-B insulating stick.
DIPS-B INSULATING STICKS (STICKS)

1. Socket
2. Joint
3. Handle limiter

DIPS-110-B Stick
DIPS-110-B/II Stick
DIPS-220-B Stick
DIPS-400-B Stick
The TDO-4-B traction earthing and disconnecting stick and the railway special type earthing devices type U1-SK, U1-SK/A, U1-SK/B, U1-SK/C, U1-SK/D, U1-SK/E are designed for earthing overhead traction installation by connecting the auxiliary extension arm of the traction conductor with the railway rail.

The TDO-4-B traction stick with a rated voltage of 4 kV is made of epoxy-glass tube. It consists of three insulating elements:
- upper, made of orange colour tube filled with polyurethane foam with the head of the UDI insulating stick and a limiter of the handle,
- middle, made of standard (S) empty tube used as an extension rod,
- lower, made of standard (S) empty tube used as an extension rod.

All parts of the stick are interconnected by means of joints made of plastic with high mechanical and electrical properties. Traction earthing and disconnecting stick is equipped with the ZO type manipulating catch designed for clamping in the UDI stick head. This set up can be used for servicing the disconnecting switches that are not equipped with a drive. The head of the TDO-4-B stick and handle limiter are made of plastic. Plug for the bottom hole of the stick is made of shock resistant rubber. There is TDO-4-B/I version of stick, which has equal lenghts of segments and it has shorter protective cover: 1800 mm.

Portable earthing devices: U1-SK, U1-SK/A, U1-SK/B, U1-SK/C, U1-SK/D, U1-SK/E are made for currents up to \( I_r = 9kA \) for time \( t_r = 1s \). Cross section of wire is \( 50 \text{ mm}^2 \). Length of wire can be choose from range 7 – 14 [m] with 0.2 [m] gradation.

The U1-SK railway special type earthing device consists of:
- the WT-Z7 line clamp equipped with a spring-operated self-locking clamp on the extension arm and a spark rod. This clamp co-operates with the head of the TDO-4-B insulating stick,
- earthing conductor made of copper cable with cross-section of 50 mm\(^2\) covered with transparent plastic protection,
- the WR-3 earth clamp made of aluminium alloy, the design of which allows to clamp it to the traction rail foot.

The size of the earthing device copper conductor has been increased to 50 mm\(^2\).

In the standard design of the U1-SK earthing device the earthing conductor is L=8m or L=10m long. In this case the earthing device is designated respectively:

**U1-SK-8-9/1-50** or **U1-SK-10-9/1-50**

For the other length of the earthing device conductor its denotation is as follows:

**U1-SK-L-9/1-50**

where L is the ordered length of the earthing conductor expressed in meters. The length L is in the range from 7 m up to 14 m graded every 0.2 m.

The U1-SK/A railway special earthing device consists of:
- the WT-3/D line clamp equipped with screw type clamp, cruciform articulated joint and a tip for fastening in the TDO/A-4-B stick,
- earthing conductor made of copper cable with cross-section of 50 mm\(^2\) with a transparent plastic cover.
– the WR-4 earth clamp, with a steel housing, and the aluminium clamp assures appropriate electrical contact.

Similarly as for the U1-SK earthing device also the U1-SK/A earthing device as a standard is equipped with earthing conductor made of copper cable L=8 or L=10 m long. In this case it is denoted respectively:

\[ U1\text{-SK/A-8-9/1-50} \text{ or } U1\text{-SK/A-10-9/1-50} \]

It is also possible to order the other length of the conductor L by including it in the denotation of the earthing device being ordered:

\[ U1\text{-SK/A-L-9/1-50} \]

The U1-SK/B and U1-SK/C earthing devices are a combination of the earthing devices described above.

The U1-SK/B earthing device consists of:
- the WT-Z7 line clamp,
- earthing conductor made of copper cable L=8 or L=10 m long,
- the WR-4 earth clamp.

Its standard denotation is the following:

\[ U1\text{-SK/B-8-9/1-50} \text{ or } U1\text{-SK/B-10-9/1-50} \]

When ordering the other length L of the conductor, one should include its length in meters in the U1-SK/B-L-9-50 general denotation.

The U1-SK/C earthing device consists of:
- the WT-3/D line clamp,
- earthing conductor made of copper cable L=8 or L=10 m long,
- the WR-3 earth clamp.

Its standard denotation is appropriately:

\[ U1\text{-SK/C-8-9/1-50} \text{ or } U1\text{-SK/C-10-9/1-50} \]

When ordering the other length L of the conductor one should include its length in meters in the U1-SK/C-L-9-50 general denotation.

The U1-SK/D and U1-SK/E earthing devices are a version of the earthing devices described above, but with WT-Z8 snap type (latch) clamp.

The U1-SK/D earthing device consists of:
- the WT-Z8 line clamp,
- earthing conductor made of copper cable L=8 or L=10 m long,
- the WR-4 earth clamp.

Its standard denotation is the following:

\[ U1\text{-SK/D-8-9/1-50} \text{ or } U1\text{-SK/D-10-9/1-50} \]

When ordering the other length L of the conductor, one should include its length in meters in the U1-SK/D-L-9-1-50 general denotation.

The U1-SK/E earthing device consists of:
- the WT-Z8 line clamp,
- earthing conductor made of copper cable L=8 or L=10 m long,
- the WR-3 earth clamp.

Its standard denotation is appropriately:

**U1-SK/E-8-9/1-50** or **U1-SK/E-10-9/1-50**.

When ordering the other length L of the conductor one should include its length in meters in the U1-SK/E-L-9/1-50 general denotation.

Unit package for the stick includes a protective case, and a bag for the earthing device, made of coated waterproof fabric.

Gross weights of the typical earthing devices are given in table below.

<table>
<thead>
<tr>
<th>Product name</th>
<th>Gross weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDO-4-B traction earthing and disconnecting stick</td>
<td>5.35</td>
</tr>
<tr>
<td>U1-SK-8-9/1-50 railway special earthing device</td>
<td>6.75</td>
</tr>
<tr>
<td>U1-SK-10-9/1-50 railway special earthing device</td>
<td>7.80</td>
</tr>
<tr>
<td>U1-SK/A-8-9/1-50 railway special earthing device</td>
<td>7.40</td>
</tr>
<tr>
<td>U1-SK/A-10-9/1-50 railway special earthing device</td>
<td>8.45</td>
</tr>
<tr>
<td>U1-SK/B-8-9/1-50 railway special earthing device</td>
<td>6.55</td>
</tr>
<tr>
<td>U1-SK/B-10-9/1-50 railway special earthing device</td>
<td>7.65</td>
</tr>
<tr>
<td>U1-SK/C-8-9/1-50 railway special earthing device</td>
<td>7.55</td>
</tr>
<tr>
<td>U1-SK/C-10-9/1-50 railway special type earthing device</td>
<td>8.60</td>
</tr>
<tr>
<td>U1-SK/D-8-9/1-50 railway special type earthing device</td>
<td>7.45</td>
</tr>
<tr>
<td>U1-SK/D-10-9/1-50 railway special type earthing device</td>
<td>8.5</td>
</tr>
<tr>
<td>U1-SK/E-8-9/1-50 railway special type earthing device</td>
<td>6.6</td>
</tr>
<tr>
<td>U1-SK/E-10-9/1-50 railway special type earthing device</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Technical parameters of the U1-SK earthing devices and the TDO-4-B insulating sticks are given below:

- range of the TDO-4-B stick at height from 4.8 up to 6.1 m
- the WR-3 and WR-4 earth clamps for the rails S 24, S 30, S 37, S 42, S 49, S 60
- the WT-Z7 line clamp for extension arm with diameters from 10 up to 16 mm
- the WT-Z8 line clamp for wire and extension arm with diameters from 16 up to 32 mm
- the WT-3/D line clamp for extension arm with diameters from 8 up to 45 mm

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 60855:1999 Insulating tubes filled with polyurethane foam and rods for live working.
- PN-EN 61235:1999 Empty insulating tubes.
- WTO-5/01 TDO-4-B traction earthing and isolator operating stick.
TDO-4-B TRACTION EARTHING & DISCONNECTING STICK

U1-SK, U1-SK/A RAILWAY SPECIAL EARTHING DEVICE

1. Upper part
2. Medium part
3. Lower part
4. UDI Stick head
5. Limiter of handle
6. Joint
7. ZO Manipulating catch

1. WT-Z7 Clamp
2. WR-3 Clamp
3. WT-3/D Clamp
4. WR-4 Clamp
5. Earthing conductor
U1-SK/B, U1-SK/C RAILWAY SPECIAL EARTHING DEVICE

1. WT-Z7 Clamp
2. WR-3 Clamp
3. WT-3/D Clamp
4. WR-4 Clamp
5. Earthing conductor

U1-SK/B

U1-SK/C

U1-SK/D, U1-SK/E RAILWAY SPECIAL EARTHING DEVICE

1. WT-Z8 Clamp
2. WR-3 Clamp
3. WR-4 Clamp
4. Earthing conductor

U1-SK/D

U1-SK/E
A stick with rated voltage 30 kV a.c. for relocation of rubber insulated conductors is dedicated to move (relocate) the rubber insulated conductor with a diameter up to 100 mm behind the excavators and belt conveyors in the area of open pits. It can also be used for relocation of power cables. The length of the stick’s insulating part is adequate to maintenance devices with voltages up to 30kV. The sticks manufactured in two versions I and II are made of glass-epoxy tube filled with polyurethane foam. From one side the sticks of both versions are terminated with special catch formed in such a way to hook up and comprise the rubber insulated conductor with a diameter up to 100 mm.

Unique design of the grip part with two hand guards and a distance sleeve allows to transfer large longitudinal loads and simultaneously separates the insulating part of the stick from the grip section. Difference between version I and version II lies in the shape of the chamber terminating the grip part of the stick. Each of them is capable of secure closing and sealing with lead and is designed for storing a set of documents concerning the particular stick. Special type of structural design of this stick assures high electrical and mechanical strength.

Due to the character of operation the sticks do not have any unit packages, and are only protected from damage during transport by means of packing paper.

Gross weight: DPPO-B/I – 3.30 kg, DPPO-B/II – 2.55 kg

Reference documents:
- WTO-2/03 DPPO-B stick for relocation of rubber insulated conductors.

DPPO-B STICK (STICK) FOR RELOCATION OF RUBBER INSULATED CONDUCTORS
The AOWN-5 sound-optical voltage detector is designed for acoustic and optical signalling of the presence of alternating voltage in 50 Hz networks with the rated voltage from 0.23 kV up to 400 kV. It works in conjunction with the UDI-B universal insulating stick designed for appropriate rated voltage.

The AOWN-5 detector operates within the following rated voltage ranges:

<table>
<thead>
<tr>
<th>Symbol of the detector</th>
<th>Voltage range [kV]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOWN-5/1</td>
<td>0.23 – 1</td>
</tr>
<tr>
<td>AOWN-5/2</td>
<td>3 – 11</td>
</tr>
<tr>
<td>AOWN-5/3</td>
<td>6 – 17.5</td>
</tr>
<tr>
<td>AOWN-5/4</td>
<td>12 – 36</td>
</tr>
<tr>
<td>AOWN-5/5</td>
<td>30 – 110</td>
</tr>
<tr>
<td>AOWN-5/6</td>
<td>110</td>
</tr>
<tr>
<td>AOWN-5/8</td>
<td>110 – 400</td>
</tr>
</tbody>
</table>

The AOWN-5 detector is equipped with cylindrical bridging resistant housing “2” made of grey colour plastic. It is shock resistant according to the PN-EN 61243-1:2007 Polish Standard (IEC 61243-1:2003). Its design assures splash proofing. One side of the detector is terminated with aluminium contact pin “1” of L category (i.e. with no extension), of the length specified for the ranges according to the PN-EN 61243-1:2007 Polish Standard. The other side of the detector is terminated by the holder “5” for fastening in the UDI-B universal insulating stick quick clamping head. On special request detector may be produced with U universal socket (according to PN-EN 60832-2 appendix A). The AOWN-5 detector is made according to the I-st type group of signalling (i.e. the detector with wide range of rating voltage) defined by the PN-EN 61243-1:2007 Polish Standard. The detector has two different signals: acoustic and visual and additionally is equipped with a self-test. It is destined for internal and external usage in the range of temperatures from –25 °C up to +70 °C and relative humidity from 20 % up to 96 % - it responds to the N+W climatic category according to the PN-EN 61243-1:2007. The detector is powered with an alkaline 9V battery of 6LR661 type. It is permissible to use - environment friendly - nickel-metallic-hydrogen 8.4 V, 150 mAh battery of 6F22 NiMH type and suitable charger e.g. of the GP Batteries. The battery can be replaced easily; the procedure is described in the Operating Manual.

The AOWN-5 Detector is equipped with a microprocessor electronic system assuring high stability of thresholds of signalling voltage and high stolidity to decrease the supply voltage (there is no possibility to adjust the sensitivity of the detector by the user). Occasional switching the detector on will not cause the battery to discharge because after 2 minutes the detector automatically will switch off. During self-testing and during indicating the presence of voltage, the AOWN-5 detector is emitting very well audible and visible acoustic and visual signals.

AOWN-5 operates as follows:

The self-testing follows automatically the switching on of the switch “8” by pressing it for about 2 sec. At the same time red diodes “7” and “9” are switching on and a continuous modulated audible signal is emitted for about 1 sec. Then the detector is in the “standby” state. During this state the detector is emitting continuous modulated acoustic and visual signals. Discharging the battery is signalled with a separate signal code: 3 times acoustic and visual signal and after that the detector is switched off.

The AOWN detector is supplied with protective cover made of coated fabric. The set also includes the Operating Manual and a Quality Certificate.

The AOWN-5 acoustic visual voltage detectors are denoted by CE mark.

Reference documents:

- PN-EN 61243-1:2007 Live working. Voltage detectors. Capacitive type to be used for voltages exceeding 1 kV a.c.
1. Contact electrode in AOWN-5/4 version
2. Cylindar housing
3. Body
4. Rubber sealing
5. Holder
6. Name plate
7. Red diode
8. Switch
9. Red diode
10. Audible signalling device
11. Plate of battery polarity
12. Battery
AOUF-1/1 ACOUSTIC VISUAL PHASE COMPARATOR

The AOUF-1/1 acoustic visual phase comparator is used for phasing in nets and alternating current devices 50 Hz and rated voltage from 0.23 kV up to 1.2 kV. It works in conjunction with UDI-B universal insulating stick with appropriate rating voltage.

It is equipped with cylindrical housing made of grey colour plastic, resistant for bridging. It is also drop-resistant and impact-resistant according to PN-EN 61481:2004+A/C Polish Standard (IEC 61481:2001). Its design assures splash-proofing.

From one side it is ended with contact electrode having a length specified in the PN-EN 61481:2004+A/C standard and at the other side it is ended with holder for fastening in the head of the UDI-B universal insulating stick. On special request detector may be produced with "Euro" socket.

The AOUF-1/1 comparator is made according to B signalling class, it means signalling of the phase' non-coincidence for phase angles from 60° up to 300° and it has two different signals: acoustic and visual and additionally is equipped with a self-test. It is destined for internal and external usage in the range of temperatures from –25 °C up to +70 °C and relative humidity from 20 % up to 96 % - it responds to the N+W climatic category according to the PN-EN 61481:2004+A/C standard.

The comparator is powered with an alkaline 9V battery of 6LR61 type. It is permissible to use - environment friendly - nickel-metallic-hydride 8.4 V, 150 mAh battery of 6F22 NiMH type and suitable chargers e.g. of the GP Batteries. The comparator is not equipped with batteries and chargers (user must buy them). The battery can be replaced easily; the procedure is described in the Operating Manual. The AOUF-1/1 comparator is equipped with a microprocessor electronic system high insensitivity for the supply voltage decreasing and high tolerance for frequency fluctuation. Occasional switching the comparator on e.g. during transportation will not cause the battery discharge because after 2 minutes the comparator automatically will switch off.

During self-testing and during indicating the phase swirling, the comparator is emitting very well audible and visible acoustic and visual signals.

The AOUF-1/1 acoustic visual phase comparators are denoted by CE mark.

Reference documents:
PN-EN 61481:2004+A/C Live working. Portable phase comparators for alternating voltages from 1 kV to 36 kV.
WTO-5/09 AOUF-1/1 acoustic visual phase comparator.
1. Contact electrode
2. Cylindrical housing
3. Body
4. Rubber sealing
5. Holder
6. Nameplate
7. Red diode
8. Switch
9. Green diode
10. Audible signalling device
11. Plate of battery polarity
12. Battery
AOUF-1/2 ACOUSTIC VISUAL PHASE COMPARATOR

The AOUF-1/2 acoustic visual phase comparator is used for phasing in nets and alternating current devices 50 Hz and rated voltage from 3 kV up to 36 kV. It works in conjunction with UDI-B universal insulating stick with appropriate rating voltage.

It is equipped with cylindrical housing made of black color plastic, resistant for bridging. It is also drop-resistant and impact-resistant according to PN-EN 61481:2004+A/C Polish Standard (IEC 61481:2001). Its design assures splash-proofing.

From one side it is ended with contact electrode having a length specified in the PN-EN 61481:2004+A/C standard and at the other side it is ended with holder for fastening in the head of the UDI-B universal insulating stick. On special request detector may be produced with „Euro” socket.

The AOUF-1/2 comparator is made according to B signalling class, it means signalling of the phase’ non-coincidence for phase angles from 60° up to 300° and it has two different signals: acoustic and visual and additionally is equipped with a self-test. It is destined for internal and external usage in the range of temperatures from –25 °C up to +70 °C and relative humidity from 20 % up to 96 % - it responds to the N+W climatic category according to the PN-EN 61481:2004+A/C standard.

The comparator is powered with an alkaline 9V battery of 6LR61 type. It is permissible to use - environment friendly - nickel-metallic-hydride 8.4 V, 150 mAh battery of 6F22 NiMH type and suitable chargers e.g. of the GP Batteries. The comparator is not equipped with batteries chargers (user must buy them). The battery can be replaced easily; the procedure is described in the Operating Manual. The AOUF-1/2 comparator is equipped with a microprocessor electronic system assuring high stability of adjusted signalling voltage and high insensitivity for the supply voltage decreasing (it is no possible to adjust the comparator sensitivity by the user). Occasional switching the comparator on e.g. during transportation will not cause the battery discharge because after 2 minutes the comparator automatically will switch off.

During self-testing and during indicating the phase swirling, the comparator is emitting very well audible and visible acoustic and visual signals.

The AOUF-1/2 acoustic visual phase comparators are denoted by CE mark.

Reference documents:
PN-EN 61481:2004+A/C Live working. Portable phase comparators for alternating voltages from 1 kV to 36 kV.
WTO-1/07 AOUF-1/2 acoustic visual phase comparator.
1. Contact electrode
2. Cylindrical housing
3. Body
4. Rubber sealing
5. Holder
6. Nameplate
7. Red diode
8. Switch
9. Green diode
10. Audible signalling device
11. Plate of battery polarity
12. Battery
DPPE-1 SOUND-OPTICAL AC ELECTRIC FIELD DETECTOR

The DPPE-1 is detector of alternate electrical field which is designed to detect presence of AC electrical field without contact between detector and field source (electrical devices and installations). Indication is sound-optical signal, characteristic of detection is directional. Detectors are designed to work with fields around devices under voltage of 0.23 kV - 400 kV range and frequency of 50Hz/60Hz. Detector operates within the following rated voltage ranges:

- 0.23 kV – 400 kV - DPPE-1
- 1 kV – 30 kV - DPPE-1/A
- 30 kV – 400 kV - DPPE-1/B

Versions of detector vary with sensitivity and destination: DPPE-1 is designed for non-electrical users: it has biggest sensitivity and indicates presence of field from long distance. Detectors DPPE-1/A i DPPE-1/B are designed for energeticists (power electricans). Device can be used indoor and outdoor in temperature range of -25°C to +70°C (-13° to 158°Fahrenheit) and relative humidity from 20 to 96% – N+W climatic category according to PN-EN 61243-1:2007 standard.

Detector is equipped with cylindrical housing made of black colour plastic, fits IP5X standard. It can be carried on hand (watch alike) or –with using additional strap- on helmet.

Detector is powered from two AAA type batteries (LR03 1.5V), which are easy to replace. After battery exchange device tests itself and control level of batteries, what is signalled with a separate signal code: 3 times acoustic and visual signal.

DPPE-1 operates as follows:

After diagnostic self-test detector turns in „stand-by” state, during it waits for presence of electric field. When device is placed in electrical field area were intensity is bigger then threshold, emits acoustic and visual signal. Frequency of signaling increase when intensity of electrical field increase (when device get closer to field source). Characteristic of detection is directional – the best is when detector’s main surface is diverted to field source.

<table>
<thead>
<tr>
<th>Parameters of detector DPPE-1:</th>
<th>Parameters of detector DPPE-1/A:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol: DPPE-1</td>
<td>Symbol: DPPE-1/A</td>
</tr>
<tr>
<td>Weight: 0.1 kg</td>
<td>Weight: 0.1 kg</td>
</tr>
<tr>
<td>Threshold of electric field intensity: 400 V/m</td>
<td>Threshold of electric field intensity: 3 kV/m</td>
</tr>
<tr>
<td>Range: 0.23 kV – 400 kV</td>
<td>Range: 1 kV – 30 kV</td>
</tr>
<tr>
<td>Frequency 50 Hz, 60 Hz</td>
<td>Frequency 50 Hz, 60 Hz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters of detector DPPE-1/B:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol: DPPE-1/B</td>
</tr>
<tr>
<td>Weight: 0.1 kg</td>
</tr>
<tr>
<td>Threshold of electric field intensity: 25 kV/m</td>
</tr>
<tr>
<td>Range: 30 kV – 400 kV</td>
</tr>
<tr>
<td>Frequency 50 Hz, 60 Hz</td>
</tr>
<tr>
<td>IP Code Symbol: IP5X</td>
</tr>
</tbody>
</table>
Detectors DPPE-1, DPPE-1/A and DPPE-1/B have CE mark.

Reference documents:
- PN-EN 61243-1:2007: Live working. Voltage detectors. Capacitive type to be used for voltages exceeding 1 kV a.c.
- WTO 2/09: DPPE-1 AC electric field detector.

A.C. ELECTRICAL FIELD DETECTOR DPPE-1

1. Housing – with signalling diode. During the work upper surface is most sensitive to electric field source. In order to battery exchange twist off this part;
2. Base;
3. O-ring;
4. Mounting stripe (on wrist); in helmet mounting case one should add extension stripe (it’s with device)

MOUNTING DPPE-1 ON HELMET

1. Detector
2. Extension stripe
3. Additional strings for reliable mount to the helmet
LOW VOLTAGE DETECTOR EAZYVOLT+

The EAZYVOLT+ is a digital diode type acoustic-visual low-voltage AC/DC current detector, circuit continuity detector and phase swirl direction detector (two-conductor’s method); it’s provided with LCD display. It has a few additional features mentioned below:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>12 - 750 V AC/DC</td>
</tr>
<tr>
<td>LCD resolution</td>
<td>1 V</td>
</tr>
<tr>
<td>Frequency range</td>
<td>1 - 999 Hz</td>
</tr>
<tr>
<td>Resistance measurement</td>
<td>yes</td>
</tr>
<tr>
<td>Polarization</td>
<td>yes</td>
</tr>
<tr>
<td>Continuity test</td>
<td>yes</td>
</tr>
<tr>
<td>Phase rotation</td>
<td>yes</td>
</tr>
<tr>
<td>Phase test</td>
<td>yes</td>
</tr>
<tr>
<td>RCD test</td>
<td>yes</td>
</tr>
<tr>
<td>Backlight</td>
<td>yes</td>
</tr>
<tr>
<td>Voltage detection without battery</td>
<td>yes</td>
</tr>
<tr>
<td>IP protection</td>
<td>IP65</td>
</tr>
<tr>
<td>Range of use</td>
<td>-15°C ÷ +45°C</td>
</tr>
<tr>
<td></td>
<td>20% ÷ 95% RH</td>
</tr>
<tr>
<td>Battery supply</td>
<td>2x AAA / LR3</td>
</tr>
<tr>
<td>Dimensions</td>
<td>239 x 68 x 29 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>235 g</td>
</tr>
</tbody>
</table>

Reference documents:
PN-EN 61010-1:2011 Safety requirements concerning the electrical measuring instruments for automatics and laboratory devices. General requirements.

The C.A. 760N is a digital diode type acoustic-visual low-voltage AC/DC current detector, circuit continuity detector and phase swirl direction detector (two-conductor’s method). The C.A. 760N includes:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>12 - 690 V AC 12 – 750 V DC</td>
</tr>
<tr>
<td>Frequency range</td>
<td>DC, 16 2/3 - 800 Hz</td>
</tr>
<tr>
<td>Input impedance</td>
<td>&gt;400kΩ</td>
</tr>
<tr>
<td>Polarization</td>
<td>yes</td>
</tr>
<tr>
<td>Continuity test</td>
<td>yes</td>
</tr>
<tr>
<td>Phase rotation</td>
<td>yes</td>
</tr>
<tr>
<td>IP protection</td>
<td>IP65</td>
</tr>
<tr>
<td>Climax</td>
<td>-15°C ÷ +45°C</td>
</tr>
<tr>
<td></td>
<td>20% ÷ 95% RH</td>
</tr>
<tr>
<td>Battery supply</td>
<td>2x AAA / LR3</td>
</tr>
<tr>
<td>Est. quantity of tests on one</td>
<td>~7000</td>
</tr>
<tr>
<td>battery cycle</td>
<td></td>
</tr>
<tr>
<td>dimension</td>
<td>163 x 64 x 40 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>210 g</td>
</tr>
</tbody>
</table>

LOW VOLTAGE DETECTOR C.A. 762

Description

1. Disconnectable test points: Ø 2mm
2. Guard – protection against skid. There is a guard on the circumference to protect the operator against occasional contact with a non-isolated conductor.
3. Auto-test pushbutton / test of the 30 mA differential disconnectors switch off.
4. Phase swirl direction pushbutton.
5. Diode set for danger voltages 50V up to 690V low voltages 12V up to 24V of continuity (green) and the polarity indicator.
6. Diode set for low voltages 12V up to 24V.
7. Diode phase swirl direction clockwise.
8. Diode phase swirl direction counterclockwise.

Reference documents:
PN-EN 61010-1:1999 Safety requirements concerning the electrical measuring instruments for automatics and laboratory devices. General requirements.

The WDS diode voltage detector for bus-bars is designed for detection high voltage presence of alternating current (a.c.) in the bus-bars of substations and internal switching stations. There are three types of the detectors depending on the range of rated current in bus-bars of substations or internal switching stations:

<table>
<thead>
<tr>
<th>Type of voltage detector</th>
<th>Range of AC [kV]</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDS-1</td>
<td>6 – 15</td>
</tr>
<tr>
<td>WDS-2</td>
<td>15 – 45</td>
</tr>
<tr>
<td>WDS-3</td>
<td>45 – 110</td>
</tr>
</tbody>
</table>

The WDS voltage detector has housing made of plastic. The housing together with an electronic system is fastened to a metal base with rivets. The base is fastened on the bus-bars of a switching station or substation and makes it possible to mount the detector in required position (rotation round the base axle and angle of inclination about 20°). There are two plastic bands enclosed to the detector - they may be used for fastening the detector to the bus-bars. The LED diodes of the electronic system signal presence of high voltage by flashing. The electronic system assures stability of the detector’s parameters and clear indication of high voltage presence.

A unit package includes a protective cover made of coated waterproof fabric.

Reference documents:
- PN-EN 61243-1:1998 Live working. Capacitance indicators for voltages higher than 1 kV.
- PN-92/E-04060 High voltage test techniques. General definitions and test requirements.
- WTO-9/01 WDS diode voltage detector for bus-bars.

The WDS diode voltage detector for bus-bars is designed for detection high voltage presence of alternating current (a.c.) in the bus-bars of substations and internal switching stations. There are three types of the detectors depending on the range of rated current in bus-bars of substations or internal switching stations:
VisiVolt™ Passive Voltage Indicator

VisiVolt™ Passive Voltage Indicator is designed for permanent installation on conductors of indoor and outdoor medium-voltage systems. A large sign appearing on the VisiVolt™ indicator display indicates status of voltage presence. Device operates within the following rated voltages 3 kV – 36 kV in two ranges; VV-A version operates between 3 kV and 13.5 kV; VV-B version operates between 13.5 kV and 36 kV. It’s no need to proceed periodical tests.

<table>
<thead>
<tr>
<th>VisiVolt™ type</th>
<th>VV-A</th>
<th>VV-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal voltage ( U_N )</td>
<td>kV</td>
<td>3.0 – 13.5 (^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.0 – 13.5 (^2)</td>
</tr>
<tr>
<td>Rated voltage, max,</td>
<td>kV</td>
<td>3.6 – 17.5 (^3)</td>
</tr>
<tr>
<td>Threshold voltage ( (p-g \ &amp; p-p) ) (^4,\ 5)</td>
<td></td>
<td>&gt; 0.6 kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 45% ( U_N )</td>
</tr>
<tr>
<td>1-phase system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal voltage ( U_N ) ( p-g )</td>
<td>kV</td>
<td>3.5 – 6.0</td>
</tr>
<tr>
<td>Threshold ( (p-g) )</td>
<td>(^4)</td>
<td>&gt; 1.0 kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 78% ( U_N )</td>
</tr>
<tr>
<td>Nominal frequency</td>
<td>Hz</td>
<td>50 – 60</td>
</tr>
<tr>
<td>Response time</td>
<td>s</td>
<td>&lt; 1 at temperature – 20°C and above</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 10 at temperature – 40°C</td>
</tr>
<tr>
<td>Short-time withstand current (1s) (^6)</td>
<td>kA</td>
<td></td>
</tr>
<tr>
<td>Peak withstand current (1s) (^6)</td>
<td>kA</td>
<td></td>
</tr>
<tr>
<td>Operation temperature range</td>
<td>°C</td>
<td>od – 40°C do +85°C</td>
</tr>
<tr>
<td>Physical dimensions</td>
<td>mm</td>
<td>H:92 x W:63 x D:38</td>
</tr>
<tr>
<td>Net weight</td>
<td>g</td>
<td>109</td>
</tr>
</tbody>
</table>

1) On not insulated (bare) circular-section conductors and on bars of width up to 30 mm
2) On insulated conductors (insulation thickness to 3 mm) and bars wider then 30 mm
3) Depending on stick distance (see recommended minimum clearances)
4) \( p-g \) voltage = phase-ground voltage; \( p-p \) voltage = phase-phase voltage
5) For stick distance ranges within limits given in installation and operation instructions
6) Rated withstand currents given are valid to VisiVolt™ indicators only and do not supersede the specifications of the system the indicators are installed on.

Indicator has manual and straps for mounting on the bars.

**Distribution and service:** Wytwórnia Sprzętu Elektroenergetycznego AKTYWIZACJA Sp. Pracy.
WTNS-2 TRACTION VOLTAGE DETECTOR

The WTNS-2 traction voltage detector is designed for signalling the presence or absence of direct voltage in d.c. networks, particularly in railway and tram traction in the range from 0.2 kV up to 4 kV. The device is bipolar – works with positive and negative voltages. Detector works in conjunction with TDO-4-B, TDI-B and TDI/I-B or UDI-B insulating stick filled with polyurethane foam with rated voltage not less than 10 kV. It consists of the two parts:
- resistance part, equipped with the contact pin fastened in the stick head,
- measuring part, equipped with digital display and magnetic earth clamp.
They are connected to each other with wire with silicone insulation.
The detector is designed for internal and external usage in the range of the temperatures from –25°C up to +75°C and relative humidity from 20% up to 96% - it complies with N+Ws climatic category according to PN-EN 61243-1:2007.
The detector is powered with an alkaline 9V battery of 6LR61 type. It is permissible to use - environment friendly - nickel-metallic-hydrogen 8.4 V, 150-mAh battery of 6F22 NiMH type and suitable chargers e.g. of the GP Batteries. The detector is not equipped with batteries and chargers (the user must buy them). The battery can be replaced easily; the procedure is described in the Operating Manual for the WTNS-2 detector.
During self-testing and during indicating the voltage presence, the WTNS-2 detector emits very well audible signal and visible signal on its display. Connection the contact electrode of the detector resistance part to a traction conductor enables to discharge the conductor capacity and to get proper information about existence or absence the voltage, and digital display (in the measuring part) enables to determine an approximately value of the traction conductor voltage.
After switching on the detector (by connection of electrode to magnetic earth clamp) self-testing process automatically starts up (it tests electronic circuit and continuity of wire). It is signalled by the number “8.8.8.8.” on the display and short modulated acoustic signal. After that, the detector passes into the “stand-by” state; the number “0.00” on the display and intermittent acoustic signal indicate it.
During indication, the detector displays the voltage value and emits continuous modulated acoustic signal. Discharging the battery is signalled by the letters “bA” on the display and after that - if the battery is exhausted - the detector is switched off. If the detector measuring range has been exceeded, the display shows “−−−−”. The detector switching off takes place after 3 sec. pressing the switch or it switches off itself when you wait approximately 2 min.
Device can be used when there is no possibility to connect to ground the measuring part (a.e. there’s no rail), in this case in order to operate measuring part UDI-B stick with special adaptor DWNP-1 should be used

Reference documents:
WTO-6/09     WTNS-2 traction voltage detector.
PN-EN 61243-1:2007  Live working. Voltage detectors. Capacitive type to be used for voltages exceeding 1 kV A.C.
PN-92/E-04060  High-voltage test techniques. General definitions and test requirements.
EN 61557-1:2007  Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. Equipment for testing, measuring or monitoring of protective measures. General requirements.
WTNS-2 TRACTION VOLTAGE DETECTOR

1. Resistance part with contact electrode and the UDI terminal
2. Measuring part with digital display
3. Contact electrode
4. Conductor connecting the resistance and measuring parts
5. Cover of wire
6. Holder
7. Battery
8. Name plate

9. DWNP-1-adapter
10. Holder
11. Contact electrode

DWNP-1-adapter for WTNS-2 indicator (optional)
DWNP-1 TWO STICK A.C. VOLTAGE DETECTOR WITH PHASE COMPARATION FUNCTION

DWNP-1 two stick A.C. voltage detector is designed for checking presence of voltage in range 10V - 1000V; it has LED display and indicates level of voltage with 5V step. Detector works in conjunction with TDO-4-B, TDI and TDI/I or UDI-B; device consist of two parts:

- resistance part, equipped with the contact pin fastened in the stick head,
- measuring part, equipped with digital display and magnetic earth clamp, connected with a wire with silicon insulation.

The detector is designed for internal and external usage in the range of the temperatures from –25°C up to +75°C and relative humidity from 20% up to 96% - it complies with N+W climatic category according to EN 61243-3:2002. The detector is powered with an alkaline 9V battery of 6LR61 type. It is permissible to use - environment friendly - nickel-metallic-hydrogen 8.4 V, 150-mAh battery of 6F22 NiMH type and suitable chargers e.g. of the GP Batteries. The detector is not equipped with batteries and chargers (the user must buy them). The battery can be replaced easily (drawing below).

The detector is equipped with a microprocessor electronic system assuring high stability of adjusted signalling voltage (there is no possibility to adjust the sensitivity of the detector by the user) and it is resistant to short-lived increase of supply voltage.

During self-testing and during indicating the voltage presence, the DWNP-1 detector emits very well audible signal and visible signal on its display. After switching on detector (by short-circuiting electrodes of two parts) self-testing process automatically starts up (test of electronic circuit and continuity of wire); it is signalled by the number "8888" on the display (by about 2 sec.) and short modulated acoustic signal. After that, the detector passes into the “stand-by” state; the number “0” on the display and intermittent acoustic signal indicate it. During indication, the detector displays the voltage value and emits continuous modulated acoustic signal. Discharging the battery is signalled by the letters “bA” on the display and after that - if the battery is exhausted - the detector is switched off.

If the detector measuring range has been exceeded, the display shows “−−−−”.

The detector switching off takes place after 3 sec. pressing the switch or it switches off itself when you wait approximately 2 min. As an option there is a possibility to buy an adapter, which enables fasten of the measuring part in the UDI stick head, in this configuration device can be use as a two stick phase detector.

DWNP-1 detector is marked with CE.

Reference documents:

WTO-7/09 DWNP-1 two stick A.C. voltage detector.
PN-EN 61243-1:2007 Live working. Voltage detectors. Capacitive type to be used for voltages exceeding 1 kV A.C.
PN-92/E-04060 High-voltage test techniques. General definitions and test requirements.
PN-EN 61557-1: 2007 Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. Equipment for testing, measuring or monitoring of protective measures. General requirements.
DWNP-1 TWO STICK A.C. VOLTAGE DETECTOR

1. Resistance part with contact electrode and the UDI terminal.
2. Measuring part with digital display.
3. DWNP-1 contact hook.
4. Additional contact pin.
5. Conductor connecting the resistance and measuring parts.
6. Adapter DWNP-1 (optional).
7. Handle fastened in UDI head.
8. Adapter’s contact pin.

10. Plate of battery polarity.

Battery replacement
LOW VOLTAGE TESTER VT-2

Megger VT-2 is a single-stick voltage tester of alternating current which enables safe and easy checking a voltage presence in circuits and electrical arrangements. VT-2 voltage tester is an acustic-visual LED indicator equipped with internal operation test arrangement supplied with 2x AAA 1.5 V battery.

Specification:

<table>
<thead>
<tr>
<th>The voltage range</th>
<th>90 V to 1000 V AC 50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>177 mm x 27 mm</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-5ºC do +40ºC</td>
</tr>
<tr>
<td>Weight</td>
<td>100 g</td>
</tr>
<tr>
<td>battery</td>
<td>2x AAA</td>
</tr>
<tr>
<td>Category</td>
<td>Cat. III 1000 V</td>
</tr>
<tr>
<td>IP protection</td>
<td>IP54</td>
</tr>
<tr>
<td>LED light</td>
<td></td>
</tr>
</tbody>
</table>

VT-2 tester is marked with CE.

Reference documents:

IEC 61010-1 Electrical equipment for measurement, control, and laboratory use
The CHM ultrasonic height meter is designed to measurement power network conductor’s hanging in three-conductors configuration of the CHM300 type or six-conductors configuration of the CHM600 type. It works on principle of measurement the deceleration time between the moments of wave dispatching and reflection from a measured object. Maximum conductors hanging height is 23 m (for E model). To compensate environment temperature influence on propagation speed of waves, the instrument has been equipped with temperature sensor. It enables to automatically compensate temperature influence. The ultrasonic meter is equipped with a cover made of leather which protects it against mechanical damages.

<table>
<thead>
<tr>
<th>Type</th>
<th>300</th>
<th>300E</th>
<th>600</th>
<th>600E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout</td>
<td>LCD</td>
<td>LCD</td>
<td>LCD</td>
<td>LCD</td>
</tr>
<tr>
<td>Measuring range (min conductors’ diameter 25 mm)</td>
<td>3 m - 15 m</td>
<td>3 m - 23 m</td>
<td>3 m - 15 m</td>
<td>3 m - 23 m</td>
</tr>
<tr>
<td>Measuring range (min conductors’ diameter 12 mm)</td>
<td>3 m - 15 m</td>
<td>3 m - 15 m</td>
<td>3 m - 15 m</td>
<td>3 m - 15 m</td>
</tr>
<tr>
<td>Measuring range (min conductors’ diameter 5,5 mm)</td>
<td>3 m - 12 m</td>
<td>-</td>
<td>3 m - 12 m</td>
<td>-</td>
</tr>
<tr>
<td>Measuring range (min conductors’ diameter 2,5 mm)</td>
<td>3 m - 10 m</td>
<td>-</td>
<td>3 m - 10 m</td>
<td>-</td>
</tr>
<tr>
<td>Measuring accuracy</td>
<td>0,5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution (range &lt; 10 m)</td>
<td>5 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution (range &lt; 10 m)</td>
<td>10 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum distance between conductors</td>
<td>150 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work temperature</td>
<td>-10 °C to +40 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work time of batteries (Long Life)</td>
<td>50 000 measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring units</td>
<td>meters or inches or feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic switch off</td>
<td>after 3 minutes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions (height x width x depth)</td>
<td>205 mm x 100 mm x 70 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>0,5 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Warranty: 12 months since the date of sale.

The CHM ultrasonic height meters are denoted by CE mark

Thermal Imaging Camera

The device detects excessive temperature deviation by thermovision. The device in the simplest version is slightly more expensive than the pyrometer, offering an extensive range of features: it has an 80x60 dot matrix resolution, 2 inch LCD screen, micro SD memory card slot, micro USB port for communication and Li-Ion battery charging, JPG with parameters, ergonomic and durable housing, intuitive interface.

It is an ideal tool for solving problems in electrical installations, mechanical components, thermal tests of buildings, industrial equipment, heating and air conditioning networks and safe, remote inspections of high voltage installations.
U PORTABLE EARTHING DEVICE

The U Portable earthing device protects the workplace at line and station electrical equipment, equipped with round conductors or flat bus-bars disconnected from the power source through the connection to the earth clamp. Depending on the number of line clamps, one-, two-, three-, four- or five-clamp earthing devices are manufactured and they are denoted adequately U1, U2, U3, U4, U5; the clamps can be connected in serial or in parallel. Types U1, U2, U3 are manufactured for all values of the short circuit currents \( I_{r1} \) for time of duration of short circuit \( t_r = 1 \) s, specified in table I. Types U4 and U5 are manufactured for max current \( I_{r1} = 9 \) kA and time \( t_r = 1 \) s.

The primary model of portable earthing device bases on WR-2z earth clamp as well as line clamps:
- for round conductors WT-2, WT-2/B (for the diameter up to 29mm), or WT-3, WT-3/A, WT-3/B (for the diameters up to 42 mm),
- for flat bus-bars WT-P, WT-P/A,
- for flat bus-bars and round conductors WT-2/A, WT-2/B.

The WT-2 clamp depending on the version can be used for round conductors, flat bus-bars or as an universal one. The versions differ with kind of clamping. WT-2/B clamps for flat bus-bars makes possible fastening at the angle of 45° (WT-P can be fastened at the angle of 90°). The WT-2/B clamps are designed in such a way to be snapped in the head of insulating stick for installing the earthing device. In this configuration it can be used both for round conductors and for flat bus-bars, if the user is equipped with the same number of sticks as line clamps of the earthing device. The clamps above are designed for rated current \( I_{r1} \) up to 31.5 kA for the time \( t_r = 1 \) s. There is a possibility to order one phase device with rated current \( I_r=45\text{kA} \) for rated time 0.25s. On request other clamps (a.e. WR-8) may be used. For parallel version, with two-, three-, four- and five clamps there is a middle connector which connects the short-circuiting conductors with the earth conductor. For serial version, short-circuiting conductors are fastened directly on clamps. The middle connector is resistant to moisture penetration in the conductor’s area and assures electrical insulation of the connected conductors from external influences. It makes possible to join any configurations of the earthing device, including the light one. Such solution is reliable and stable and also protects the user against occasional contact with live parts during servicing. The middle connector minimises dangers for user’s life during exploitation of the earthing device and during short-circuit keeps heat emission to a minimum. Device can work in the range of temperatures between \(-25^\circ\text{C} \) and \(+55^\circ\text{C} \) in case when PVC insulation of wire is used or between \(-40^\circ\text{C} \) and \(+70^\circ\text{C} \) when wire has silicone insulation. Clamps are made of aluminium alloy or brass. The screw terminated with a knob allows controlling the jaw’s pressure. The pressure of the jaws equals approximately 1 kN (WT-2). The spring in the line clamps provides constant pressure and prevents against loosening. Line and earth clamps are connected to one another by means of a copper link coated with a flexible transparent plastic cover. Deflection elements protect the link (in the place of fastening) against damage and against moisture penetration. Installation and fastening of the WT-2 and WT-3 line clamps on round conductors is made by means of an appropriate insulating stick for earthing devices installation DU-A (or UDI-B) with the ZU manipulating catch fastened in the head.

The WT-3A clamp with two knobs is designed for installation by means of an insulating stick and the ZU manipulating catch on round conductors situated both above and below the lineman (e.g. from the shelf of stick). The WT-3/B clamp is designed to snap in the head of an insulating stick (the insulating stick must be mounted) and for installation on round conductors. The installation and fastening of the WT-P and WT-2/A line clamps on flat bus-bars is carried out by means of the insulating sticks. The WT-P/A clamp on flat bus-bars is designed to be snapped into the head of insulating stick (the insulating stick must be mounted). For the rated current \( I_{r1} \) and rated time \( t_r = 1 \) s conductors of the earth device have the cross sections according to table I & II.
### Table I

<table>
<thead>
<tr>
<th>Type of earthing device</th>
<th>All types</th>
<th>U1, U2, U3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (I_r) [kA] for rated time (t_r = 1) [s]</td>
<td>4</td>
<td>6.5</td>
</tr>
<tr>
<td>Peak current (I_m) [kA]</td>
<td>10</td>
<td>16.2</td>
</tr>
<tr>
<td>Joule’s integral ([A^2s])</td>
<td>16</td>
<td>42</td>
</tr>
<tr>
<td>Cross section of conductor [mm(^2)]</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

### Table II – special version for high current

<table>
<thead>
<tr>
<th>Type of earthing device</th>
<th>U1-P with silicone insulation with WT-P clamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (I_r) [kA]</td>
<td>31.5</td>
</tr>
<tr>
<td>Rated time (t_r) [s]</td>
<td>1</td>
</tr>
<tr>
<td>Peak current (I_m) [kA]</td>
<td>78.7</td>
</tr>
<tr>
<td>Joule’s integral ([A^2s])</td>
<td>992</td>
</tr>
<tr>
<td>Cross section of conductor [mm(^2)]</td>
<td>150</td>
</tr>
</tbody>
</table>

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 Standard, is shown in the diagram I.

### Diagram I

Permissible short-circuiting current \(I_r\) as a function of short-circuiting time \(t_r\) for different sections of the earth conductors.

ATTENTION:

In the range of times \(t_r\):  
- \(1\) s ÷ \(3\) s – guaranteed calculated current  
- \(0.1\) s ÷ \(1\) s – calculated current, after checking the electrodynamic resistance of the earthing device (special option)

ATTENTION:

Special version of one-phase portable earthing device with WT-P line clamp and WR-2z earth clamp with 150mm\(^2\) insulated silicone wire can be used for rated short-circuit currents of up to 45kA / 0.25s.
The multi-clamp earthing devices with different $L$ and $L_1$ lengths may be provided in the range from 0.1 m up to 24 m graded every 0.2 m.

It’s possible to use light earthing devices, whose earth conductor has a smaller cross section than the sections of the short-circuiting conductors, but they can be used only in not solidly earthed networks. Appropriate choice of minimal earth conductor sections depending on the short-circuiting conductors can be done according to table III (it is permissible to use bigger sections of the earth conductors than minimal).

<table>
<thead>
<tr>
<th>Section of short-circuiting conductor $S_1$ [mm$^2$]</th>
<th>Cross section of earth conductor $S$ [mm$^2$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>16</td>
</tr>
<tr>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>95</td>
<td>35</td>
</tr>
<tr>
<td>120</td>
<td>50</td>
</tr>
<tr>
<td>150</td>
<td>50</td>
</tr>
</tbody>
</table>

**ATTENTION:** The cross section $S$ of the earth conductor given in table III is the minimal section. It is permissible to manufacture the light earthing devices with larger cross section $S$ of the earth conductor.

A unit package makes a protective cover made of coated waterproof fabric.

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**DENOTATION OF VERSIONS OF THE U EARTHING DEVICES**

**I. U1 SINGLE-CLAMP PORTABLE EARTHING DEVICE**

**U1–A–L–I/t-S-(C)**

where:

- **A** denotation of kind of the line clamp
- **O-WT-2** WT-2 line clamp for round conductor up to 31.5 kA
- **O-WT-3** WT-3 line clamp for round conductor up to 31.5 kA
- **O-WT-3/A** WT-3/A line clamp for round conductor up to 31.5 kA
- **O-WT-3/B** WT-3/B line clamp for round conductor up to 31.5 kA
- **P** WT-P line clamp for flat bus-bar up to 25 kA
- **P/A** WT-P/A line clamp for flat bus-bar up to 25 kA
- **P-WT-2/A** WT-2/A line clamp for flat bus-bar and round conductor up to 31.5 kA
- **WT-2/B** WT-2/B line clamp for flat bus-bar and round conductor up to 31.5 kA
- **L** length $L = 0.1 – 24$ m of the earth conductor (recommended standardised lengths of conductors as per table II)
- **I** rated current $I_{t1}$ [kA] for rated time $t = 1$ [s] of the earth conductor (as per table I)
- **t** rated short circuit time $t_r$
- **S** section of the earthing device conductors [mm$^2$] (as per table I)
- **C** denotation of kind of the earth clamp (WR-2z, WR-6, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.
Examples of denotation:

1. Portable, single-clamp earthing device for round conductors and flat-bus bar (WT-2 clamp) with earth conductor L = 16 m long and rated current I_{r1} = 25 kA, made of copper line with section 120 mm^2 with WR-2z earth clamp:

\[ U1-O-WT-2-16-25-120-(WR-2z) \]

2. Portable, single-clamp earthing device for round conductors (WT-3 clamp) with earth conductor L = 8 m long and rated current I_{r1} = 31.5 kA, made of copper line with section 150 mm^2 with silicone insulation, WR-2z earth clamp:

\[ U1-O-WT-3-8-31.5-150-(WR-2z)-(SI) \]

II. U2-U5 PORTABLE MULTI-CLAMP EARTHING DEVICE

UX-A-L/L_{1}-I/t-S-(B)(C)

where:

X number of line clamps: 2, 3, 4 or 5
A type of line clamp (the same as for single-clamp earthing devices)
L length of earth conductor L = 0.1 – 24 m (recommended standardised lengths of conductors as per table II)
L_{1} length of the short-circuiting conductor L = 0.1 – 24 m (recommended standardised lengths of conductors as per table II)
I rated current I_{r1} [kA] at time t_{r} = 1 [s] of the short circuiting conductors and the earth conductor (as per table I)
t rated short circuit time t_{r}
S sections [mm^2] of the short-circuiting and earth conductors of the earth device (as per table I)
B connection method of multi-clamps earthing device conductors:
- I earthing device with insulated middle connector
- S serial connected earthing device
C denotation of kind of the earth clamp (WR-2z, WR-6, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:

1. Portable, five-clamp earthing device for round conductors or flat bus-bars (WT-2/B clamp) with earth conductor L=5 m long, short circuiting conductors L_{1}=1.6 m long and rated current I_{r1} = 6.5 kA, made of copper line with section 25 mm^2, insulated middle connector with WR-2z earth clamp:

\[ U5-WT-2/5/1.6-6.5/1-25-(I)(WR-2z) \]

2. Portable, three-clamp earthing device for round conductors (WT-3/A clamp) with earth conductor L=3 m long, short circuiting conductors L_{1}=1 m long and rated current I_{r1} = 31.5 kA, made of copper line with section 150 mm^2 and serial clamp connection with WR-7 earth clamp:

\[ U3-O-WT-3/3/1-31.5-150-(S)(WR-7) \]

3. Portable, three-clamp earthing device for flat bus-bars (WT-P clamp) with earth conductor L=5 m long, short circuiting conductors L_{1}=3 m long and rated current I_{r1} = 25 kA, made of copper line with section 120 mm^2 with silicone insulation, insulated middle connector with WR-2z earth clamp:

\[ U3-P-5/3-25/1-120-(I)(WR-2z)-(SI) \]
III. U2-U5 PORTABLE LIGHT MULTI-CLAMP EARTHING DEVICE

UXL-A-L_1-I/t-S/I_1/t-S_1-(B)(C)

where:

UXL  denotation of the light portable earthing device with the number of line clamps: $X = 2, 3, 4$ or $5$

A  type of line clamps (the same as for single-clamp earthing device)

L  length of the earth conductor $L = 0.1 - 24$ m (recommended standardised lengths of conductors as per table II)

$L_1$  length of the short-circuiting conductor $L = 0.1 - 24$ m (recommended standardised lengths of conductors as per table II)

I  rated current $I_{r1}$ [kA] for rated time $t_r=1$ [s] of the earth conductor (as per table I)

t  rated short circuit time $t_r$

S  section of the earth conductor [mm$^2$] (as per table I)

$I_{r1}$  rated current [kA] for rated time $t_r=1$ [s] of the short-circuiting conductor (as per table I)

$S_1$  section of the short-circuiting conductor [mm$^2$] (as per table I)

B  connection method of multi-clamps earthing device conductors:

- I - earthing device with insulated middle connector
- S - serial connected earthing device

C  denotation of kind of the earth clamp (WR-2z, WR-6, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Minimum section $S$ of the earth conductor for appropriate section $S_1$ of the short-circuiting conductor shall not be smaller than that given in table III.

Above denotation applies to the parallel clamp connection. While ordering version with clamps in the serial connection, the word serial must be added after the earthing device denotation. The U3 light earthing devices are not manufactured with cross type middle connector.

Example of denotation:

Portable, four clamp, light earthing device for round conductors (WT-3 clamp) with earth conductor $L=3$ m long and rated current $I_{r1}=6.5$ kA, made of copper line with cross section $25$ mm$^2$, short circuiting conductors $L_1=2$ m long and rated current $I_{r1}=9$ kA, made of copper line with cross section $35$ mm$^2$, with WR-2z earth clamp:

U4L-O-WT-3-3/2-6.5/1-25/9/1-35-(I)(WR-2z)

While ordering the earthing device with clamps in different version than standard one should remember to denote its version in the denotation of the earthing device.

Reference documents:
EN 61230:2008  Live working. Portable earthing or earthing and short-circuiting equipment.
EN 61138:2007  Conductors designed for portable earthing and short-circuiting equipment.
WTO-10/01   U portable earthing device.
CLAMPS OF U PORTABLE EARTHING DEVICE

WT-P Line clamp
(for flat bus bars)
standard version

WT-P/A Line clamp
(for installation in the
snap of UDI insulating
stick head)

WR-7 Earth clamp

WR-K25 Earth clamp
(for flat bus bars, round
conductors and ball-type terminal)
CLAMPS OF U PORTABLE EARTHING DEVICE

WT-2 line clamp
for round conductors with diameters up to 30mm (cross-section up to 300mm$^2$)

WT-2/A Line clamp
(for flat bus-bars and round conductors, for installation in the head of UDI stick)
„A” version

WT-2/B Line clamp
(for flat bus-bars and round conductors, for installation in the head of UDI stick).
„B” version
WT-3 Line clamp
for round conductors with diameter up to 42 mm (cross-section up to 840 mm$^2$)
Standard version

WT-3/A Line clamp (suitable for installation on conductor situated under workplace of the wireman).
"A" version

WT-3/B Line clamp
(for installation in the snap of UDI insulating stick’s head
“B” version

WR-2z Earth clamp
**Z PORTABLE SHORT-CIRCUITING DEVICE**

The Z portable earthing devices are designed for fast, easy and reliable short-circuiting the line conductors of power networks and indoor and outdoor electrical equipment of low, medium and high voltage, for different one second rated currents \( I_{r1} \) up to 31.5 kA. They should be used in the situations when service staff is not sure as far as the properties of the existing earthing equipment is concerned and there is no possibility to use the P earthing device extension. It can work in the range of temperatures between \(-25^\circ C\) and \(+55^\circ C\) in case when PVC insulation of wire is used or between \(-40^\circ C\) and \(+70^\circ C\) when wire has silicone insulation. Depending on the number of line clamps, two-, three-, four- and five-clamp short-circuiting devices are manufactured and they are denoted adequately Z2, Z3, Z4 and Z5. The clamps are connected in series. Short-circuiting conductors are fastened directly to the clamps. The types Z2 and Z3 are manufactured for all values of the short circuit currents \( I_{r1} \) - specified in the table I - for short circuit duration time \( t_r = 1 \) s. The types Z4 and Z5 are manufactured for max current \( I_{r1} = 9 \) kA for the time \( t_r = 1 \) s.

Short-circuiting devices are manufactured with the following line clamps:
- WT-2, WT-2/B for round cables (for diameters up to 29 mm) or WT-3, WT-3/A WT-3/B (for diameters up to 42 mm),
- WT-P, WT-P/A or WT-2/A, WT-2/B for flat bus-bars.

The WT-2 clamp – depending on version - can be used for round cables (basic version), for flat bus-bars or as universal. This clamp can be used for earthed round cables up to diameter of 29 mm. When clamping flat-bus bars, the WT-2/A makes fastening possible at the angle of 45° (the WT-P used up to now can be fastened at the angle of 90°). The WT-2/B clamps are designed to be snapped in the UDI-B insulating stick head. In this configuration it can be used both for round cables and for flat bus-bars, if the user is equipped with the number of insulating sticks that equals the number of line clamps of the earthing device. The clamps, in all versions, are designed for rated current \( I_{r1} \) up to 31.5 kA for the time \( t_r = 1 \) s. WR-6 clamp can be used up to 13kA for the time \( t_r = 1 \) s and WR-8 clamp can be used up to 18kA for the time \( t_r = 1 \) s. Z portable short-circuiting device is resistant to moisture penetration into the cables connection area.

Clamps are made of aluminium alloy or brass. The screw terminated with a knob allows controlling the jaws’ pressure. The pressure of the jaws equals approximately 1 kN (WT-2 clamp). The spring in the line clamps provides constant pressure and prevents their loosening.

The line clamps are connected to one another by means of a stranded copper conductor with flexible covering made of transparent plastic. Deflection elements with adhesive protect the wire (at the place of fastening) against damage and moisture penetration.

The installation and fastening of the WT-2 and WT-3 line clamps on round conductors is carried out by means of appropriate DU-A (or UDI-B) insulating stick with a ZU manipulating catch fastened in the head.

The WT-3A clamp with two knobs is designed for installation by means of an insulating stick and the ZU manipulating catch on round conductors situated both above and below of the lineman (e.g. from the stick’s shelf).

The WT-3/B clamp is designed to snap in the head of an insulating stick (the insulating stick must be mounted) and for installation on round conductors.

The installation and fastening of the WT-P and WT-2/A line clamps on flat bus-bars is carried out by means of the insulating sticks. The WT-P/A clamp on flat bus-bars is designed to be snapped in the head of an insulating stick (the insulating stick must be mounted).

For the rated current \( I_{r1} \) and rated time \( t_r = 1 \) s conductors of the short-circuiting device have the cross-sections according to table.
### Table

<table>
<thead>
<tr>
<th>Type of short-circuiting device</th>
<th>All types</th>
<th>Z2 &amp; Z3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ for rated time [kA/s]</td>
<td>4 6.5 9</td>
<td>13 18.5 25 31.5</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10 16.2 22.5</td>
<td>32.5 46.2 62.5 78.7</td>
</tr>
<tr>
<td>Joule’s integral $[A^2s]$</td>
<td>16 42 81</td>
<td>169 342 625 992</td>
</tr>
<tr>
<td>Cross section of conductor $[mm^2]$</td>
<td>16 25 35</td>
<td>50 95 120 150</td>
</tr>
</tbody>
</table>

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 (PN-EN 61230:2011) Standard, is shown in the diagram I.

### Diagram I

Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earth conductors.

**ATTENTION:**

In the range of times $t_r$: 1 s ÷ 3 s - guaranteed calculated current

0.1 s ÷ 1 s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

There are following standard lengths conductors of the short-circuiting device: $L_1 = 1, 2, 3, 4, 5, 8 [m]$.

Following an adequate agreement, the devices with different $L_1$ lengths may be provided in the range from 1 m up to 8 m, graded every 0.2 m.
DENOTATION OF THE U SHORT-CIRCUITING DEVICE VERSIONS

\[ ZX-A-L_1-I/t-S-(B) \]

where:

- **X**  
  number of the line clamps 2, 3, 4 or 5

- **A**  
  denotation of the line clamp kind

  - **O-WT-2**  
    WT-2 line clamp for round conductor up to 31.5 kA
  
  - **O-WT-3**  
    WT-3 line clamp for round conductor up to 31.5 kA
  
  - **O-WT-3/A**  
    WT-3/A line clamp for round conductor up to 31.5 kA
  
  - **O-WT-3/B**  
    WT-3/B line clamp for round conductor up to 31.5 kA
  
  - **P**  
    WT-P line clamp for flat bus-bar up to 25 kA
  
  - **P/A**  
    WT-P/A line clamp for flat bus-bar up to 25 kA
  
  - **P-WT-2/A**  
    WT-2/A line clamp for flat bus-bar and round conductor up to 31.5 kA
  
  - **WT-2/B**  
    WT-2/B line clamp for flat bus-bar and round conductor up to 31.5 kA

- **L_1**  
  length \( L_1 = 0.3 - 24 \) [m] of the short-circuiting conductor (recommended conductors of the standard lengths)

- **I**  
  rated current \( I_{t_1} \) [kA] for rated time \( t_1 = 1 \) [s] of the short-circuiting conductor (as per table)

- **t**  
  rated short-circuiting time (a.g. \( t_1 = 1 \) [s])

- **S**  
  cross-section of the short-circuiting device conductors [mm\(^2\)] (as per table)

- **B**  
  method of wires connection:

  - **S**  
    serial connection

**Examples of denotation:**

1. Portable, **five**-clamp short-circuiting device for **round** conductors or flat bus-bars (**WT-2/B** clamp) with short-circuiting conductor \( L_1 = 1 \) m long and rated current \( I_{t_1} = 6.5 \) kA, made of copper cable with section 25 mm\(^2\):

   \[ Z5-WT-2/B-1-6.5/1-25-(S) \]

2. Portable, **four**-clamp short-circuiting device for **round** conductors (**WT-3/A** clamp) with short-circuiting conductor \( L_1 = 3 \) m long and rated current \( I_{t_1} = 9 \) kA, made of copper cable with section 35 mm\(^2\):

   \[ Z4-O-WT-3/A-3-9/1-35-(S) \]

3. Portable, **three**-clamp short-circuiting device for **flat** bus-bars (**WT-P** clamp) with short-circuiting conductor \( L_1 = 5 \) m long and rated current \( I_{t_1} = 25 \) kA, made of copper cable with section 120 mm\(^2\):

   \[ Z3-P-5-25/1-120-(S) \]

While ordering the short-circuiting device with clamps in different version than standard one should remember to denote its version in the denotation of the short-circuiting device.

A unit package makes a protective cover made of coated waterproof fabric.

Reference documents:

- PN-EN 61230:2011  
  Live working. Portable earthing or earthing and short-circuiting equipment.

- PN-EN 61138:2009  
  Conductors designed for portable earthing and short-circuiting equipment.

- WTO-14/01  
  Z portable short-circuiting device.
Z PORTABLE SHORT-CIRCUITING DEVICE

WT-3 Clamp

WT-2 Clamp

WT-P Clamp
P EARTHING DEVICE EXTENSION

The P earthing device extension is designed for reliable connection of the earthing device with an earthing system not directly accessible in the earthing place of network, overhead and indoor electrical equipment of low, medium and high voltage in the circuits for different rated currents $I_r$. The highest one second rated current can not exceed 31.5 kA. The extension is an element of earthing system and fulfils the requirements of the PN-EN 61230:2011 standard. It is used when servicing personnel is not sure as far as characteristic of the nearest accessible earthing is concerned, and shall use the other (remote) earthing to install earthing device. The earthing device extension can work in the range of the temperatures between $-25^\circ C$ and $+55^\circ C$ in case when PVC insulation of wire is used or between $-40^\circ C$ and $+70^\circ C$ when wire has silicone insulation.

The P earthing extension consists of three main elements: WR-2z earth clamp, conductor made of a copper link and a joint plate.

The WR-2z earth clamp is made of aluminium alloy. Rotation of the screw terminated with a knob causes the clamping or releasing the extension jaws. The pressure of the jaws equals approximately 1 kN. The WR-2z earth clamp can be used for rated current $I_{r1}$ up to 31.5 kA for time $t_r = 1$ s.

The WR-2z earth clamp is connected to a joint plate with copper link conductor coated with flexible coating made of transparent plastic.

The joint plate is made of copper covered with zinc. It makes it possible to join two WR-2z earth clamps. The deflection element protects the wire (in the place of fastening) against damage and moisture penetration so that the earthing extension cable is resistant to moisture penetration.

For the rated current $I_{r1}$ and rated time $t_r = 1$ s the earthing device extension conductor has the cross sections according to table.

<table>
<thead>
<tr>
<th>Type of extension</th>
<th>All types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ for rated time [kA/s]</td>
<td>4</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [MA²s]</td>
<td>16</td>
</tr>
<tr>
<td>Cross section of conductor [mm²]</td>
<td>16</td>
</tr>
</tbody>
</table>

Maximum length of earthing device extension is $L=24$ [m], graded every 0.2 m.

A unit package makes a protective bag made of coated waterproof fabric.

**DENOTATION OF THE P EARTHING EXTENSION**

$P-L-I/t-S-(C)$

where:

- **P** denotation of the extension
- **L** the extension conductor length $L = 8$ [m]
- **I** rated current $I_{r1}$ [kA]
- **t** rated time [s] (as per table)
- **S** cross-section of the extension conductor [mm²] (as per table)
- **C** denotation of the earth clamp
In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:
1. Earthing device extension with conductor \( L = 8 \) m long and rated current \( I_{11} = 9 \) kA, made of copper cable with section \( 35 \) mm\(^2\) with WR-8 earth clamp:
   
   \[ \text{P-8-9/1-35-(WR-8)} \]

2. Earthing device extension with cable \( L = 8 \) m long and rated current \( I_{11} = 18.5 \) kA, made of copper cable with section \( 95 \) mm\(^2\) with WR-2z earth clamp:
   
   \[ \text{P-8-18.5/1-95-(WR-2z)} \]

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-15/01 P earthing device extension.

P EARTHING DEVICE EXTENSION

1. Earth clamp
2. Joint plate
3. Copper cable conductor
U1-WP HIGH CURRENT PORTABLE EARTHING DEVICE with co-operating DI-B INSULATING STICK

The U1-WP high current portable earthing device with co-operating DI-B insulating stick protects the workplace at line and station electrical equipment, equipped with flat bus-bars disconnected from the power source through the connection to the earth clamp. The set can be mounted on bars with dimensions: gauge up to 50 mm, defined width: 60, 80 or 100 mm. U1-WP device is produced one-phase version, it can be used for currents up to 60kA for time duration of short circuit $t_r = 1$ s. Conducting parts of clamps are manufactured from copper, mechanical parts from stainless steel or galvanised steel. The screw terminated with a knob allows controlling the jaw’s pressure. Line clamp WZ-1/A and earth clamp WZ-1 are connected to one another by means of a copper links coated with a flexible transparent plastic cover. Deflection elements protect the link (in the place of fastening) against damage and against moisture penetration. The installation and fastening of the line clamp on flat bus-bars is carried out by means of the insulating stick and $\frac{1}{2}”$ torque spanner. The WZ-1/A clamp is designed to be snapped into the head of insulating stick (the insulating stick must be mounted). Device consists of two parallel wires with cross-section $120\text{mm}^2$ and length up to 16m. Earthing device has cover from waterproof fabric.

**DENOTATION OF U1-WP EARTHING DEVICE**

U1-WP-WZ-1/A(b1)-L-I/t-2xS-WZ-1(b2)-(SI)

where:

- WZ-1/A – phase clamp
- WZ-1 – earth clamp
- b1, b2 – denotation of bar width (60, 80 lub 100 mm)
- L – length of wire [m]
- I – rated short-circuit current [kA]
- t – rated short-circuit time [s]
- S - wire’s cross-section (two conductors $120\text{mm}^2$)
- (SI) – denotation of silicone insulation of wire

Examples of denotation:

U1-WP-WZ-1/A(60)-3-60/1-2x120-WZ-1(80)-(SI)

Portable single-clamp earthing device for flat bus-bars with line clamp WZ-1/A type for 60mm width bus-bar, 3 meter long wire, rated current $I_{t1} = 60\text{ kA}/1\text{s}$, made of two copper wires with cross-section $2\times 120\text{ mm}^2$ with silicone insulation, WZ-1 type earth clamp.

**DENOTATION OF DI-B STICK**

DI-N-B

where:

- N- stick’s rated voltage
- B- denotation of filled tube
### TABLE I

<table>
<thead>
<tr>
<th>Stick's symbol</th>
<th>Rated voltage [kV]</th>
<th>Max work voltage [kV]</th>
<th>Dimension of sticks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L min [mm]</td>
<td>L max [mm]</td>
<td>L1 [mm]</td>
</tr>
<tr>
<td>DI-1-B</td>
<td>1</td>
<td>1</td>
<td>500 2200 250</td>
</tr>
<tr>
<td>DI-10-B</td>
<td>10</td>
<td>10</td>
<td>900 2200 520</td>
</tr>
<tr>
<td>DI-20-B</td>
<td>20</td>
<td>20</td>
<td>1100 2200 600</td>
</tr>
<tr>
<td>DI-30-B</td>
<td>30</td>
<td>30</td>
<td>1160 2200 660</td>
</tr>
<tr>
<td>DI-40-B</td>
<td>40</td>
<td>40</td>
<td>1360 2200 830</td>
</tr>
<tr>
<td>DI-110-B</td>
<td>110</td>
<td>110</td>
<td>2200 2200 1300</td>
</tr>
</tbody>
</table>

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-3/10 U1-WP Earthing device.

**DI-B INSULATING STICK**

\[ L \]

L – Total length of the stick
L1 – Length of the insulating element

**CLAMPS OF U1-WP DEVICE**

**WZ-1 earth clamp**

**WZ-1/A line clamp**

b1 – width of bus-bar, user choose in the order one of defined (60, 80 lub 100mm)
U-NN/A PORTABLE LOW VOLTAGE EARTHING DEVICE

The U-NN/A portable low voltage earthing device is intended for earthing the conductors in circuits of overhead lines, for different rated currents $I_r$ (the highest one second rated current shall not exceed $I_{r1} = 9 \text{kA}$). Permissible temperature of work is between $-25^\circ\text{C}$ and $+55^\circ\text{C}$ in case when PVC insulation of wire is used or between $-40^\circ\text{C}$ and $+70^\circ\text{C}$ when wire has silicone insulation.

The earthing device consists of maximum seven snap type line clamps (firmly fastened to insulating holders connected with short circuiting conductors), earthing conductor and earth clamp. Short circuiting conductors are fastened directly on clamps.

The insulating holder allows using the earthing devices for round conductors of the power lines with voltage up to 1 kV. The holder handle together with limiter is made of plastic piece and insulating part of epoxy-glass rod.

Stranded copper conductors are protected by means of flexible shield made of transparent plastic. Deflection elements protect the wire against damaging in the place of fastening and against penetration and harmful interaction of moisture.

For the U-NN/A device the WT-Z2 snap-type line clamp is used, and the earth clamp could be: snap-type KL (made of aluminium flat bar) or screw-type WR-6 or other on special request. KL earth clamp can be put on and taken off by one hand – it makes easier mounting and dismounting the earthing device particularly at work on transition sticks. The KL earth clamps allow rapid and firm fastening on the 50 x 50 mm angle or flat bar up to 50 mm wide.

For the rated current $I_{r1}$ and rated time $t_r = 1 \text{s}$, conductors of the earthing device have the cross sections according to table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All types of earthing devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$, for $t_r = 1\text{s}$ [kA]</td>
<td>4</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [A$^2\text{s}$]</td>
<td>16</td>
</tr>
</tbody>
</table>

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 Standard, is shown in the diagram I.

**Diagram I**

Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earth conductors.

**ATTENTION:**

In the range of times $t_r$:  
- $1 \text{s} \div 3 \text{s}$ - guaranteed calculated current  
- $0.1 \text{s} \div 1 \text{s}$ - calculated current, after checking the electrodynamic resistance of the earthing device (special option)
The earthing devices are manufactured as standard versions with the lengths according to table II.

<table>
<thead>
<tr>
<th>UX</th>
<th>L [m]</th>
<th>1</th>
<th>3</th>
<th>8</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L₁[m]</td>
<td>0.7</td>
<td>1</td>
<td>0.7</td>
<td>1</td>
</tr>
</tbody>
</table>

On special request the earthing device with the earthing and short circuiting conductors with the lengths L+L₁ for 0.1 m up to 24 m, graded every 0.2 m may be supplied.

The unit package makes protective bag made of coated waterproof fabric with the strap to throw it over an arm.

**DENOTATION METHOD:**

Ux-NN/A-L/L₁-I/t-S-(B)(C)

where:

- X – number of line clamps: 1, 2, 3, 4, 5, 7
- L – the earthing conductor length [m]
- L₁ – the short circuiting conductor length [m] (it does not exist for X=1)
- I – rated current I₁ [kA] for rated time t₁ =1 s. as per table 1
- t – rated short-circuit time [s]
- S – cross-section [mm²] of short circuiting conductors as per table 1
- B – connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector
  - S serial connected earthing device
- C – denotation of kind of the earth clamp (WR-2z, WR-3, WR-4, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “-(SI)” is added to denotation.

**Denotation Examples:**

1. **U-NN/A five-clamp portable low voltage earthing device with earthing conductor L= 8 m long, short-circuiting conductors L₁ = 0.7 m, rated current I₁ = 9 kA, made of copper cable with cross-section 35 mm², insulated middle connector with WR-6 earth clamp:**

   U5-NN/A-8/0.7-9/1-35-(I)(WR-6)

2. **U3-NN/A three-clamp portable low voltage earthing device with earthing conductor L= 3 m long, short-circuiting conductors L₁ = 1 m, rated current I₁ = 6.5 kA, made of copper cable with cross-section 25 mm², with serial wire connection, KL earth clamp**

   U3-NN/A-3/1-6.5/1-25-(S)(KL)

U-NN/A portable earthing devices are denoted by CE mark.

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-1/02 U-NN/A portable low voltage earthing devices.
1. WT-Z2 Snap type line clamp
2. KL Earth clamp
3. WR-6 Earth clamp
4. Insulating holder
5. Short circuiting conductor
6. Earthing conductor
The Z-NN/A portable low voltage short-circuiting devices are designed for short-circuiting line conductors of overhead lines in circuits for different rated currents $I_r$ (maximum 1 second rated current $I_{r1} = 9\, \text{kA}$). It can work in the temperature range between $-25^\circ\text{C}$ and $+55^\circ\text{C}$ in case when PVC insulation of wire is used or between $-40^\circ\text{C}$ and $+70^\circ\text{C}$ when wire has silicone insulation. The device consists of maximum seven snap line clamps fixed to insulating holders, connected in series to one another with short-circuiting conductors. Short-circuiting conductors are directly fastened to terminals. The insulating holder makes it possible to use the short-circuiting devices for round conductors of power lines with voltage up to 1 kV. The handle of the insulating holder is made of a plastic piece and insulating part is made of an epoxy glass rod.

Copper cables are coated with a flexible cover made of transparent plastic. Deflection elements with adhesive protect the cable (in the place of fastening) against damage and moisture penetration and unfavourable interaction. Thanks to that the conductor of the earthing device is resistant to moisture penetration. The Z-NN/A short-circuiting device is supplied with the WT-Z2 snap line clamps made of aluminium flat bars. Each line clamp is easily installed and removed with one hand. It makes mounting and dismounting of the short-circuiting device easy particularly when the lineman works on sticks of overhead lines.

For the rated current $I_{r1}$ and rated time $t_r = 1\, \text{s}$, cables of the short-circuiting device have the cross sections according to table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All types of short-circuiting devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ for rated time $t_r = 1, \text{s}$ [kA]</td>
<td>4, 6.5, 9</td>
</tr>
<tr>
<td>Cross-section of short-circuiting device conductor [mm$^2$]</td>
<td>16, 25, 35</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10, 16.2, 22.5</td>
</tr>
<tr>
<td>Joule’s integral [A$^2\text{s}$]</td>
<td>16, 42, 81</td>
</tr>
</tbody>
</table>

A unit package makes a protective cover made of coated waterproof fabric with a belt to throw the package over arm.

On special request the portable low voltage short-circuiting devices with the lengths $L, L_1$ of the short-circuiting conductors may be provided in the range from 0.1 m up to 16 graded every 0.2 m.

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 (PN-EN 61230:2011) Standard, is shown in the diagram I.

Permissible short-circuiting current $I_c$ as a function of short-circuiting time $t_r$ for different sections of the earth conductors.
ATTENTION:
In the time range $t_r$:  
1 s ÷ 3 s - guaranteed calculated current  
0.1 s ÷ 1 s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

DENOTATION METHOD:

$$ZX-NN/A- L_{t}\mathcal{I}_N/t-S-(B)$$

where:

- $X$ – number of line clamps: 2, 3, 4, 5, 6, 7
- $L_{t}$ – length of the short circuiting conductor [m]
- $I_N$ – rated current [kA] for rated time $t_r = 1$ s. as per table
- $S$ – cross-section [mm$^2$] of short circuiting conductors as per table
- $B$ – connection method of multi-clamps earthing device conductors:
  - S serial connected earthing device

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Denotation Example:
$Z-NN/A$ five-clamp portable low voltage earthing device with short-circuiting conductor $L_{t} = 0.7$ m long, rated current $I_{N} = 6.5$ kA, made of copper cable with cross-section 25 mm$^2$ serial wire connection

$Z5-NN/A-0.7-6.5/1-25-(S)$

$Z-NN/A$ portable short-circuiting devices are denoted by CE mark.

Reference documents:
PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
WTO-8/01 Z-NN/A portable low voltage short-circuiting devices.

**Z-NN/A PORTABLE LOW VOLTAGE SHORT-CIRCUITING DEVICE**

1. WT-Z2 Snap type line clamp  
2. Insulating holder  
3. Holder handle  
4. Short-circuiting conductor
The U-SN/A portable medium voltage earthing device is intended for earthing the conductors in circuits of overhead lines, for different rated currents $I_{r1}$ (the highest one second rated current shall not exceed $I_{r1} = 9$ kA). Permissible operating temperature is between $-25^\circ C$ and $+55^\circ C$ in case when PVC insulation of wire is used or between $-40^\circ C$ and $+70^\circ C$ when wire has silicone insulation.

The earthing device consists of maximum five snap type line clamps, an earthing conductor and an earth clamp. The line clamps are firmly fastened to the insulating holder with hand limiter and they are connected with short circuiting conductors; in the standard version they are connected in parallel and optionally in series. Short circuiting conductors are fastened directly on clamps. The parallel version of the device includes an insulated middle connector as standard. It connects short circuiting conductors with earthing conductor and may be produced as protected against moisture penetration as well as assuring external electrical insulation of mutually connected cables.

Insulating holder makes it possible to use earthing device for round conductors of diameter up to 16 mm for power lines with voltage up to 30 kV. The insulating holder is made of epoxy resin tube. Stranded copper conductors are protected with transparent plastic cover. Deflection elements with adhesive protect the cable against damaging in the place of fastening and protect against penetration and harmful action of moisture. Thanks to that, the earthing device conductor is resistant to moisture penetration. For the U-SN/A device the WT-Z2 snap type earth clamp and the KL earth clamp made of aluminium flat bar are supplied. Each line clamp can be put on and taken off by one hand – it makes easier mounting and dismounting the earthing device particularly at work on transition sticks.

The WR-2z and KL earth clamps can be applied interchangeably in the U-SN/A earth devices and it is also possible to use the WR-6 line clamp. Unless a different earth clamp is defined in the order, the U-SN/A earthing device is supplied in the standard version.

For the rated current $I_{r1}$ and rated time $t_r = 1$ s, conductors of the earthing device have the cross sections according to the table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All types of earthing devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$, for $t_r = 1$s [kA]</td>
<td>4, 6.5, 9</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>16, 25, 35</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10, 16, 22.5</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
<td>16, 42, 81</td>
</tr>
</tbody>
</table>

The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_r$ specified in the Polish Standard PN-EN 61230:2011 (IEC 61230:2008) is shown in the diagram.

**Diagram**

Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.

**ATTENTION:**

In the range of times $t_r$: 
The earthing devices are manufactured as standard versions with the lengths according to table II.

<table>
<thead>
<tr>
<th>UX</th>
<th>L [m]</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1[m]</td>
<td>0.7</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Following an adequate agreement, there is possibility to supply the lengths earthing devices with overall lengths (given below) of conductors in the range since 0.5 [m] up to 24 [m] graded every 0.2 [m]:
- L – for one-clamp earthing device,
- L+L1 for the multi-clamp parallel earthing device
- L+XL1 for the multi-clamps series earthing device

The unit package makes protective bag made of coated waterproof fabric with the strap to throw it over an arm.

**DENOTATION METHOD:**

UX-SN/A-L/L1-I/t-S-(B)(C)

where:

- X – number of line clamps: 1, 2, 3, 4, 5
- L – the earthing conductor length [m]
- L1 – the short circuiting conductor length [m] (it does not exist for X=1)
- I – rated current \(I_t\) [kA] for rated time \(t_r=1\) s. as per table 1
- S – cross-section \([\text{mm}^2]\) of short circuiting conductors as per table 1
- B – connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector
  - S serial connected earthing device
- C – denotation of kind of the earth clamp (WR-6, KL, WR-8 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

**Denotation Examples:**

3. **U-SN/A five-clamp** portable medium voltage earthing device with earthing conductor \(L=1\) m long, short-circuiting conductors \(L1 = 0.7\) m, rated current \(I_{t1} = 9\) kA, made of copper cable with cross-section \(35\) mm\(^2\), serial connection of wire, WR-6 earth clamp:
   
   U5-SN/A-1/0.7-9/1-35-(S)(WR-6)

4. **U-SN/A one-clamp** portable medium voltage earthing device with earthing conductor \(L=1\) m long, rated current \(I_{t1} = 9\) kA, made of cable with cross-section \(35\) mm\(^2\), KL earth clamp:
   
   U1-SN/A-1/9/1-35-(KL)

5. **U3-SN/A three-clamp** portable medium voltage earthing device with earthing conductor \(L=3\) m long, short-circuiting conductors \(L1 = 1\) m, rated current \(I_{t1} = 6.5\) kA, made of copper cable with cross-section \(25\) mm\(^2\) with silicone insulation and insulated middle connector, WR-6 earth clamp:
   
   U3-SN/A-3/1-6.5-25-(I)(WR-6)-(SI)

**Reference documents:**

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-2/02 U-SN/A portable medium voltage earthing device.
1. WT-Z2 Snap type line clamp
2. KL Earth clamp
3. WR-2z Earth clamp
4. WR-6 Earth clamp
5. Insulating holder
6. Short circuiting conductor
7. Earthing conductor
Z-SN/A PORTABLE MEDIUM VOLTAGE SHORT-CIRCUITING DEVICES

The Z-SN/A portable medium voltage short-circuiting devices are designed for short-circuiting line conductors of overhead lines in circuits for different rated currents $I_r$ (maximum 1 second rated current $I_{r1} = 9$ kA). It can work in the temperature range from $-25^\circ$ C up to $+55^\circ$ C in case when PVC insulation of wire is used or between $-40^\circ$ C and $+70^\circ$ C when wire has silicone insulation. The device consists of maximum five snap line clamps fixed to insulating holders, connected in series to one another with short-circuiting conductors. Short-circuiting conductors are directly fastened to terminals. The insulating holder makes it possible to use the short-circuiting devices for round conductors of power lines with voltage up to 30 kV. The handle of the insulating holder is made of a moulded plastic piece and the insulating part is made of epoxy glass rod. Copper cables are coated with a flexible cover made of transparent plastic. Deflection elements with adhesive protect the cable (in the place of fastening) against damage and moisture penetration and unfavourable interaction. Thanks to that the conductor of the short-circuiting device is resistant for moisture penetration. The Z-NN/A short-circuiting device is supplied with the WT-Z2 snap line clamps made of aluminium flat bars. It makes mounting and dismounting of the short-circuiting device easy, particularly when the lineman works on sticks of overhead lines. For the rated current $I_{r1}$ and rated time $t_r = 1$ s, cables of the short-circuiting device have the cross sections according to the table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All types of short-circuiting devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ for rated time $t_r = 1$ [s] [kA]</td>
<td>4</td>
</tr>
<tr>
<td>Cross-section of short-circuiting device conductor [mm$^2$]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
<td>16</td>
</tr>
</tbody>
</table>

A unit package makes a protective cover made of coated waterproof fabric with a belt to throw the package over an arm. Following an adequate agreement, the short-circuiting devices with different lengths $L_1$ in the range from 1 m up to 16 m may be provided, graded every 0.2 m but overall length of the short-circuiting device should not be bigger than 16 m.

**DENOTATION METHOD:**

ZX-SN/A- L$_1$I$_N$/t-S-(B)

where:

- $X$ – number of line clamps: 2, 3, 4, 5
- $L_1$ – length of the short-circuiting conductor [m]
- $I_N$ – rated current [kA] for rated time $t_r = 1$ s. as per table
- $S$ – cross-section [mm$^2$] of short-circuiting conductors as per table
- $B$ – connection method of multi-clamps earthing device conductors: ( S - serial connected)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

**Denotation Example:**

Z-SN/A five-clamp portable medium voltage short-circuiting device with short-circuiting conductor $L_1 = 2$ m long, rated current $I_{r1} = 6.5$ kA, made of copper cable with cross-section 25 mm$^2$

ZX-SN/A-2-6.5/1-25-(S)

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-16/01 Z-SN/A portable medium voltage short-circuiting devices.
The U-WN & U-WN/A portable high voltage earthing device is intended for earthing the conductor in overhead line circuits, for different rated currents $I_r$ (highest one second rated current shall not exceed $I_{r1} = 13$ kA). Permissible operating temperature is between -25ºC and +55ºC in case when PVC insulation of wire is used or between -40ºC and +70ºC when wire has silicone insulation. The earthing device consists of one, two or three WN or WN/A clamp units, short circuiting conductors (in the standard version they are connected in series), an earth conductor and an earth clamp. The clamping unit consists of the WT-Z4 snap line clamp, fastened on the UIWN insulating holder (U-WN type) or WT-Z4/A clamp (U-WN/A type) adapted to co-operation with the DU-A (or UDI-B) insulation stick of appropriate rated voltage. The UIWN insulating holder is made of an epoxy resin tube, an epoxy resin bar and a handling limiter. Short circuiting conductors are fastened directly on clamps. The parallel version of the three-clamp earthing device includes an insulated middle connector. The standard middle connector in parallel version (connects short circuiting conductors with earth conductor) is protected against penetration of moisture and it assures external electrical insulation of connected with cables.

The WT-Z4 & WT-Z4/A line clamps make it possible to use earthing device for round conductors of diameter from 16 mm up to 32 mm at power lines with voltage up to 110 kV. The UIWN insulating holder is made of an epoxy resin tube. Stranded copper conductors are protected with a transparent plastic cover. Deflection elements with adhesive protect the cable against damage in the place of fastening and protect against penetration and disadvantageous action of moisture. Thanks to that the conductor of the earthing device is resistant to moisture penetration. With the earthing devices: U1-WN, U3-WN, U1-WN/A, U3-WN/A snap line clamps are supplied as standard, appropriately: WT-Z4, WT-Z4/A made of aluminium alloy. Each line clamp can be put on and taken off by one hand – it makes easier assembly and disassembly the earthing device of the conductor particularly at work on transition sticks. As an earth clamp KL snap-type clamp can be applied, or screw-type: WR-8, WR-2z, or other.

For the rated current $I_{r1}$ and rated time $t_r = 1$ s the earthing device extension conductor has the cross sections according to table I.

<table>
<thead>
<tr>
<th>Rated current $I_{r1}$, for $t_r = 1s$ [kA]</th>
<th>4</th>
<th>6.5</th>
<th>9</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor cross section [mm²]</td>
<td>16</td>
<td>25</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td>Peak current $I_{m}$ [kA]</td>
<td>10</td>
<td>16.2</td>
<td>22.5</td>
<td>37.58</td>
</tr>
<tr>
<td>Joule’s integral [A²s]</td>
<td>16</td>
<td>42</td>
<td>81</td>
<td>15.92</td>
</tr>
</tbody>
</table>

The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_r$ specified in the Standard IEC 61230:2008 is shown in the diagram. Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.
ATTENTION:
In the range of times \( t_r \):
\[
\begin{align*}
1 \text{ s} & \div 3 \text{ s} & \text{- guaranteed calculated current} \\
0.1 \text{ s} & \div 1 \text{ s} & \text{- calculated current, after checking the electrodynamic resistance of the earthing device (special option)}
\end{align*}
\]

The earthing devices are manufactured as standard versions with the lengths according to table II.

<table>
<thead>
<tr>
<th>UX</th>
<th>L [m]</th>
<th>3</th>
<th>5</th>
<th>5</th>
<th>8</th>
<th>12</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L1 [m]</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Following an adequate agreement, there is possibility to supply the lengths earthing devices with overall lengths (given below) of conductors up to 24 [m] graded every 0.2 [m]:
- L – for one-clamp earthing device,
- L+L₁ for the multi-clamp parallel earthing device
- L+XL₁ for the multi-clamps series earthing device

A unit package makes a protective cover made of coated waterproof fabric with a belt to throw the package over arm.

**DENOTATION METHOD:**

Single clamp device

\[
\text{U1-WN-L-I/t-S-(C)} \quad \& \quad \text{U1-WN/A-L-I/t-S-(C)}
\]

and

multi clamp device

\[
\text{UX-WN-L/L₁-I/t-S-(B)(C)} \quad \& \quad \text{UX-WN/A-L/L₁-I/t-S-(B)(C)}
\]

where:

<table>
<thead>
<tr>
<th>X</th>
<th>number of line clamps: 2,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>the earthing conductor length [m]</td>
</tr>
<tr>
<td>L₁</td>
<td>the short circuiting conductor length [m] (it does not exist for X=1)</td>
</tr>
<tr>
<td>I</td>
<td>rated current ( I_{r1} ) [kA] for rated time ( t_r = 1 \text{ s} ) as per table 1</td>
</tr>
<tr>
<td>S</td>
<td>section ([\text{mm}^2]) of short circuiting conductors as per table 1</td>
</tr>
<tr>
<td>B</td>
<td>connection method of multi-clamps earthing device conductors:</td>
</tr>
<tr>
<td></td>
<td>I earthing device with insulated middle connector</td>
</tr>
<tr>
<td></td>
<td>S serial connected earthing device</td>
</tr>
<tr>
<td>C</td>
<td>denotation of kind of the earth clamp (WR-2z, WR-3, WR-4, WR-7, WR-K25 or other)</td>
</tr>
</tbody>
</table>

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

**Denotation Examples:**

1. **U3-WN/A**
   - three-clamp portable high voltage earthing device with earthing conductor \( L = 8 \text{ m} \) long,
   - short-circuiting conductors \( L₁ = 4 \text{ m} \), rated current \( I_{r1} = 6.5 \text{ kA} \), made of copper wire with cross-section \( 25 \text{ mm}^2 \), **series** version, with **WR-8** earth clamp:
   \[
   \text{U3-WN/A-8/4-6.5/1-25-(S)(WR-8)}
   \]

2. **U1-WN**
   - one-clamp portable high voltage earthing device with earthing conductor \( L = 12 \text{ m} \) long,
   - rated current \( I_{r1} = 4 \text{ kA} \), made of conductor with cross-section \( 16 \text{ mm}^2 \) with KL earth clamp:
   \[
   \text{U1-WN-12/4/1-16-(KL)}
   \]

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-3/03 U-WN and U-WN/A portable high voltage earthing device.
1. WT-Z4/A Snap type line clamp
2. WR-2z Earth clamp
3. KL Earth clamp
4. Short-circuiting conductor
5. Earth conductor

1. WT-Z4/B Snap type line clamp
2. WR-2z Earth clamp
3. KL Earth clamp
4. Short-circuiting conductor
5. Earth conductor
U-WN PORTABLE HIGH VOLTAGE EARTHING DEVICE

1. WT-Z4/A Snap type line clamp
2. WR-2z Earth clamp
3. KL Earth clamp
4. Short circuiting conductor
5. Earth conductor

U3-WN parallel version

U-WN/A PORTABLE HIGH VOLTAGE EARTHING DEVICE

1. WT-Z4/B Snap type line clamp
2. WR-2z Earth clamp
3. KL Earth clamp
4. Middle connector
5. Short circuiting conductor
6. Earth conductor

U3-WN/A parallel version
The portable snap earthing device for small diameters is used for protecting the workplace at electrical power line and station installations equipped with round conductors with diameters up to 16 mm² by the connection with the ground electrode. The U-SM is designed for rated currents I₁ from 4 kA up to 13 kA (see table 1). The single-clamp earthing device consists of the snap type earth clamp connected by the earthing conductor to one line clamp of snap type. For: two-, three, four- and five clamp versions, of snap type earth clamp connects suitably with: two, three, four or five line clamps of snap type. Standard connector connecting short circuiting current conductors with the earthing conductor may be manufactured as protected against moisture penetration and assuring external electrical insulation of connected cables. Stranded copper conductor is protected with transparent plastic cover. Deflection elements with adhesive protect the cable against damage in the place of fastening. The WT-Z3 line clamps and KL earth clamp are made as bent aluminium constructions. The KL earth clamp may be used for 50 x 50 mm angle or for 50 mm hoop iron. On request the other earth clamp may be supplied. The design of the line clamp gives the possibility of installing and removing from the level of the earth by means of TDI-B telescopic insulating stick with height 9.15m or 7.65m or 4.7m. Installation of the U-SM earthing device is fulfilled with the ZU manipulating catch. For dismounting the ZL catch is used. It prevents the clamp from falling down to the earth at the moment of unlocking the clamp.

The U-SM earthing devices are designed mainly for earthing overhead lines of low and medium voltage - installed directly from the earth they considerably make the process of preparing the workplace easy.

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 (PN-EN 61230:2011) Standard, is shown in the diagram I. Permissible short-circuiting current I₁ as a function of short-circuiting time t₁ for different sections of the earth conductors.

### TABLE I

<table>
<thead>
<tr>
<th>U-SM earthing devices (all kinds)</th>
<th>Cross-section [mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current I₁, for t₁ =1s [kA]</td>
<td>4 6.5 9 13</td>
</tr>
<tr>
<td>Conductor cross section [mm²]</td>
<td>16 25 35 50</td>
</tr>
<tr>
<td>Peak current Iₘ [kA]</td>
<td>10 16.2 22.5 37.58</td>
</tr>
<tr>
<td>Joule’s integral [A²s]</td>
<td>16 42 81 15.92</td>
</tr>
</tbody>
</table>

The cross sections of the earthing device conductors in relation to rated currents I₁ and rated time t₁ are given in the table 1.

**Diagram I**

**ATTENTION:**
In the range of times t₁:

\[ 1 \text{ s} \div 3 \text{ s} \] - guaranteed calculated current
0.1 s ÷ 1 s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

The earthing devices employ standardised lengths of conductors, as per table II.

<table>
<thead>
<tr>
<th>TABLE II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U1-SM</strong></td>
</tr>
<tr>
<td><strong>U2, U3, U4,</strong></td>
</tr>
<tr>
<td><strong>U5-SM</strong></td>
</tr>
</tbody>
</table>

Following the adequate agreement, the earthing device with different lengths of the cables may be provided. The lengths are:

- L from 0.5 up to 16 m for the U1-SD earthing device, graded every 0.5 m.
- L = 20 – L1 and L1 from 0.5 up to 20 m for the U2, U3, U4, U5-SM graded every 0.5 m

**DENOTATION METHOD:**

UX-SM-L/L1-I-S

where:

- X - number of the line clamps: 1, 2, 3, 4, 5
- L - the earthing cable length [m] - as per table II
- L1 - length of line/short circuiting conductor [m] acc. to table II, for X=1, L1 does not exist
- I - rated current \( I_{t1} \) [kA] for rated time \( t_r \), as per table I
- S - cross-section \([\text{mm}^2]\) of earthing conductor and line conductors as per Table I
- B - connection method of multi-clamps earthing device conductors:
  - I - earthing device with insulated middle connector
  - S - serial connected earthing device
- C - denotation of kind of the earth clamp (WR-2z, WR-6, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

**Denotation Example:**

1. **Five**-clamp portable earthing device for small diameters, with earthing conductor \( L = 2 \) m long, line conductors \( L1 = 8 \) m and rated 1-second current \( I_{t1} = 6.5 \) kA, made of copper cable with cross-section of \( 25 \) mm\(^2\), with insulated middle connector, with WR-2z earth clamp:

   **U5-SM-2/8-6.5/1-25-(I)(WR-2z)**

2. **Three**-clamp portable earthing device for small diameters, with earthing conductor \( L = 4 \) m long, line (short circuiting) conductors \( L1 = 12 \) m and rated 1-second current \( I_{t1} = 4 \) kA, made of copper cable with cross-section of \( 16 \) mm\(^2\) with silicone insulation, serial version, with the **WR-6** earth clamp:

   **U3-SM-4/12-4/1-16-(S)(WR-6)-(SI)**

The unit package makes protective bag made of coated waterproof fabric.

**Reference documents:**

PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
WTO-11/02 U-SM Portable snap earthing device for small diameters.
1. WT-Z3 Line clamp
2. KL Earth clamp
3. WR-2z Earth clamp
4. Middle connector
5. Line conductor
6. Earth conductor
U-SD SNAP PORTABLE EARTHING DEVICE FOR BIG DIAMETERS

The U-SD snap portable earthing device for big diameters is used for protecting the workplace at electrical power line and substation equipped with round conductors with diameters from 185 up to 525 mm\(^2\) by the connection with the ground electrode. The U-SD is designed for rated currents \(I_{r1}\) from 4 kA up to 13 kA (see table I). The single-clamp earthing device consists of the KL portable, snap type earth clamp connected by the earth conductor to one WT-Z9 snap type line clamp. For: double-, three-, four- and five clamp versions, snap type earth clamp connects suitably with: two, three, four or five snap type line clamps.

Standard insulated middle connection is manufactured as protected against penetration of moisture and it assures external electrical insulation of connected cables. Device may be also manufactured in serial version (S).

Stranded copper conductor is protected with a transparent plastic cover. Deflection elements with adhesive protect the cable against damage in the place of fastening. The WT-Z9 line clamps and earth clamp are made as bent aluminium constructions. The KL earth clamp may be used for angle 50 x 50 mm or for 50 mm hoop iron. On request the WR-2z, WR-8 or other earth clamp may be supplied.

The design of the line clamp enables installing and taking it off from the level of the earth by means of a TDI-B telescopic insulating stick with height 9.15m or 7.65m or 4.7m from a stick of overhead line by means of appropriate UDI-B insulating stick.

Installation of the U-SD earthing device is carried out with a ZU manipulating catch. For dismounting a ZL catch is used. It prevents against falling its down to the earth at the moment of unlocking the clamp.

The cross sections of the earthing device conductors in relation to rated currents \(I_{r1}\) and rated time \(t_r\) are given in table I.

<table>
<thead>
<tr>
<th>All types of earthing devices</th>
<th>Cross section [mm(^2)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (I_{r1}), for (t_r = 1)s [kA]</td>
<td>4</td>
</tr>
<tr>
<td>Conductor cross section [mm(^2)]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current (I_m) [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [A(^2)s]</td>
<td>16</td>
</tr>
</tbody>
</table>

The choice of the earth device for different rated currents and times specified in IEC 61230:2008 (PN-EN 61230:2011) Standard, is shown in the diagram I.

Diagram I

Permissible short-circuiting current \(I_r\) as a function of short-circuiting time \(t_r\) for different sections of the earth conductors.

ATTENTION:

In the range of times \(t_r\):
- \(1\) s \(\div\) 3 s - guaranteed calculated current
- \(0.1\) s \(\div\) 1 s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)
The earthing devices employ standardised lengths of conductors, as per table II.

<table>
<thead>
<tr>
<th>TABLE II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Following the adequate agreement, the earthing device with different lengths of the cables may be provided. The lengths are:

- for the U1-SD earthing device: L from 0.5 up to 16 m, graded every 0.5 m.
- for the U2, U3, U4, U5 -SD earthing devices: L = 20 – L1  0.5 and L1 from 0.5 up to 20 m, graded every 0.5 m.

DENOTATION METHOD:

UX-SD-L/L1-I/t-S-(B)(C)

where:

- X - number of the line clamps: 1, 2, 3, 4, 5
- L - the earthing cable length [m] - recommended as per table II
- L1 - length of line/short circuiting conductor [m] acc. to table II, for X=1, L1 does not exist
- I - rated current $I_{r1}$ [kA] for rated time $t_r$, as per table I
- S - cross-section [mm$^2$] of earthing conductor and line conductors as per table I
- B - connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector
  - S serial connected earthing device
- C - denotation of kind of the earth clamp (WR-2z, WR-6, WR-7, WR-K25 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

If instead of the KL snap type earth clamp is to be used the WR-2z clamp, after the earthing device denotation one should write (WR-2z).

Denotation Example:

3. Five-clamp portable earthing device for big diameters, with earthing conductor L= 4 m long, line (short circuiting) conductors L1 = 12 m and rated 1-second current $I_{r1} = 6.5$ kA, made of copper cable with cross-section of 25 mm$^2$, with the standard middle connector, with the WR-2z earth clamp:

   U5-SD-4/12-6.5/1-25-(I)(WR-2z)

4. Three-clamp portable earthing device for big diameters, with earthing conductor L= 6 m long, line (short circuiting) conductors L1 = 16 m and rated 1-second current $I_{r1} = 4$ kA, made of copper cable with cross-section of 16 mm$^2$, with the standard middle connector, with the KL earth clamp:

   U3-SD-6/16-4-16-(I)(KL)

The unit package makes protective bag made of coated waterproof fabric.

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-13/02 U-SD Snap portable earthing device for big diameters.
U-SD SNAP PORTABLE EARTHING DEVICE FOR BIG DIAMETERS

1. WT-Z9 Line clamp
2. KL Earth clamp
3. WR-2z Earth clamp
4. Middle connector
5. Line conductor
6. Earth conductor
The U-BM earthing device is used for protecting the workplace at electrical power installations equipped with BM type fuse bases, by connecting one side of a base (on the side of the device being earthed) with the earth and at the same time electrical separation of the other side. There are two kinds of the U-BM earthing devices: U-BM00 for bases with fuse sizes 000 and 00 and U-BM123 for bases with fuse sizes 1, 2 and 3. The U-BM123 earthing device is designed for rated currents $I_r$ from 4 kA up to 9 kA and U-BM/00 for rated currents $I_r$ from 4 kA up to 6.5 kA (see table 1). Permissible operating temperature is between -25°C and +55°C for conductors covered with polyvinyl chloride and -40°C and +70°C for conductors covered with silicone.

The functions of line clamps fulfil line inserts. Depending on the number of line clamps, respectively U1-BM single-clamp and U3-BM three-clamp earthing devices are manufactured. The WR-6 or WR-6/A or WR-8 earth clamps made of brass can be mounted to all earthing device versions. Opening and closing the earth clamps jaws is accomplished by hand operated screw terminated with a knob or screw co-operated with UI-1 insulating holder.

In the three-clamp earthing device, line clamps are connected - through a connector - to the earth clamp by a copper cable of the same cross-section. The connector which connects short-circuit conductors to the earthing conductor is resistant to moisture penetration and assures electrical external insulation of the connected cables.

In the single-clamp earthing device line clamp is connected to the earth clamp by means of a copper cable. Deflection elements with glue protect the wire against damage in the place of fastening and protect against moisture penetration.

Each line clamp consists of two knives:
- earthing /made of copper, galvanic covered with silver layer/, connected to the copper cable,
- insulating /made of plastic/,
- catch intended for fastening holder used for inserting and removing fuse link from the fuse base.

A whole clamp is made by injection moulding method and makes not dismountable part.

The U-BM123 and U-BM-00 line clamps of the earthing device may be inserted and removed from bases by means of a typical holder used for inserting and removing the fuse links (e.g. WTNU manufactured by Apena), whereas the line clamps for the earthing devices: U-BM/123/A, U-BM00/A are installed by the insulating holder UI-1 equipped with a spring snap allowing quick installation or disconnection of the line clamp. The insulating holder UI-1 designed for installing the line clamps of the earthing devices U-BM/123/A and U-BM/00/A is supplied together with the earthing device. It allows precision manoeuvring with the clamp and keeps the personnel at a safe distance from the device being earthed. The earth clamp is installed and fastened manually (with the exception of WR-6/A clamp) prior to installing line clamps.

As all line clamps have the dimensions close to the dimensions of the power fuses, the switchboard may be closed after installing the earthing device, and at the same time it protects the earthing device from removal by unauthorised persons.

The cross sections of the earthing device conductors in relation to rated currents $I_r$ and rated time $t_r$ are given in table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Earthing devices: U-BM00, U-BM00/A, U-BM123, U-BM123/A</th>
<th>Earthing devices: U-BM123, U-BM123/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_r$ for $t_r=1s$ [kA]</td>
<td>4</td>
<td>6.5</td>
</tr>
<tr>
<td>Conductor cross section [mm²]</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Peak current $I_{m}$ [kA]</td>
<td>10</td>
<td>16.2</td>
</tr>
<tr>
<td>Joule’s integral [A’s]</td>
<td>16</td>
<td>42</td>
</tr>
</tbody>
</table>
The choice of the earth device for different rated currents and times specified in IEC 61230:2008 (PN-EN 61230:2011) Standard, is shown in the diagram I.

**Diagram I**
Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earth conductors.

**ATTENTION:**
In the range of times $t_r = 1 \text{ s} \div 3 \text{ s}$ - guaranteed calculated current
$0.1 \text{ s} \div 1 \text{ s}$ - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

The earthing devices employ standardised lengths of conductors, as per table II.

**TABLE II**

<table>
<thead>
<tr>
<th>Earthing device type</th>
<th>Earthing cable length $L$ [m]</th>
<th>Short-circuiting cables length $L_1$ [m]</th>
<th>Short-circuiting cables lengths [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>All single-clamp devices</td>
<td>1 : 2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>U3-BM00, U3-BM00/A</td>
<td>0.35</td>
<td>3 x 0.25</td>
<td>-</td>
</tr>
<tr>
<td>U3-BM123, U3-BM123/A</td>
<td>2.0</td>
<td>3 x 0.25</td>
<td>-</td>
</tr>
<tr>
<td>U3-BM123</td>
<td>1.0</td>
<td>-</td>
<td>0.28 0.48 0.68</td>
</tr>
</tbody>
</table>

The earthing device equipped with three line clamps and with different lengths of short-circuiting conductors is intended primarily for bases of power fuses that operate in vertical configuration. There is possibility to manufacture earthing device with other lengths $L$ and $L_1$ graded every 0.02 or 0.05 [m], if:
- the conductors' lengths $L$ of the single-clamp earthing device or
- the sum of the conductors; lengths $L+L_1$ or $L+L_3$ (when the length of the short-circuiting conductors are different and $L_1<L_2<L_3$) of the multi-clamp earthing device with conductors connected in parallel do not exceed 4 [m].

The device is packed in a bag made of coated, waterproof fabric.

**DENOTATION METHOD:**

I. SINGLE-CLAMP EARTHING DEVICE FOR POWER FUSE BASES

U1-A-L-I/t-S-(C) for conductors covered with polyvinyl chloride and
U1-A-L-I/t-S-(C)-(SI) for conductors covered with silicon

where:
A - kind of line clamp:
BM-00 - for fuse bases of 00 size, including ones equipped with knife jaw shields. The installation takes place by means of a fuse holder.
BM-00/A – for fuse bases of 00 size, including ones equipped with knife jaw shields. The installation takes place by means of UI-1 insulating holder.

BM123 – for fuse bases of size 1, 2 and 3, including ones equipped with knife jaw shields. The installation takes place by means of a fuse holder.

BM123/A – for fuse bases of size 1, 2 and 3, including ones equipped with knife jaw shields. The installation takes place by means of UI-1 insulating holder.

L - the earth conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)
I - rated current $I_r$ [kA] for rated time $t_r$
$t$ - rated short-circuiting time $t$ [s]
S - section [mm$^2$] of earthing cable as per table I
C - denotation of the earthing clamp (WR-6, WR-6/A, WR-8 or other)

**Denotation Examples:**

1. **Single-clamp earthing device for power fuse bases**, with the BM-00 line clamp and earthing conductor $L=1$ m long and rated current equal to $4$ kA/1s, made of copper cable $16$ mm$^2$, with the WR-6 earth clamp:

   $U1$-BM-00-1-4/1-16-(WR-6)

2. **Single-clamp earthing device for power fuse bases**, with the BM123 line clamp and earthing conductor $L=2$ m long covered with silicon and rated current $I_r=9$ kA/1s, made of copper cable $35$ mm$^2$ covered with silicon, with the WR-8 earth clamp:

   $U1$-BM123-2-9/1-35-(WR-8)-(SI)

**II. THREE-CLAMP EARTHING DEVICE FOR POWER FUSE BASES:**

**U3-A-L/L1-I/t-S-(B)(C) -** for equal lengths of short-circuiting conductors covered with polyvinyl chloride

**U3-A-L/L1-I/t-S-(B)(C)-(SI) -** for equal lengths of short-circuiting conductors covered with silicon

**U3-A-L/L1/L2/L3-I/t-S-(B)(C) -** for equal lengths of short-circuiting conductors covered with polyvinyl chloride

**U3-A-L/L1/L2/L3-I/t-S-(B)(C)-(SI) -** for equal lengths of short-circuiting conductors covered with silicon

where:

A – kind of line clamps

BM-00 – for fuse bases of 00 size, including ones equipped with knife jaw shields. The installation takes place by means of a fuse holder.

BM-00/A – for fuse bases of 00 size, including ones equipped with knife jaw shields. The installation takes place by means of UI-1 insulating holder.

BM123 – for fuse bases of size 1, 2 and 3, including ones equipped with knife jaw shields. The installation takes place by means of a fuse holder.

BM123/A – for fuse bases of size 1, 2 and 3, including ones equipped with knife jaw shields. The installation takes place by means of UI-1 insulating holder.

**ATTENTION 1:** Lengths of the conductors: $L_1<L_2<L_3$

**ATTENTION 2:** Sum of the lengths $L_1+L_2$ or $L+L_3$ (when the short-circuiting conductors are different) shall not be bigger than 4 m

I – rated short-circuiting current $I_r$ [kA] for short-circuiting time $t_r$

$t$ – rated time $t$ [s]
S - section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short-circuit time

B - connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector
  - S serial connected earthing device

C - denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Denotation Examples:

6. **Three**-clamp earthing device for power fuse bases, with the **BM-00** line clamps, and earthing conductor L= \(0.35\) m long, short-circuiting conductor L1 = \(0.25\) m long and rated current \(I_r = 4\) kA/1s, made of copper cable \(16\) mm\(^2\) with **insulated** middle connector and **WR-8** earth clamp

   \[U3-BM-00-0.35/0.25-4/1-16-(I)(WR-8)\]

7. **Three**-clamp earthing device for power fuse bases, with the **BM-00/A** line clamps, earthing conductor L= \(0.35\) m long, short-circuiting conductor L1 = \(0.25\) m long and rated current \(I_r = 4\) kA/1s, made of copper cable \(16\) mm\(^2\), with **insulated** middle connector and the **WR-6/A** earth clamp

   \[U3-BM-00/A-0.35/0.25-4/1-16-(I)(WR-6/A)\]

8. **Three**-clamp earthing device for power fuse bases, with the **BM123** line clamps, earthing conductor covered with **silicon** L= \(2\) m long, short-circuiting conductors L1 = \(0.2\) m long and rated current \(I_r = 6.5\) kA/1s, made of copper cable \(25\) mm\(^2\), with **insulated** middle connector and the **WR-6** earth clamp

   \[U3-BM123-2/0.2-6.5/1-25-(I)(WR-6)-(SI)\]

9. **Three**-clamp earthing device for power fuse bases, with the **BM123/A** line clamps, and earthing conductor L= \(2\) m long, short-circuiting conductors L1 = \(0.2\) m long and rated current \(I_r = 4\) kA/1s, made of copper cable \(16\) mm\(^2\), with **insulated** middle connector and the **WR-6/A** earth clamp

   \[U3-BM123/A-2/0.2-4/1-16-(I)(WR-6/A)\]

10. **Three**-clamp earthing device for power fuse bases, with the **BM123** line clamps, and earthing conductor L= \(1\) m long, short-circuiting conductors L1 = \(0.28\) m, L2 = \(0.48\) m, L3=\(0.68\) m long, and rated current \(I_r = 9\) kA/1s, made of copper cable \(35\) mm\(^2\), with **insulated** middle connector and the **WR-8** earth clamp

   \[U3-BM123-1/0.28/0.48/0.68-9/1-35-(I)(WR-8)\]

U-BM portable earthing devices are denoted by CE mark.

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-5/08 U-BM Earthing Device of Power Fuse bases.
- WTO-5/02 UI-1 Insulating Holder.
U-BM EARTHING DEVICE OF POWER FUSE BASES
LINE CLAMPS

BM00 Line clamp
BM00/A Line clamp
BM123 Line clamp
BM123/A Line clamp
UI-1 - Insulating holder
U-WBM EARTHING DEVICE OF POWER FUSE BASES WITH REPLACEABLE CARTRIDGES

The U-WBM earthing device is used for protecting the workplace at electrical power installations equipped with BM type fuse bases, by connecting one side of a base (on the side of the device being earthed) with the earth and at the same time electrical separation of the other side. The U-WBM earthing device set consists of 3 small cartridges (size 00, 000 of bases) and 3 big (sizes: 1, 2, 3) and an UI-1/B insulation holder. The U-WBM earthing device is designed for rated currents \(I_r/t\) from 4 kA/s up to 7.5 kA/s. Permissible operating temperature is between -40ºC and +70ºC (conductors are covered with silicone).

The functions of line clamps fulfil cartridges. The WR-6 or WR-8 earth clamps made of brass casting are mounted in standard version, for special request it can be other clamp. Opening and closing the earth clamps jaws is accomplished by hand operated screw terminated with a knob or screw co-operated with UI-1/B insulating holder.

In the three-clamp earthing device, line clamps are connected - through a connector - to the earth clamp by a copper cable of the same cross-section. The connector which connects short-circuit conductors to the earthing conductor is resistant to moisture penetration and assures electrical external insulation of the connected cables. Deflection elements with glue protect the wire against damage in the place of fastening and protect against moisture penetration.

Each cartridge (line clamp) consists of two knives:
- earthing /made of copper, galvanic covered with silver layer/, connected to the copper cable,
- insulating /made of plastic/,
and a catch intended for fastening the UI-1/B holder used for inserting and removing the fuse link from the fuse base.

A whole clamp is made by injection moulding method and makes not dismountable part.

The U-WBM line clamps of the earthing device may be inserted and removed from bases by means of a UI-1/B insulating holder equipped with a spring snap allowing quick installation or disconnection of the line clamp. The insulating holder UI-1/B designed for installing the line clamps of the earthing devices U-WBM is supplied together with the earthing device. It allows precision manoeuvring with the clamp and keeps the personnel at a safe distance from the device being earthed.

As all line clamps have the dimensions close to the dimensions of the power fuses, the switchboard may be closed after installing the earthing device, and at the same time it protects the earthing device from removal by unauthorised persons.

The cross sections of the earthing device conductors in relation to rated currents \(I_r\) and rated time \(t_r\) are given in table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Erthing devices U-WBM configuration with cartridges 00, 000</th>
<th>Erthing devices U-WBM configuration with cartridges 1, 2, 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (I_r), for (t_r = 1s) [kA/s]</td>
<td>4 6.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Conductor cross section [mm²]</td>
<td>16 25</td>
<td>35</td>
</tr>
<tr>
<td>Peak current (I_m) [A]</td>
<td>8 13</td>
<td>15</td>
</tr>
<tr>
<td>Joule’s integral [MA²·s]</td>
<td>16 42</td>
<td>56.25</td>
</tr>
</tbody>
</table>

The earthing devices employ standardised lengths of conductors, as per table II.
TABLE II

<table>
<thead>
<tr>
<th>Earthing device type</th>
<th>Earthing cable length L [m]</th>
<th>Short-circuiting cables lengths [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L1</td>
</tr>
<tr>
<td>U3-WBM</td>
<td>1.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

The earthing device equipped with three line clamps and with different lengths of short-circuiting conductors is intended primarily for bases of power fuses that operate in vertical configuration. There is possibility to manufacture earthing device with other lengths L and L1 graded every 0.1 [m], if:
- the conductors’ lengths L of the single-clamp earthing device or
- the sum of the conductors; lengths L+L1 or L+L3 (when the length of the short-circuiting conductors are different and L1<L2<L3) of the multi-clamp earthing device with conductors connected in parallel do not exceed 4 [m].

The device is packed in a bag made of coated, waterproof fabric.

DENOTATION METHOD:

UX-WBM-L/L1-I/t-S-(B)(C)-(SI)

where:
- **A** – kind of line clamps
- **WBM** – replaceable cartridge for fuse bases of 00, 000 size or 1, 2, 3 including ones equipped with knife jaw shields. The installation takes place by means of a fuse holder UI-1/B.
- **X** – number of line clamps (default: 3)
- **L** – earth conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)
- **L1** – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)
- **L2** – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)
- **L3** – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

**ATTENTION 1:** Lengths of the conductors: L1<L2<L3

**ATTENTION 2:** Sum of the lengths L1+L2 or L+L3 (when the short-circuiting conductors are different) shall not be bigger than 4 m

- **I/t** – rated short-circuiting current I_r [kA] for short-circuiting time t, [s]
- **S** - section [mm^2] of the earthing device conductors resulted from rated current and short-circuit time
- **B** - connection method of multi-clamps earthing device conductors:
  - **I** earthing device with insulated middle connector
  - **S** earthing device with serial connection
- **C** - denotation of earth clamp (WR-6, WR-8 or other)
- **(SI)** - denotation of wire’s silicone insulation

**Denotation Examples:**

1. **Three**-clamp earthing device for power fuse bases, with the 00, 000 and 1, 2, 3 line clamps, earthing conductor L= 1.5 m long, short-circuiting conductor L1 = 0.5 m long and rated current I_r = 4 kA/1s, made of copper cable 16 mm^2 with silicone insulation, **insulated** middle connector and WR-6 earth clamp:
   
   U3-WBM-1,5/0,5-4/1-16-(I)(WR-6)-(SI)

2. **Three**-clamp earthing device for power fuse bases, with the 00, 000 and 1, 2, 3 line clamps, earthing conductor L= 1 m long, short-circuiting conductors: L1 = 0.5 m, L1 = 0.7 m, L1 = 0.9 m long, rated current I_r = 7.5 kA/1s (size 1, 2, 3 configuration) and, rated current I_r = 6.5 kA/1s (size 00, 000 configuration), made of copper cable 35 mm^2 with silicone insulation, **insulated** middle connector and WR-8 earth clamp:
   
   U3-WBM-1/0,5/0,7/0,9-(6,5/1;7,5/1)-35-(I)(WR-8)-(SI)
The U-WBM portable earthing device are denoted by CE mark.

Reference documents:
WTO-3/15  UI-1/B insulating holder.
WTO-2/15  U-WBM earthing device for Power Fuse bases.

U-WBM  PORTABLE EARTHING DEVICE

UI-1/B  INSULATING HOLDER

440
U-BM4/A PORTABLE EARTHING DEVICE FOR POWER FUSE BASES

The U-BM4/A earthing device is used for protecting the workplace at electrical power installations equipped with NH or PN type fuse bases (size 4) by connecting one side of a base (on the side of the device being earthed) with the earth and at the same time electrical separation of the other side. The U-BM4/A earthing device is designed for rated currents $I_r$ from 4 kA up to 13 kA. Permissible operating temperature is between −40°C and +70°C, conductors are covered with silicone.

The functions of line clamps fulfill line inserts. Depending on the number of line clamps, respectively U1-BM single-clamp and U3-BM three-clamp earthing devices are manufactured. The WR-6 or WR-6/A or WR-8 earth clamps made of brass casting can be mounted to all earthing device versions. Opening and closing the earth clamps jaws is accomplished by hand operated screw terminated with a knob.

In the three-clamp earthing device, line clamps are connected - through a connector - to the earth clamp by a copper cable of the same cross-section. The connector which connects short-circuit conductors to the earthing conductor is resistant to moisture penetration and assures electrical external insulation of the connected cables.

In the single-clamp earthing device line clamp is connected to the earth clamp by means of a copper cable. Deflection elements with glue protect the wire against damage in the place of fastening and protect against moisture penetration.

Each line clamp consists of two knives:
- Earthing knife /made of copper, galvanic covered with silver layer/, connected to the copper cable,
- Insulating knife /made of plastic/,
- Catch intended for fastening the UI-1 holder used for inserting and removing the fuse link from the fuse base.

A whole clamp is made by injection moulding method and makes not dismountable part.

The U-BM4/A line clamps of the earthing device may be inserted and removed from bases by means of the insulating holder UI-1 equipped with a spring snap allowing quick installation or disconnection of the line clamp.

The insulating holder UI-1 designed for installing the line clamps of the earthing devices U-BM4/A is supplied together with the earthing device. It allows precision manoeuvring with the clamp and keeps the personnel at a safe distance from the device being earthed. The earth clamp is installed and fastened manually prior to installing line clamps.

As all line clamps have the dimensions close to the dimensions of the power fuses, the switchboard may be closed after installing the earthing device, and at the same time it protects the earthing device from removal by unauthorised persons.

The cross sections of the earthing device conductors in relation to rated currents $I_r$ and rated time $t_r$ are given in table 1.

### TABLE I

<table>
<thead>
<tr>
<th>Parameter</th>
<th>U-BM4/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_r$, for $t_r=1s$ [kA]</td>
<td>4 6.5 9 13</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>16 25 35 50</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>8 13 18 26</td>
</tr>
<tr>
<td>Joule’s integral [MA$^2$s]</td>
<td>16 42 81 169</td>
</tr>
</tbody>
</table>

The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_r$ specified in the IEC 61230:2008 (PN-EN 61230:2011) Standard is shown in the diagram.
Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.

ATTENTION: In the range of times $t_r = 1 \text{ s} \div 3 \text{ s} -$ guaranteed calculated current

The U-BM4/A earthing devices are produced with standard lengths of conductors:

earting conductor - 2m; short-circuiting conductors -0.4m, 0.7m, 1m.

The earthing device equipped with three line clamps and with different lengths of short-circuiting conductors is intended primarily for bases of power fuses that operate in vertical configuration.

There is possibility to manufacture earthing device with other lengths $L$ and $L1$ graded every 0.1 [m], if:

- the conductors’ lengths $L$ of the single-clamp earthing device or
- the sum of the conductors; lengths $L+L1$ or $L+L3$ (when the length of the short-circuiting conductors are different and $L1<L2<L3$) of the multi-clamp earthing device with conductors connected in parallel do not exceed 4 [m].

The device is packed in a bag made of coated, waterproof fabric.

DENOTATION METHOD:

I. SINGLE-CLAMP EARTHING DEVICE FOR POWER FUSE BASES:

$U1$-BM4/A-L/I/t-S-(C)-(SI)

where:

$BM4/A$ - kind of line clamp for fuse bases of 4 size, including ones equipped with knife jaw shields

$L$ - the earth conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

$I/t$ - rated current $I_r$ for rated time $t_r$ [kA/s],

$S$ - cross-section [mm$^2$] of earthing cable as per table I

$C$ - denotation of the earth clamp (WR-6, WR-6/A, WR-8)

(SI) - denotation of wire’s silicone insulation

Denotation Examples:

1. Single-clamp earthing device for power fuse bases, with the BM4/A line clamp and earthing conductor $L=2$ m long covered with silicon and rated current $I_r = 9$ kA/1s, made of copper cable 35 mm$^2$ covered with silicone, with the WR-8 earth clamp:

$U1$-BM4/A-2-9/1-35-(WR-8)-(SI)

II. THREE-CLAMP EARTHING DEVICE FOR POWER FUSE BASES:

$U3$-BM4/A-L/L1-I/t-S-(I)(C)-(SI) - for equal lengths of short-circuiting conductors covered with silicon

$U3$-BM4/A-L/L1/L2/L3-I/t-S-(I)(C)-(SI) - for different lengths of short-circuiting conductors covered with silicon

where:

$BM4/A$ – kind of line clamps for fuse bases of 4 size, including ones equipped with knife jaw shields.

$L$ – earth conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

$L1$ – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

$L2$ – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

$L3$ – short-circuiting conductor length (from 0.2 m to 4 m, graded every 0.02 m or 0.05 m)

ATTENTION 1: Lengths of the conductors: $L1<L2<L3$

ATTENTION 2: Sum of the lengths $L1+L2$ or $L+L3$ (when the short-circuiting conductors are different) shall not be longer than 4 m
\[ \frac{I}{t} \text{ - rated short-circuiting current } I, \text{ for short-circuiting time } t, \text{ [kA/s]} \]

\[ S \text{ - cross-section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short-circuit time} \]

\[ I \text{ - connection method of multi-clamps earthing device conductors} – I \text{ for insulated middle connector} \]

\[ C \text{ - denotation of earth clamp (WR-6, WR-6/A, WR-8)} \]

\[ (SI) \text{ - denotation of wire’s silicone insulation} \]

**Denotation Examples:**

1. Three-clamp earthing device for power fuse bases size 4, with the BM4/A line clamps, and earthing conductor \( L = 2 \text{ m long, short-circuiting conductor } L_1 = 0.5 \text{ m long and rated current } I_r = 9 \text{ kA/1s, made of copper cable } 35 \text{ mm}^2 \text{ covered with silicone, with insulated middle connector and WR-6 earth clamp:} \]

   \[ \text{U3-BM4/A-2/0,5-9/1-35-(I)(WR-6)-(SI)} \]

2. Three-clamp earthing device for power fuse bases, with the BM4/A line clamps, and earthing conductor \( L = 1 \text{ m long, short-circuiting conductors } L_1 = 0.4 \text{ m, } L_2 = 0.7 \text{ m, } L_3 = 1 \text{ m long, and rated current } I_r = 9 \text{ kA/1s, made of copper cable } 35 \text{ mm}^2 \text{ covered with silicone, with insulated middle connector and the WR-8 earth clamp:} \]

   \[ \text{U3-BM4/A-2/0,4/0,7/1-9/1-35-(I)(WR-8)-(SI)} \]

Reference documents:

- WTO-5/02 U1-1 insulating holder.

**U-BM4/A PORTABLE EARTHING DEVICE OF POWER FUSE BASES**

![U-BM4/A PORTABLE EARTHING DEVICE OF POWER FUSE BASES](image)

**UI-1 Insulated holder**
U-BG EARTHING DEVICE OF POWER FUSE BASES (FOR THREADED SOCKETS)

The U-BG earthing device for power fuse bases is used for protecting workplaces at electrical power installations, equipped with E14, E18, E27 or E33 threaded fuse bases, by connecting one side of the base to the earth (on the side of the thread for screwing in the fuse head). The screw cartridges function as line clamps. Permissible operating temperature is between -25°C and +55°C for conductors covered with polyvinyl chloride and -40°C and +70°C for conductors covered with silicone.

Depending on the number of screw cartridges, the U1-BG one-clamp, the U2-BG two-clamp, and U3-BG three-clamp are manufactured. The earth clamp mounted to the earthing device can be WR-6, WR-6/A (made of brass) or other. The screw terminated with a knob allows controlling the clamp jaws’ pressure of WR-6 earth clamp and at WR-6/A control of the clamp jaws pressure is carried out by the UI-1 insulating holder. In the three-phase earthing device the screw cartridges are connected with stranded copper conductor through the connector to the earth clamp by means of a copper cable of the same cross-section through insulated middle connector with earth clamp (the screw cartridges are connected in parallel). For the single-clamp earthing device the screw cartridge is connected with copper cable directly to the earth-clamp. The standard connector connecting short circuiting conductors with the earth conductor can be manufactured as protected against penetration of moisture and it assuring external electrical insulation of connected cables.

Deflection elements with adhesive established near connectors protect the cables against damaging in the place of fastening. Each screw cartridge consists of a copper sleeve, with threads E14, E18, E27 or E33. The sleeve is blinded with a plastic stopper at the thread side at the other end is terminated with a special catch that co-operates with an insulating holder UI-1 used for screwing and unscrewing the screw cartridge from the fuse base and for installation WR-6/A earth clamp. On the threaded sleeve is rotary mounted a copper sleeve with a tap for cable thimble. For the E14 and E18 thread the sleeve has the sufficient length for earthing modern bases equipped with disconnecting switches. As all line screw cartridges have the dimensions, it is possibly to close switchgear after installation an earthing device and thereby to protect the earthing device from removal by unauthorised persons.

Together with earthing device UI-1 insulating holder is supplied. It is equipped with spring snap, it allows rapid installation and dismantling the screw cartridge and allows precision and safe manoeuvring the screw cartridge when it is switched in and out.

The UI-1 insulating holder can safely work at the rated voltage up to 1 kV.

The unit package makes a protective bag made of coated waterproof fabric.

The cross sections, of the conductors of the U-BG earthing device in relation to rated currents \(I_{r1}\) and rated time \(t_r = 1\) s, are given in table I.

| TABLE I |
|-----------------|-----|
| Rated current \(I_{r1}\) at \(t_r = 1\) s \([\text{A}]\) | 4 |
| Conductor cross section \([\text{mm}^2]\) | 16 |
| Peak current \(I_m\) \([\text{kA}]\) | 10 |
| Joule’s integral \([\text{A}^2\text{s}]\) | 16 |

The earthing devices employ standardised lengths of conductors, as per table II.

<p>| TABLE II |
|-----------------|-----|-----|</p>
<table>
<thead>
<tr>
<th>Type of earthing device</th>
<th>Length of earth cable (L) ([\text{m}])</th>
<th>Length of line cable (L1) ([\text{m}])</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1-BG</td>
<td>0,9</td>
<td>-</td>
</tr>
<tr>
<td>U3-BG</td>
<td>0,7</td>
<td>0,25</td>
</tr>
</tbody>
</table>
Following an adequate agreement, the device may be delivered with different cables lengths in the range of doubled lengths of short circuiting conductors and earth conductor given in table II, graded every 0.05 m.

**DENOTATION METHOD:**

**I. SINGLE-PHASE EARTHING DEVICE FOR POWER FUSE BASES**

*FOR THREADED SOCKETS/

\[ \text{U1-BG-A-L-I/t-S-(C)} \]

where:

A – kind of line fuse cartridge:

- \( \text{E14} \) – for fuse bases with E14 thread
- \( \text{E18} \) – for fuse bases with E18 thread
- \( \text{E27} \) – for fuse bases with E27 thread
- \( \text{E33} \) – for fuse bases with E33 thread

L – length of earthing cable [m]

I – rated short-circuiting current \( I_r \) [kA] for short-circuiting time \( t_r \)

t – rated time \( t_r \) [s]

S – section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short-circuit time

C – denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)

- In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Denotation example:

1. Single-phase earthing device for fuse bases, for \( \text{E18} \) threaded sockets, with earthing cable \( L = 0,9 \) m long and rated current \( I_{r_1} = 4 \) kA, made of copper wire with cross-section 16 mm\(^2\) with earth clamp the WR-6:

\[ \text{U1-BG-E18-0,9-4/1-16-(WR-6)} \]

2. Single-phase earthing device for power fuse bases, for \( \text{E27} \) threaded sockets, with earthing cable \( L = 0,9 \) m long and rated current \( I_{r_1} = 4 \) kA, made of copper wire with cross-section 16 mm\(^2\) with silicone insulation, with earth clamp the WR-6/A:

\[ \text{U1-BG-E27-0,9-4/1-16-(WR-6/A)-(SI)} \]

**II. THREE-PHASE EARTHING DEVICE FOR POWER FUSE BASES**

\[ \text{U3-BG-A-L/L1-I/t-S-(B)(C)} \]

where:

A – kind of line fuse cartridge:

- \( \text{E14} \) – for fuse bases with E14 thread
- \( \text{E18} \) – for fuse bases with E18 thread
- \( \text{E27} \) – for fuse bases with E27 thread
- \( \text{E33} \) – for fuse bases with E33 thread

L – length of earthing cable [m]

I – rated short-circuiting current \( I_r \) [kA] for short-circuiting time \( t_r \)

t – rated time \( t_r \) [s]

S – section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short-circuit time

B – connection method of multi-clamps earthing device conductors:

- I – earthing device with insulated middle connector

C – denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)

- In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Denotation Example:
1. **Three-phase** earthing device for fuse bases, for E14 threaded sockets, with earthing conductor L= 0.7 m long, short-circuiting conductors L1=0.25 m long and rated I_{r1} = 4 kA, made of copper wire with section 16 mm², with earth clamp the WR-6/A:

   U3-BG-E14-0.7/0.25-4/1-16-(I)(WR-6/A)

2. **Three-phase** earthing device for fuse bases, for E33 threaded sockets, with earthing conductor L= 0.7 m long, short-circuiting conductors L1=0.25 m long and current I_{r1} = 4 kA, made of copper wire with section 16 mm² with silicone insulation, with earth clamp the WR-8:

   U3-BG-E33-0.7/0.25-4/1-16-(I)(WR-8)-(SI)

**U-BG portable earthing devices are denoted by CE mark.**

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-9/02 U-BG earthing device for fuse bases.
- WTO-5/02 UI-1 Insulating Holder.

**U-BG LINE FUSE CARTRIDGES WITH UI-1 HOLDER**

**U-BG EARTHING DEVICE OF POWER FUSE BASES**
Earth clamp with E14 thread

Earth clamp with E18 thread

Earth clamp with E27 thread

Earth clamp with E33 thread

WR-8 Earth clamp

WR-6/A Earth clamp

WR-6 Earth clamp

U1-BG earthing device

U3-BG earthing device with insulated middle connector
The U-LI10 portable earthing device is designed for earthing insulated lines equipped with bolt-type terminal with diameter of 10 mm (e.g. made by “MALICO”). Maximum rated current $I_{r1}$ for rated time $t_r = 1$ second is $I_{r1} = 4$ kA.

Permissible operating temperature is between -25°C and +55°C for conductors covered with polyvinyl chloride and -40°C and +70°C for conductors covered with silicone. The earthing device consists of: maximum five cylindrical line clamps (made of plastic) connected in serial with short circuiting conductors, earthing conductor with earth clamp.

Short circuiting conductors are clamped directly inside of the line clamps.

The conductors made of copper cable are covered with protection transparent plastic. Deflection element with glue protects the cable (in the place of fastening the earth clamp) against damage and against negative influence of moisture penetration.

The earthing device is equipped in the earth clamp – WR-6, KL or other. The WR-6 earth clamps are made as brass castings and they are clamped by screwing home the screw provided with rotary mounted clamp. The KL snap-type earth clamp made of aluminium flat bar enables quick and reliable fastening it on 50 x 50 mm angle or on 50 mm wide flat bar.

The cross sections of the earthing device for the rated current $I_{r1}$ and rated time $t_r = 1$ s are given in table I.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>U-LI10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ [kA] for rated time $t_r = 1$ [s]</td>
<td>4</td>
</tr>
<tr>
<td>Conductor’s cross section [mm$^2$]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current $I_{m}$ [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
<td>16</td>
</tr>
</tbody>
</table>

The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_r$ specified in the IEC 61230:2008 (PN-EN 61230:2011) Standard is shown in the diagram.

**Diagram**

Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.

**Attention:**

In the range of times $t_r = 1$ s ÷ 3 s - guaranteed calculated current

0.1 s ÷ 1 s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

The standard lengths of the earthing device conductors are given in table II:
TABLE II

<table>
<thead>
<tr>
<th>L [m]</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 [m]</td>
<td>0.5</td>
<td>0.7</td>
<td>0.9</td>
<td>1</td>
</tr>
</tbody>
</table>

For special order, the earthing devices with 20 m of conductor’s total length (short-circuiting conductor and earthing conductors) may be provided (in the range from 0.1 m, graded every 0.2 m).

A unit package makes a protective cover made of coated waterproof fabric with the strap to carry it on shoulder.

DENOTATION METHOD:

UX-LI10-L/L1-I/t-S-(B)(C)

where:

- **X** - number of line clamps: 1, 3, 4, 5
- **L** - length of earthing conductor [m]
- **L1** - length of short circuiting conductor [m] – it doesn’t exist for X=1
- **I** - rated current \( I_{t_1} \) for the time \( t_r=1 \text{s} \) of short-circuiting conductors and earthing conductor [kA]
- **t** - rated time \( t_r \) [s]
- **S** - section [mm\(^2\)] of the earthing device conductors resulted from rated current and short-circuit time
- **B** - connection method of multi-clamps earthing device conductors:
  - **I** earthing device with insulated middle connector
  - **S** serial connected earthing device
- **C** - denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:

1. Portable, five-clamp earthing device for U5-LI10 insulated lines with earthing conductor \( L=8 \text{ m} \) long, short circuiting conductors \( L_1=0.7 \text{ m} \) long and rated current \( I_{t_1}=4 \text{ kA} \), made of copper cable with section 16 mm\(^2\), earth clamp WR-6:

   U5-LI10-8/0.7-4/1-16-(I)(WR-6)

2. Portable, three-clamp earthing device for U3-LI10 insulated lines with earthing conductor \( L=12 \text{ m} \) long, short circuiting conductors \( L_1=0.5 \text{ m} \) long and rated current \( I_{t_1}=4 \text{ kA} \), made of copper cable with section 16 mm\(^2\) with silicone insulation (SI), serial connection, earth clamp KL with:

   U3-LI10-12/0.5-4/1-16-(S)(KL)-(SI)

U-LI10 portable earthing devices are denoted by CE mark.

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
1. WT-I10 Line clamp
2. WR-6 Earth clamp
3. WR-8 Earth clamp
4. KL Earth clamp
5. Line conductor
6. Earth conductor
U-LI11 PORTABLE EARTHING DEVICE for INSULATED LINES  
(11 mm bolt diameter)

The U-LI11 portable earthing device is designed for earthing insulated lines equipped with bolt-type terminal with diameter of 11 mm (e.g. of type TTD2 CC made by “SICAME”). Maximum rated current \(I_{r1}\) for rated time \(t_r=1\) second is \(I_{r1}=4\) kA. Permissible operating temperature is between -25ºC and +55ºC for conductors covered with polyvinyl chloride and -40ºC and +70ºC for conductors covered with silicone.

The earthing device consists of:
- maximum five cylindrical line clamps (made of plastic) connected in serial with short circuiting conductors,
- earthing conductor with earth clamp.

Short circuiting conductors are clamped directly inside of the line clamps.

The conductors made of copper cable are covered with protection transparent plastic. Deflection element with glue protects the cable (in the place of fastening the earth clamp) against damage and against negative influence of moisture penetration.

The earthing device is equipped in the earth clamp: WR-6, KL or other.

The WR-6 earth clamp are made as brass castings and it is clamped by screwing home the screw provided with rotary mounted clamp.

The KL snap-type earth clamp made of aluminium flat bar enables quick and reliable fastening it on 50 x 50 mm angle or on 50 mm wide flat bar.

The cross sections of the earthing device for the rated current \(I_{r1}\) and rated time \(t_r=1\) s are given in table I.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>U-LI11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current (I_{r1}) [kA] for rated time (t_r=1) [s]</td>
<td>4</td>
</tr>
<tr>
<td>Conductor’s cross section [mm(^2)]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current (I_m) [kA]</td>
<td>10</td>
</tr>
<tr>
<td>Joule’s integral [A(^2)s]</td>
<td>16</td>
</tr>
</tbody>
</table>

The standard lengths of the earthing device conductors are given in table II:

| TABLE II         |
|------------------|--------|
| \(L\) [m]        | 8      | 10    | 12    | 14    |
| \(L_1\) [m]      | 0.5    | 0.7   | 0.9   | 1     |

For special order, the earthing devices with 20 m of conductor’s total length (short-circuiting conductor and earthing conductors) may be provided (in the range from 0.1 m, graded every 0.2 m).

A unit package makes a protective cover made of coated waterproof fabric with the strap to carry it on shoulder.

DENOTATION METHOD:
UX-LI11-L/L₁₁-I/t-S-(B)(C)

where:
X    - number of line clamps: 1, 2, 3, 4, 5
L    - length of earthing conductor [m]
L₁₁  - length of short circuiting conductor [m] – it doesn’t exist for X=1
I    - rated current I₁₁ for the time tᵣ=1s of short-circuiting conductors and earthing conductor [kA]
t    - rated time tᵣ [s]
S    - section [mm²] of the earthing device conductors resulted from rated current and short-circuit time
B    - connection method of multi-clamps earthing device conductors:
   - I earthing device with insulated middle connector
   - S serial connected earthing device
C    - denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:
1. Portable, five-clamp earthing device for U₅-LI11 insulated lines with earthing conductor L=8 m long, short circuiting conductors L₁₁=0.7 m long and rated current I₁₁ = 4 kA, made of copper cable with section 16 sq. mm, earth clamp WR-6:

   U₅-LI11-8/0.7-4/1-16-(S)(WR-6)

2. Portable, three-clamp earthing device for U₃-LI11 insulated lines with earthing conductor L=12 m long, short circuiting conductors L₁₁=0.5 m long and rated current I₁₁ = 4 kA, made of copper cable with section 16 sq. mm with silicone insulation, earth clamp KL:

   U₃-LI11-12/0.5-4/1-16-(S)(KL)-(SI)

U-LI10 portable earthing devices are denoted by CE mark.

Reference documents:
PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
WTO-3/05 U-LI10 and U-LI11 portable earthing devices for insulated lines.
U-LI11 PORTABLE EARTHING DEVICE for INSULATED LINES

1. LI-11 line clamp of snap-type
2. WR-6 earth clamp
3. WR-8 earth clamp
4. KL earth clamp
5. Short-circuiting conductor
6. Earthing conductor
U-MP PORTABLE EARTHING DEVICE FOR SMALL DIAMETERS

The U-MP portable earthing device for small diameters conductors (5 – 10 mm) is intended for earthing the conductors in circuits with voltage up to 1 kV. The earthing device consists of maximum seven line clamps which are firmly fastened to insulating holders; mount of line clamp on a conductor is provided by screw the insulating holder clockwise. The holder handle together with limiter is made of plastic moulded piece and insulating part of epoxy-glass rod. The U-MP earthing device is designed for rated short-circuit currents $I_{r1}$ from 4 kA up to 6.5 kA per 1s. Permissible temperature of work is between -40ºC and +70ºC, insulation is made of silicone. Stranded copper conductors are protected by means of flexible shield made of transparent plastic. Deflection elements protect the wire against damaging in the place of fastening and against penetration and harmful interaction of moisture.

In standard version of U-MP device is provided with the WR-6 earth clamp; for special request it could be other (e.g. WT-K25/B with insulating holder up to 1 kV). Each line clamp (WT-6 type) can be put on and taken off by one hand – it makes easier mounting and dismounting the earthing device. Every U-MP earthing device could be manufactured as a serial or in parallel connection of line clamps. For parallel version, with (from 2 to 7) clamps there is a connector which connects the short-circuiting conductors with the earth conductor. For serial version, short-circuiting conductors are fastened directly on clamps. The connector is resistant to moisture penetration in the conductor’s area and assures electrical insulation of the connected conductors from external influences. Such solution is reliable and stable and also protects the user against occasional contact with live parts during servicing. The connector used in this earthing device permitted to minimize life hazard of user during exploitation.

For the rated current $I_{r1}$ and rated time $t_r = 1$ s, conductors of the earthing device have the cross sections according to table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All types of earthing devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$, for $t_r = 1$s [kA]</td>
<td>4</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>16</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>8</td>
</tr>
<tr>
<td>Joule’s integral [MA$^2$s]</td>
<td>16</td>
</tr>
</tbody>
</table>

The U-MP earthing devices are produced with standard lengths of conductors: earthing conductor - 2m; short-circuiting conductors - 1m.

On special request the earthing device with the earthing and short circuiting conductors with the lengths $L+L_1$ for 0.1 m up to 24 m, graded every 0.2 m may be supplied.

The unit package makes protective bag made of coated waterproof fabric with the strap to throw it over an arm.

**DENOTATION METHOD:**

UX-MP-L/L1-I/t-S-(B)(C)-(SI)

where:
- $X$ – number of line clamps
- MP - type of earthing device (with line clamps WT-6 type)
- L – earth conductor length
- $L_1$ – short-circuiting conductor length
- $I/t$ - rated short-circuiting current $I_s$ for short-circuiting time $t_r$ [kA/s]
- S - cross-section [mm$^2$] of the earthing device conductors resulted from rated current
B - connection method of multi-clamps earthing device conductors – S for serial connection; I for insulated middle connector

C - denotation of earth clamp (WR-6, WR-8 or other)
(SI) - denotation of wire’s silicone insulation

**Denotation Examples:**

1. Three-clamp earthing device for small diameters, with the WT-6 line clamps, and earthing conductor L= 2 m long, short-circuiting conductor L1 = 0.5 m long and rated current Ir = 6.5 kA/1s, made of copper cable 25 mm² covered with silicone, with insulated middle connector and WR-6 earth clamp:

   U3-MP-2/0.5-6.5/1-25-(I)(WR-6)-(SI)

2. Five-clamp earthing device for small diameters, with WT-6 line clamps, and earthing conductor L= 1 m long, short-circuiting conductors L1 = 0.4 m, long, and rated current Ir = 4 kA/1s, made of copper cable 16 mm² covered with silicone, with serial connection of line clamps and the WR-8 earth clamp:

   U5-MP-1/0.4-4/1-16-(S)(WR-8)-(SI)

Reference documents:


**U-MP PORTABLE EARTHING DEVICE FOR SMALL DIAMETERS**
U-S PORTABLE EARTHING DEVICE FOR BOLT TYPE TERMINAL

The U-S portable earthing device for bolt type terminal is used for protecting the workplace at electrical equipment and lines equipped with bolt type terminal (e.g. for RSK-6 cabinets). The WT-S line clamp is made of a profiled copper tube and is equipped with a special slider that provides adequate electrical contact. Permissible operating temperature is between -25°C and +55°C for conductors covered with polyvinyl chloride and -40°C and +70°C for conductors covered with silicone.

The line clamps are installed by means of the insulating stick designed for installing earthing devices (DU-A or UDI-B). A special tip of the clamp allows placing it directly into the stick head, put it on the element being earthed and take the stick off without the necessity of releasing the head snap. The earthing device may be supplied in one or three-clamp versions. In the three-clamp device the line clamps are connected to the insulated middle connector by means of short-circuiting conductors made of copper cable further connected to the earth clamp: WR-6 made of brass, or WR-2z made of aluminium alloy, or other.

In the single-phase version the line clamp is directly connected by earth conductor (made of copper cable) to the WR-6 or WR-2z or other earth clamp. The U-3S device is resistant to moisture penetration into conductor’s area.

Connection point of conductors is also resistant to moisture penetration and it ensures electrical insulation of the connected cables. Deflection elements with adhesive protect the wire against damage in the places of fastening and against penetration of moisture.

For the rated current \( I_{1} \) and rated time \( t_{r} = 1 \text{ s} \), conductors of the earthing device have the cross sections according to table.

<table>
<thead>
<tr>
<th>Rated current ( I_{1} ) for ( t_{r} = 1 \text{ s} ) [kA]</th>
<th>4</th>
<th>6.5</th>
<th>9</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthing device conductor section ( [\text{mm}^{2}] )</td>
<td>16</td>
<td>25</td>
<td>35</td>
<td>50</td>
</tr>
</tbody>
</table>

The standard lengths of the earthing device conductors are as follows:
- for single-clamp \( L = 1.5 \text{m} \)
- for three-clamp \( L = 1 \text{m}, L_{1} = 0.7 \text{m} \)

Following adequate agreement other lengths of the single-clamp and three-clamp conductors may be provided. The range of the lengths \( L \) and \( L_{1} \) is from 0.7 m up to 8 m, graded every 0.2 m

**DENOTATION METHOD:**

UX-S-L/L1-I/t-S-(B)(C)

where:

- \( X \) - number of line clamps: 1, 2, 3
- \( L \) - length of earthing conductor [m]
- \( L_{1} \) - length of short circuiting conductor [m] – it doesn’t exist for \( X=1 \)
- \( I \) - rated current \( I_{1} \) for the time \( t_{r}=1 \text{ s} \) of short-circuiting conductors and earthing conductor [kA]
- \( t \) - rated time \( t_{r} \) [s]
- \( S \) - section \([\text{mm}^{2}]\) of the earthing device conductors resulted from rated current and short-circuit time
- \( B \) - connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector
  - S serial connected earthing device
- \( C \) - denotation of earth clamp (WR-6, WR-6/A, WR-8 or other)
In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Denotation Example:

1. **Single-clamp** earthing device for the bolt type terminal, with earthing conductor L = 1.5 m long and rated 1-second current equal to 9 kA, made of copper wire with cross-section 35 mm\(^2\), with the **WR-8** earth clamp:

   \[U1-S-1.5-9/1-35-(WR-6)\]

2. **Single-clamp** earthing device for the bolt type terminal, with earthing conductor L = 8 m long and rated 1-second current equal to 13 kA, made of copper wire with section 50 mm\(^2\) with silicone insulation, with the **WR-8** earth clamp:

   \[U1-S-8-13/1-50-(WR-8)-(SI)\]

The unit package makes a bag made of coated waterproof fabric.

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-11/01 U-S bolt type terminal portable earthing device.

**U-S PORTABLE EARTHING DEVICE FOR BOLT TYPE TERMINAL**

![Diagram of U-S Portable Earthing Device](attachment:image)
The U-K portable earthing device is used for protecting the work location at line and station electrical equipment, equipped with round conductors or flat bus-bars or that which have ball type terminals disconnected from the power source by connection to the earth clamp. Permissible operating temperature is between -25°C and +55°C for conductors covered with polyvinyl chloride and -40°C and +70°C for conductors covered with silicone. Depending on the number of line clamps, one-, two-, three-, four- or five-clamp earthing devices are manufactured; the clamps can be connected in serial or in parallel. Types U1-K, U2-K, U3-K are manufactured for all values of the short circuit currents $I_t$ for time of duration of short circuit $t_r = 1$ s, specified in table I. Types U4-K and U5-K and U4L-K and U5L-K are manufactured for max current $I_t = 9$ kA and time $t_r = 1$ s. The primary model of portable earthing device bases on the WR-K25 earth clamp, for client desire it can be manufactured the other type, e.g. WR-2z or WT- K25/B with holder up to 1 kV (with exception the U1-K version, because such version is typical phase comparator) and the WT-K25 line clamps. For client desire it can be manufactured other type of line clamp, e.g. WT-K25/A or WT- K25/B with holder up to 1 kV. Serial type of the earthing device with the WT-K25/B line and earth clamps in the case when short circuiting conductors and earth conductor have the same length ($L_1=L$) is defined as a phase comparator. The WT-25K line clamp can be used for flat bus-bars or ball type terminal. The WT-25K/A and WT- 25K/B line clamps can be used as an universal for round conductors, flat bus-bars or ball type terminals $\varnothing 25$ or $\varnothing 20$. The versions differ with kind of clamping. When used for round conductors the WT-K25/A and WT-K25/B clamps can be used for diameters of the earthed conductors up to 34 mm. When used for flat bus-bars, the WT-K25, WT-K25/A and WT-K25/B clamps make possible fastening at the angle of 45° to the bars 34 mm thick. The WT-K25/A clamps are designed to be snapped in the head of insulating stick for installing the earthing device (DU-A or UDI-B). In this configuration it can be used both for round conductors, for flat bus-bars and for ball-type terminals, if the user is equipped with the same number of sticks as line clamps of the earthing device. The line and earth clamps, in all versions, are designed for rated current $I_t$ up to 31.5 kA for the time $t_r = 1$ s. There is a possibility to order one phase device with rated current $I_t=45$kA for rated time 0.25s. On request other clamps (a.e. WR-8) may be used. For parallel version, with two-, three-, four- and five clamps there is a connector which connects the short-circuiting conductors with the earth conductor. For serial version, short-circuiting conductors are fastened directly on clamps. The connector is resistant to moisture penetration in the conductor’s area and assures electrical insulation of the connected conductors from external influences. It makes possible to join any configurations of the earthing device, including the light one. Such solution is reliable and stable and also protects the user against occasional contact with live parts during servicing. The connector in this earthing device permitted to minimize life hazard of user during exploitation and considerably limited heat emitting during short-circuit. All line clamps are made of brass. The screw terminated with a knob allows controlling the jaw’s pressure. The pressure of the jaws equals approximately 1 kN. Line clamps and earth clamp are connected to one another by means of a copper cable coated with a flexible transparent plastic cover. Deflection elements protect the cable (in the place of fastening) against damage and moisture penetration. For the rated current $I_t$ and rated time $t_r = 1$ s conductors of the earthing device have the cross sections according to table I & II.

<table>
<thead>
<tr>
<th>Table I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated current</strong> $I_t$ for rated time [kA/s]</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>Peak current $I_{m}$ [kA]</td>
</tr>
<tr>
<td>Joule’s integral [A²s]</td>
</tr>
<tr>
<td>Cross section of conductor [mm²]</td>
</tr>
</tbody>
</table>
### Table II – special version for high current

<table>
<thead>
<tr>
<th>Type of earthing device</th>
<th>U1-K with silicone insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_r$ [kA]</td>
<td>31.5</td>
</tr>
<tr>
<td>Rated time $t_r$ [s]</td>
<td>1</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>78.7</td>
</tr>
<tr>
<td>Joule’s integral [A’s]</td>
<td>992</td>
</tr>
<tr>
<td>Cross section of conductor [mm$^2$]</td>
<td>150</td>
</tr>
</tbody>
</table>

It is possible to manufacture the earthing devices with different L and L1 lengths graded every 0.1 m, if:

- the length L of single-clamp earthing device or
- sum of the lengths L+L1 of multi--clamp earthing device with conductors connected in parallel or
- sum of the lengths L+(X-1)L1 of multi-clamp earthing device with conductors connected in series will not exceed 24 [m].

The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_r$ specified in the IEC 61230:2008 Standard is shown in the diagram. Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.

**Diagram**

ATTENTION:
In the range of times $t_r$:

- $1 \text{ s} ÷ 3 \text{ s}$ - guaranteed calculated current
- $0.1 \text{ s} ÷ 1 \text{ s}$ - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

A unit package of the earthing device makes a protective cover made of coated waterproof fabric.
The production program involves also portable light earthing devices, whose earth conductor has a smaller cross section than the sections of the short-circuiting conductors. They can be used in networks, which are not directly earthed.

Proper choice of minimal earth conductor sections depending on the short-circuiting conductors can be done according to table III.

<table>
<thead>
<tr>
<th>Section of short-circuiting conductor $S_1$ [mm$^2$]</th>
<th>Cross section of earth conductor $S$ [mm$^2$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>16</td>
</tr>
<tr>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>95</td>
<td>35</td>
</tr>
<tr>
<td>120</td>
<td>50</td>
</tr>
<tr>
<td>150</td>
<td>50</td>
</tr>
</tbody>
</table>

Attention: The sections $S$ of the earthing device given in table III are minimal; it is permissible to manufacture the light earthing devices with larger sections of the earth conductors.

DENOTATION OF VERSIONS OF THE U-K EARTHING DEVICES

I. U1-K SINGLE-CLAMP PORTABLE EARTHING DEVICE

$U1-K-A-L/-I/t-S–(C)$

where:

- **A** - denotation of the line clamp
  - **WT-K25** - line clamp for flat bus-bar and ball type terminal up to 31.5 kA/1s
  - **WT-K25/A** - line clamp for round conductor, flat bus-bar and ball type terminal up to 31.5 kA/1s
  - **WT-K25/B** - line clamp for round conductor, flat bus-bar and ball type terminal up to 31.5 kA/1s
- **L** - length of the earth conductor (from 0.3 [m] to 24 [m] graded every 0.1 [m])
- **I** - rated short-circuit current $I_r$ [kA] for rated time $t_r$ [s]
- **t** - rated short-circuit time $t_r$ [s]
- **S** - section [mm$^2$] of the earthing device conductors resulted from rated current and short circuit time
- **C** - denotation of earth clamp (WR-8, WR-2z or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:

1. Portable, single-clamp earthing device for round conductors, flat-bus bar and ball type terminal (WT-K25/A clamp) with earth conductor $L = 16$ m long and rated current $I_r = 25$ kA/1s, made of copper cable with section 120 mm$^2$ and **WR-K25** earth clamp:

   $U1-K-WT-K25/A-16-25/1-120-(WR-K25)$

2. Portable, single-clamp earthing device for flat-bus bar and ball type terminal (WT-K25 clamp) with earth conductor $L = 8$ m long and rated current $I_r = 31.5$ kA/1s, made of copper cable with section 150 mm$^2$ with silicone insulation, with **WR-2z** earth clamp:

   $U1-K-WT-K25-8-31.5/1-150-(WR-2z)-(SI)$

II. U2-U5-K PORTABLE MULTI-CLAMP EARTHING DEVICE

$UX-K-A-L/L1/I/t-S–(B)(C)$

where:
X - number of line clamps (from 2 to 5)
A - type of line clamp:
  WT-K25 - line clamp for flat bus-bar and ball type terminal to 31.5 kA/1s
  WT-K25/A - line clamp for round conductor, flat bus-bar and ball type terminal to 31.5 kA/1s
  WT-K25/B - line clamp for round conductor, flat bus-bar and ball type terminal to 31.5 kA/1s
L - length of the earth conductor (from 0.3 [m] graded every 0.1 [m])
L1 - length of the short-circuiting conductor (from 0.3 [m] graded every 0.1 [m])

ATTENTION: Total length of multi-clamp earthing device in series and parallel version shall not exceed 24 m

I - rated short-circuit current \( I_r \) [kA] for short-circuit time \( t_r \) [s]
t - rated short-circuit time \( t_r \) [s]
S - section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short circuit time
B - connection method of multi-clamps earthing device conductors:
  - I earthing device with insulated middle connector or
  - S earthing device connected in series
C - denotation of the earth clamp (WR-K25, WR-2z, WT-K25/B or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Examples of denotation:
1. Portable, five-clamp earthing device for round conductor, flat bus-bar and ball type terminal (WT-K25/A clamp) with earth conductor \( L = 5 \) m long, short circuiting conductors \( L_1 = 1.6 \) m long and rated current \( I_r = 6.5 \) kA/1s, made of copper cable with section 25 mm\(^2\) and WR-K25 earth clamp:

   U5-K-WT-K25/A-5/1.6-6.5/1-25-(I)(WR-K25)

2. Portable, three-clamp earthing device for flat bus-bar and ball type terminal (WT-25 clamp) with earth conductor \( L = 3 \) m long, short circuiting conductors \( L_1 = 1 \) m long and rated current \( I_r = 31.5 \) kA/1s, made of copper cable with section 150 mm\(^2\) and serial clamp connection and WR-2z earth clamp:

   U3-K-WT-K25-3/1-31.5/1-150-(S)-(WR-2z)-(SI)

3. Portable, four-clamp earthing device for flat bus-bar and ball type terminal (WT-K25 clamp) with earth conductor \( L = 8 \) m long, short circuiting conductors \( L_1 = 5 \) m long and rated current \( I_r = 13 \) kA/1s, made of copper cable with section 50 mm\(^2\) with silicone insulation, insulated middle connector and WR-K25 earth clamp:

   U4-K-WT-K25-8/5-13/1-50-(I)-(WR-K25)-(SI)

III. U2-U5-K PORTABLE LIGHT MULTI-CLAMP EARTHING DEVICE

Denotation of the light earthing device (i.e. the device which has cross-section of the earth conductor smaller than that of the short circuiting conductors) is as follows:

   UXL-K-A-L/L1-I/t-S/I1/t-S1-(B)-(C)

where:
X - number of line clamps (from 2 to 5)
A - type of line clamp:
WT-K25 - line clamp for flat bus-bar and ball type terminal to 31.5 kA/1s
WT-K25/A - line clamp for round conductor, flat bus-bar and ball type terminal to 31.5 kA/1s
WT-K25/B - line clamp for round conductor, flat bus-bar and ball type terminal to 31.5 kA/1s

L - length of the earth conductor (from 0.3 [m] graded every 0.1 [m])
L1 - length of the short-circuiting conductor (from 0.3 [m] graded every 0.1 [m])

ATTENTION: Total length of multi-clamp earthing device in series and parallel version shall not exceed 24 m

I - rated short-circuit current \( I_r \) [kA] for rated time \( t_r \) [s]

\( t \) - rated short-circuit time \( t_r \) [s]

S - section \([\text{mm}^2]\) of the earthing device conductors resulted from rated current and short circuit time

I1 - rated short-circuit current \([\text{kA}]\) for rated time \( t_r \) [s]

S1 - section \([\text{mm}^2]\) of the short-circuiting conductors resulted from rated current and short circuit time

B - connection method of multi-clamps earthing device conductors:
- I earthing device with insulated middle connector or
- S earthing device connected in series

C - denotation of the earth clamp (WR-2z, WR-K25, WT-K25/B)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Example of denotation:

Portable, four clamp, light earthing device for round conductors flat bus-bar and ball type terminal (WT-K25/A clamp) with earth conductor \( L=3 \) m long and rated current \( I_r = 6.5 \) kA/1s, made of copper cable with cross section 25 mm\(^2\), short circuiting conductors \( L1=2 \) m long and rated current \( I_r = 9 \) kA/1s, made of copper cable with cross section 35 mm\(^2\), insulated middle connector and WR-K25 earth clamp

U4L-K-WT-K25/A-3/2-6.5/1-25/9/1-35-(I)-(WR-K25)

The U-K portable earthing devices in the range of low voltages are denoted by CE mark.

Reference documents:
PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
WTO-1/05 U-K portable earthing device for ball type terminal.
CLAMPS OF THE U-K PORTABLE EARTHING DEVICE

WT-K25 line clamp
(for round conductors, flat bus bars and ball type terminal)

WT-K25/B line clamp and earth clamp
with holder to 1 kV (for round conductors, flat bus bars and ball type terminal)

WT-K25 line clamp
(for round conductors, flat bus bars and ball type terminal – for fastening in the UDI head)
"A" Version

WR-K25 earth clamp
Z-K PORTABLE SHORT-CIRCUITING DEVICE FOR BALL TYPE TERMINAL

The Z-K portable short-circuiting device is designed for fast, easy and reliable short-circuiting the line conductors of power networks and indoor and out-door electrical equipment of low, medium and high voltage, for different rating currents $I_r$ (one second rated currents is not bigger than $I_r = 31.5$ kA). It is an element of earthing system. It should be used in the situations when service staff is not sure as far as the properties of the existing earthing equipment is concerned and there is no possibility to use the P earthing device extension. In such situation one should earth the outer line conductor (in accessible place) and in the work location of the service staff, one should short (connect) the other conductors with the - earlier earthed - line conductor. Permissible operating temperature is between -25ºC and +55ºC for conductors covered with polyvinyl chloride and -40ºC and +70ºC for conductors covered with silicone. Depending on the number of line clamps, two-, three-, four- and five-clamp short-circuiting devices are manufactured and they are denoted adequately Z2-K, Z3-K, Z4-K and Z5-K. The primary model of portable short-circuiting device bases on the WT-K25 earth clamps. For client desire, the other line clamps can be manufactured, e.g. WT-K25/A or WT-K25/B with insulating handles up to 1 kV.

The WT-K25 line clamp can be used for flat bus-bars or ball type terminal. The WT-25K/A and WT-25K/B line clamps can be used as an universal for round conductors, flat bus-bars or ball type terminals Ø25 or Ø20. The versions differ with kind of clamping. When used for round conductors the WT-K25/A and WT-K25/B clamps can be used for diameters of the earthed conductors up to 34 mm. When used for flat bus-bars, the WT-K25, WT-K25/A and WT-K25/B clamps make possible fastening at the angle of 45° to the bars 34 mm thick. The WT-K25 clamp is put on insulating stick’s head (UDK-A or UDI-B), mounted on flat bus bar or ball type terminal and then dismantled. The WT-K25/A clamps are designed to be snapped in the head of insulating stick for installing the earthing device. In this configuration it can be used both for round conductors, for flat bus-bars and for ball-type terminals, if the user is equipped with the same number of sticks as line clamps of the earthing device. The line and earth clamps, in all versions, are designed for rated current $I_r$ up to 31.5 kA for the time $t_r = 1$ s.

All line clamps are made of brass. The screw terminated with a knob allows controlling the jaw’s pressure. The pressure of the jaws equals approximately 1 kN. Line clamps and earth clamp are connected to one another by means of a copper cable coated with a flexible transparent plastic cover. Deflection elements with glue protect the cable (in the place of fastening) against damage and moisture penetration.

For the rated current $I_r$ and rated time $t_r = 1$ s conductors of the earthing device have the cross sections according to table.

<table>
<thead>
<tr>
<th>All types of short-circuiting devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ [kA] for rated time $t_r = 1$ [s]</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
</tr>
<tr>
<td>Cross section of earthing device conductor [mm$^2$]</td>
</tr>
</tbody>
</table>
For an orderer desire, the devices with the L1 lengths equal or bigger than 0.3 m graded every 0.1 m and total length of short-circuiting device \((X-1)L1\) not exceed 24 m, may be provided.

A unit package of the short-circuiting device makes a protective cover made of coated waterproof fabric.

**DENOTATION OF THE Z-K SHORT-CIRCUITING DEVICE VERSIONS**

\[
ZX-K-A-L1-I/t-S-(B)
\]

where:

- \(X\) - number of line clamps (from 2 to 5)
- \(A\) - type of line clamp:
  - **WT-K25** - line clamp for flat bus-bar and ball type terminal to 31.5 kA/1s
  - **WT-K25/A** - line clamp for round conductor, flat bus-bar and ball type terminal to 31.5 kA/1s
  - **WT-K25/B** - line clamp for round conductor, flat bus-bar and ball type terminal up to 31.5 kA/s
- \(L1\) - length of the short-circuiting conductor (from 0.3 [m] graded every 0.1 [m])

**ATTENTION:** Total length of multi-clamp earthing device in series version shall not exceed 24 m

- \(I\) - rated short-circuit current \(I_r\) [kA] for short-circuit time \(t_r\) [s]
- \(t\) - rated short-circuit time \(t_r\) [s]
- \(S\) - section [\(mm^2\)] of the short-circuiting device conductors resulted from rated current and short circuit time
- \(B\) - connection method of multi-clamps earthing device conductors:
  - **S** earthing device connected in series

In case when silicone insulation of wire (instead of PVC) is used symbol “−(SI)” is added to denotation.

**Examples of denotation:**

1. Portable, **five**-clamp short-circuiting device for flat bus-bars and ball type terminal (WT-K25 clamp) with short circuiting conductor \(L1=1\) m long and rated current \(I_r=6.5\) kA/1s, made of copper cable with section 25 mm² in series version:

   \[
   Z5-WT-K25-1-6.5/1-25-(S)
   \]

2. Portable, **four**-clamp short-circuiting device for round conductors flat bus-bars and ball type terminal (WT-K25/A clamp) with short-circuiting conductor \(L1=3\) m long and rated current \(I_r=9\) kA/1s, made of copper cable with section 35 mm² in series version:

   \[
   Z4-K-WT-K25/A-3-9/1-35-(S)
   \]

3. Portable, **three**-clamp short-circuiting device up to 1 kV for round conductors flat bus-bars and ball type terminal (WT-K25/B clamp) with short circuiting conductor \(L1=5\) m long and rated current \(I_r=25\) kA, made of copper cable with section 120 mm² with silicone insulation, in series version:

   \[
   Z3-K-WT-K25/B-5-25/1-120-(S)-(SI)
   \]

The Z-K short-circuiting devices in the range of low voltages are denoted by CE mark

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-2/06 Z-K portable short-circuiting device for ball type terminal.
Z-K PORTABLE SHORT-CIRCUITING DEVICE (SERIAL VERSION)

WT-K25 clamp
U-PR PORTABLE EARTHING DEVICE FOR SWITCH BAY

The U-PR portable earthing device is used for protecting the work location at switch bays where access to bolts/sockets is difficult, possible only from front side; this configuration is common in special switches used in mines. This devices are manufactured for different rated currents, max current \( I_r = 13 \text{ kA} \) and time \( t_r = 1 \text{ s} \). Permissible operating temperature is between \(-25^\circ\text{C}\) and \(+55^\circ\text{C}\) for conductors covered with polyvinyl chloride and \(-40^\circ\text{C}\) and \(+70^\circ\text{C}\) for conductors covered with silicone. Device consist of WT-4 line clamp, which are made cast. Their screws and contact elements are also made of brass. Line clamps are mounted with usage of insulating stick (DU-A or UDI-B). Jaws of clamp can be positioned in angle range 0-90° to axis of clamp’s winder. Clamps can be mounted on the rectangular shapes, which has wall span from 5 to 40 mm or on cylinders with diemeter from 12 to 35 mm, or on screw’s head or nut from M6 to M24 or other shapes with similar dimension range. Clamp’s knob allow to mount it in UDI’s head and it’s safeted from protrude during the work; user can unmount UDI stick after tightening. Clamps are screwed manually, max width of rail on with clamp can ber mount is 24 mm. Device can be designed as single-clamp, two-clamp or three-clamp. Three and two clamp device has an insulated middle connector which connects the short-circuiting conductors with the earth conductor. The connector is resistant to moisture penetration in the conductor’s area and assures electrical insulation of the connected conductors from external influences. It makes possible to join any configurations of the earthing device, including the light one. Such solution is reliable and stable and also protects the user against occasional contact with live parts during servicing.

The connector used in this earthing device permitted to minimize life hazard of user during exploitation and considerably limited heat emitting during short-circuit.

Table I shows rated currents (per one second), with cross section of wire.

| TABLE I |
|--------|------|------|------|
| Rated current \( I_r \) for \( t_r = 1\text{ s} \) [kA] | 4    | 6.5  | 9    | 13   |
| Cross section [mm²] | 16   | 25   | 35   | 50   |
| Max current \( I_m\) [kA] | 10   | 16.2 | 22.5 | 32.5 |
| Joule’s integral [A²s] | 14   | 42   | 81   | 169  |

Standard length of wires:
- for single clamp \( L = 1.5\text{ m} \)
- for three-clamp device \( L = 1\text{ m}, L_1 = 0.7\text{ m} \)

Following an adequate agreement, the earthing devices with other lengths \( L \) from 1 up to 8 m and \( L_1 \) from 0.7 up to 8 m graded every 0.05 m, may be provided. Total length of wires is 8 m.

The choice of the earthing device for different rated times \( t_r \) and corresponding currents \( I_r \) specified in the IEC 61230:2008 (PN-EN 61230:2011) Standard is shown in the diagram.

Diagram

Permissible short-circuiting current \( I_r \) as a function of short-circuiting time \( t_r \) for different sections of the earthing cables.
ATTENTION:
In the range of times \( t_r \):

- \( 1 \text{ s} ÷ 3 \text{ s} \) - guaranteed calculated current
- \( 0.1 \text{ s} ÷ 1 \text{ s} \) - calculated current, after checking the electrodynamic resistance of the earthing device (special option)

A unit package of the earthing device makes a protective cover made of coated waterproof fabric.

DENOTATION OF VERSIONS OF THE U-PR EARTHING DEVICES

U1-PR-L-I/t-S-(C) – for device with a PVC insulation
U1-PR-L-I/t-S-(C)-(SI) – for device with a silicone insulation
or
U3-PR-L/L1-I/t-S-(B)(C) – for device with a PVC insulation
U3-PR-L/L1-I/t-S-(B)(C)-(SI) – for device with a silicone insulation.

where:
- \( L_1 \) - length of the short-circuiting conductor (from 0.3 [m] graded every 0.1 [m])
- \( L \) - length of the earthing conductor (from 0.3 [m] graded every 0.1 [m])

ATTENTION: Total length of multi-clamp earthing device in series version shall not exceed 24 m.

- \( I \) - rated short-circuit current \( I_r \) [kA] for short-circuit time \( t_r \) [s]
- \( t \) - rated short-circuit time \( t_r \) [s]
- \( S \) - section [mm\(^2\)] of the short-circuiting device conductors resulted from rated current and short circuit time
- \( B \) - connection method of multi-clamps earthing device conductors:
  - \( I \) earthing device connected in series
- \( C \) - type of line earth clamp: WR-6, WR-7 or other

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Example of denotation:

1. Portable, three-clamp earthing), with earth conductor \( L=1 \) m long, short circuiting conductors \( L_1=0.7 \) m long and rated current \( I_r = 13 \) kA/1s, made of copper cable with section 50 mm\(^2\), with insulated middle connector and WR-7 earth clamp:

\[
\text{U3-PR-1/0.7-13/1-50-(I)(WR-7)}
\]

The U-PR portable earthing devices in the range of low voltages are denoted by CE mark.

Reference documents:

- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors designed for portable earthing and short-circuiting equipment.
- WTO-6/08 U-PR portable earthing device for switch bay.
U-PR PORTABLE EARTHING DEVICE

1. Line clamp
2. Earth clamp
3. Insulated middle connector
4. Short-circuiting wires
5. Earthing wire

WT-4 line clamp for U-PR
U3-ROK EARTHING DEVICE FOR ROK 6 SWITCH BAY

U3-ROK earthing device is used for protecting the workplace at ROK 6 switch bay by connecting the fastening points of the electrical cables (from the side of cable entry of the ROK 6) to the earth clamp, for different rated currents $I_{r1}$ (maximum 1 second rated current $I_{r1} = 18.5 \text{kA}$). Line clamps and earth clamp are of standard WR-8 type; their bodies are made of brass castings. Their screws and contact elements are also made of brass. Line clamps are mounted by means of the insulating stick (DU-A or UDI-B). The tip of the clamp allows fastening it directly in the head of the UDI insulating stick. After sliding on to the element being earthed, the clamp allows screwing in and releasing the stick, as in the case of a conventional WT-P clamp. The earthing device is manufactured as a triple-clamp version. The line clamps are connected to the cross-type connector by means of short-circuiting cables made of copper cable coated with a flexible transparent plastic cover and further connected to the earth clamp. The earth clamp differs from the line clamps by the fact that a knob for manual screwing of the clamp is used instead of a conventional tip to be fastened in the head of the insulating stick. The line clamps are connected to the copper cables in such a way to prevent moisture penetration to the U3-ROK earthing device cables. Deflection elements with adhesive protect the wire in the place of fastening against damage and moisture penetration.

For the rated current $I_{r1}$ and rated time $t_r = 1$ s, conductors of the earthing device have the cross sections according to the table.

<table>
<thead>
<tr>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$ for rated time $t_r = 1$ s [kA]</td>
</tr>
<tr>
<td>Cross section of earthing device conductor [mm$^2$]</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
</tr>
</tbody>
</table>

The standard lengths of the earthing device conductors are given below: $L = 1$ m, $L_1 = 0.7$ m

Following an adequate agreement, the earthing devices with other lengths $L$ from 1 up to 8 m and $L_1$ from 0.7 up to 8 m graded every 0.2 m, may be provided. The choice of the earthing device for different rated times $t_r$ and corresponding currents $I_{r1}$ specified in the IEC 61230:2008 Standard.

Diagram

Permissible short-circuiting current $I_r$ as a function of short-circuiting time $t_r$ for different sections of the earthing cables.

ATTENTION:
In the range of times $t_r$: $1$ s $\div 3$ s - guaranteed calculated current
$0.1$ s $\div 1$ s - calculated current, after checking the electrodynamic resistance of the earthing device (special option)
DENOTATION OF THE U3-ROK EARTHING DEVICES

U3-ROK–L/L₁–Iᵣ/t–S–(B)(C)

where:

L - length of the earth conductor [m]

L₁ - length of the short-circuiting conductors [m]

Iᵣ - rated short-circuit current Iᵣ [kA] for rated time tᵣ [s]

t - rated short-circuit time tᵣ [s]

S - section [mm²] of the earthing device conductors resulted from rated

B - connection method of multi-clamps earthing device conductors:

- I earthing device with insulated middle connector or

- S earthing device connected in series

C - denotation of the earth clamp (WR-2z, WR-K25, WT-K25/B)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Example of denotation:

1. U3-ROK earthing device for the ROK 6 switch bay, with earthing cable L = 1 m long, short-circuiting cables L₁ = 0.7 m long and rated current Iᵣ₁ = 13 kA, made of copper line with section 50 mm² with silicone insulation, with insulated middle connector, with WR-8 earth clamp:

U3-ROK-1/0.7-13/1-50-(I)(WR-8)-(SI)

The unit package makes a protective bag made of coated waterproof fabric.

Reference documents:

PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.

PN-EN 61138:2009 Conductors for portable Conductors designed for portable earthing and short-circuiting equipment.

WTO-7/01 U3-ROK portable earthing device for ROK 6 switch bay.

U3-ROK EARTHING DEVICE FOR ROK 6 SWITCH BAY

1. Line clamp

2. Earth clamp

3. Insulated middle connector

4. Short-circuiting wires

5. Earthing wire
The U-SR portable earthing device for screws is used for protecting the workplace at a switch bays equipped with screw by fastening them to the earth clamp. Device is designed for different rated currents $I_{r1}$ (maximum 1-second rated current $I_{r1} = 13 \text{kA}$) and for screws from M6-M16 range. Phase clamps may be installed by the insulating holder UI-1 or by UDI-B insulating stick with special adapter. WT-M phase clamps are made of brass. The earth clamp has screw terminated with a knob which allows controlling the jaw’s pressure; depending on bar’s thickness user may order different earth clamps (WR-6, WR-8, WR-2z or other). Depending on the number of line clamps, one-, two-, three-clamp earthing devices are manufactured and they are denoted adequately U1, U2, U3; the clamps are connected in parallel. In the three-clamp device the line clamps are connected to the connector by means of short-circuiting conductors made of copper cable with PVC or silicone insulation further connected to the earth clamp. Middle connector is electrical insulated and water proof. The insulating holder UI-1 or UDI’s adapter is designed for installing the line clamps of the earthing devices U-SR. User choose which of those is supplied together with the earthing device. Holder and adapter have snap-type joint to fasten and disconnection line clamps, which enable precisely clamp mounting. The UI-1 holder may be used in installation with voltages up to 1 kV or UDI-UI-1 adapter for UDI-B insulating stick.

For the rated current $I_{r1}$ and rated time $t_r = 1 \text{s}$, conductors of the earthing device have the cross sections according to the table I.

**TABLE I**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current $I_{r1}$, for $t_r = 1\text{s}$ [kA]</td>
<td>4</td>
<td>6.5</td>
<td>9</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>16</td>
<td>25</td>
<td>35</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>10</td>
<td>16.2</td>
<td>22.5</td>
<td>32.5</td>
<td>32.5</td>
</tr>
<tr>
<td>Joule’s integral [MA$^2$\text{s}]</td>
<td>16</td>
<td>42</td>
<td>81</td>
<td>169</td>
<td>169</td>
</tr>
</tbody>
</table>

Standard length of wires

Following an adequate agreement, there is possibility to supply the lengths earthing devices with overall lengths (given below) of conductors in the range since 0.5 [m] up to 24 [m] graded every 0.2 [m]:
- L – for one-clamp earthing device,
- L+L$_1$ for the multi-clamp parallel earthing device
- L+XL$_1$ for the multi-clamps series earthing device

The unit package makes protective bag made of coated waterproof fabric with the strap to throw it over an arm.

**DENOTATION METHOD:**

$$U_{x-SR-Mx_2-L/L_1-I/t-S-(B)(C)}$$

where:
- $x$ – number of line clamps: 1, 2, 3, 4, 5
- $Mx_2$ – size of screw e.g. M10
- $L$ – the earthing conductor length [m]
- $L_1$ – the short circuiting conductor length [m] (it does not exist for $X=1$)
- $I$ – rated current $I_{r1}$ [kA] for rated time $t_r = 1 \text{s}$ as per table I
- $t$ – short circuit time (1s)
- $S$ – cross-section [mm$^2$] of short circuiting conductors as per table I
- $B$ – connection method of multi-clamps earthing device conductors
− **I** earthing device with insulated middle connector
− **S** serial connected earthing device

**C** – denotation of kind of the earth clamp (WR-6, KL, WR-8 or other)

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

**Denotation Examples:**

1. **U-SR three**-clamp portable earthing device for M6 screws, with earthing conductor L = 1 m long, short-circuiting conductors L1 = 0.7 m, rated current I_r1 = 4 kA, made of copper cable with cross-section 16 mm², **parallel** version with insulated middle connector, with WR-6 earth clamp:

   U3-SR-M6-1/0.7-4/1-16-(I)(WR-6)

2. **U-SR three**-clamp portable earthing device for M12 screws, with earthing conductor L = 2 m long, short-circuiting conductors L1 = 1 m, rated current I_r1 = 13 kA, made of copper cable with cross-section 50 mm² with silicone insulation, **parallel** version with middle connector with WR-8 earth clamp:

   U3-SR-M12-2/1-13/1-50-(I)(WR-8)-(SI)

The **U-SR portable earthing device** in the range of low voltage is denoted by CE mark.

Reference documents:

- WTO-6/12 U-SR bolt type terminal portable earthing device.

**U-SR PORTABLE EARTHING DEVICE**
U1-ST SPECIAL TRAM EARTURING DEVICE

U1-ST special tram earthing device is designed for earthing overhead traction installations by connecting a traction conductor or auxiliary extension arm of the traction conductor to the tram rail equipped with groove.

The U1-ST special tram earthing device includes:

- the WT-Z7 line clamp equipped with a spring-operated self-locking clamp (which is gripped on traction conductor) and spark rod. This clamp works with quick clamping head of the UDI system of insulating stick (e.g. of the TDO-4-B or DU-A stick). Optionally, the WT-3/D line clamp - equipped with screw type clamp, cruciform articulated joint and a tip for fastening in the stick - can be mounted on a traction conductor or on extension arm of traction pillar.
- earthing conductor made of copper cable with cross-section of 50 mm$^2$ covered with transparent plastic protection and denotation,
- the WR-T earth clamp made of steel and equipped with brass current contact; its design enables to fix it in the tram rail groove independently on the rail wearing.

The size of the earthing device copper conductor has been increased to 50 mm$^2$.

In the standard design of the U1-ST earthing device the earthing conductor is L=8m or L=10m long. In this case the earthing device is denoted respectively:

**U1-ST-A-L-I/t-S-(C)**

For the other length of the earthing device conductor its denotation is as follows:

where:
- $A$ - is WT-Z7 or WT-3/D line clamp dependent on the supplied line clamp,
- $L$ - is the ordered earthing conductor length expressed in meters. The length $L$ is in the range from 7 m up to 14 m graded every 0.2 m.
- $I_r$ - rated short-circuit current $I_r$ [kA] for rated time $t_r$ [s]
- $t$ - rated short-circuit time $t_r$ [s]
- $S$ - section [mm$^2$] of the earthing device conductors – 50 mm$^2$ for U1-ST
- $B$ - connection method of multi-clamps earthing device conductors:
- $C$ - denotation of the earth clamp WR-T

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

Unit package for the stick includes a protective case, and a bag for the earthing device, made of coated waterproof fabric.

The technical parameters of the U1-ST earthing devices are given below:

- The WR-T earth clamp for the tram rail with groove (independently on the rail wearing level because wearing is compensated with the movable jaw inclination).
- the WT-Z7 line clamp for the traction conductor with diameters from 10 up to 16 mm
- the WT-3/D line clamp for the traction conductor and extension arms with diameters from 8 up to 45 mm

Reference documents:
- PN-EN 61138:2009  - Conductors for portable Conductors designed for portable earthing and short-circuiting equipment.
- WTO-2/05  - Special tram earthing device.
1. WT-Z7 clamp
2. WT-3/D clamp
3. WR-T earth clamp
4. Earthing conductor
U-STT SPECIAL EARTHING DEVICE FOR TROLLEY-BUS TRACTION

U-STT special trolley-bus earthing device is designed for earthing traction lines installations by connecting a traction wires with each other and with earth.

The U-STT special trolley-bus earthing device includes:
- two WT-Z2 line clamps line clamp equipped with a spring-operated self-locking clamp which is gripped on traction conductor,
- aluminium alloy bar connection between line clamps,
- earthing conductor made of copper cable with cross-section of 25 mm$^2$ covered with transparent plastic protection and denotation,
- the WR-2z earth clamp.

U-STT is designed for $I_r=4kA$ for $t_r=1s$, cross-section of wire is 25 mm$^2$, standard length of earthing wire is $L=6.5m$.

The earthing device is denoted respectively: **U-STT-L-I/t-S-(C)**

For the other length of the earthing device conductor its denotation is as follows:
U-STT-L-I/t-S-(C)

where:

- $L$ - is the ordered earthing conductor length expressed in meters. The length $L$ is in the range from 7 m up to 14 m graded every 0.2 m.
- $I_r$ - rated short-circuit current $I_r$ [kA] for rated time $t_r$ [s]
- $t$ - rated short-circuit time $t_r=1s$
- $S$ - section [mm$^2$] of the earthing device conductors 25 mm$^2$
- $C$ - denotation of the earth clamp (e.g. WR-2z)

Bag for the earthing device, made of coated waterproof fabric.

Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors for portable Conductors designed for portable earthing and short-circuiting equipment.
- WTO-7/12 Special trolley-bus earthing device.

**U-STT SPECIAL EARTHING DEVICE FOR TROLLEY-BUS TRACTION**

1. Phase clamps
2. rail
3. earthing conductor
4. Earthing clamp
5. Handle for fastening
U1-M3 PORTABLE EARTHING DEVICE FOR METRO-RAILWAY

U1-M3 portable earthing device is designed for earthing metro-railway traction by connecting a third rail of the traction to basic rail. Device can be used up to 18.5 kA/1s to rated current. It can be used in range of temperature: –40°C do +70°C. U1-M3 consists of two clamps, which are made of copper. They are connected with an insulated copper wire. Device is mounted by screwing stretcher stick.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Earthing device type</th>
<th>U1-M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated 1-second short-circuiting current $I_{t1}$ [kA/s]</td>
<td>18.5</td>
</tr>
<tr>
<td>Peak current $I_\text{m}$ [kA]</td>
<td>54</td>
</tr>
<tr>
<td>Joule’s Integral $\left[A^2\cdot s\right]$</td>
<td>452</td>
</tr>
<tr>
<td>Cross-section $[\text{mm}^2]$</td>
<td>120</td>
</tr>
<tr>
<td>Wire’s length [m]</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Unit package for the stick includes a protective case, and a bag for the earthing device, made of coated waterproof fabric.

**U1-M3 PORTABLE EARTHING DEVICE**

**U1-M3-L-I/t-S-(SI)** denotation:

- **U1** - 1-phase device,
- **M3** - metro type,
- **L** - wire’s length $L$ [m]
- **I/t** - rated current for $t=1\text{s}$ interval [kA/s]
- **S** - cross section [mm$^2$]
- **SI** - denotation of silicone insulation of wire

**Denotation:**
Portable earthing device for metro railway (with third rail) with wire length $L=0.75$ m long and rated current $I_{t1}=18.5$ kA (per 1 second), made of copper cable with cross-section $120$ mm$^2$ with silicone insulation:

**U1-M3-0.75-18.5/1-120-(SI)**

**Reference documents:**
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment (oryg.).
- PN-EN 61138:2009 Cables for portable earthing and short-circuiting equipment.
- WTO-4/10 U1-M3 Portable earthing device.

**U1-M3 EARTHING DEVICE FOR METRO-RAILWAY**
The UTK traction earthing device for mines is used for earthing mine traction conductor by connecting the traction line with running rail. The device consists of three main parts:

- the line clamp that is firmly fastened to the UIUTK-B insulating holder. The holder is made of the RSE insulating tube of orange colour filled with a polyurethane insulating foam, equipped with brass contact providing for rapid and firm fastening on the traction conductor,
- the WR-5 earth clamp, made of flat steel, protected by galvanic method, which is suitable for fastening by means of a knob with a rail pin for S30, S37, S42 and S49 type of rail,
- the earthing cable, made of copper cable with cross-section of 50 mm$^2$ and from 1 up to 6 m long, protected with an insulating cover from transparent plastic, with two deflection elements in the places of fastening.

The UTK traction earthing device for mines is intended for rated current $I_{r1} = 9$ kA and rated voltage 1 kV.

For the rated current $I_{r1}$ and rated time $t_{r1} = 1$ s the parameters of the earthing conductor of the device are as per table below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UTK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current for rated time $t_{r1}$ = 1 s [kA]</td>
<td>9</td>
</tr>
<tr>
<td>Conductor cross section [mm$^2$]</td>
<td>50</td>
</tr>
<tr>
<td>Peak current $I_m$ [kA]</td>
<td>22.5</td>
</tr>
<tr>
<td>Joule’s integral [A$^2$s]</td>
<td>81</td>
</tr>
</tbody>
</table>

The standard length of the earthing conductor of the device is 3 m: On special request the other lengths of the conductor may be provided in the range from 1 up to 6 m, graded every 0.5 m.

The UTK device has been approved by the decision No GE 48/94, issued by the High Mining Office, for use in underground mines.

A unit package makes a protective cover made of coated waterproof fabric.

DENOTATION METHOD:

$$UTK-L-I/t-S-(C)$$

where:

- $L$ length of the earthing conductor [m]
- $I$ rated current $I_{r1}$ for rated time $t_{r1} = 1$ s of the device [kA] as per table.
- $S$ cross-section of the earthing device conductors [mm$^2$] 50mm$^2$ in UTK
- $C$ denotation of earth clamp

In case when silicone insulation of wire (instead of PVC) is used symbol “–(SI)” is added to denotation.

UTK portable earthing devices are denoted with CE mark.
Reference documents:
- PN-EN 61230:2011 Live working. Portable earthing or earthing and short-circuiting equipment.
- PN-EN 61138:2009 Conductors for portable Conductors designed for portable earthing and short-circuiting equipment.
- PN-EN 60855:1999 Insulating foam-filled tubes and solid rods for live working.
- WTO-5/03 UTK Traction earthing device for mines.

UTK TRACTION EARTHING DEVICE FOR MINES

1. UIUTK-B insulating holder
2. WR-5 earth clamp
3. Line clamp
4. Earthing conductor
The ChM clamshell is designed for installing and removing fuse cartridges, insulating shields, insulating screens etc. in electrical equipment with voltage up to 110 kV. The arms and clamp jaws of the clamshell (made of plastic of high mechanical strength) are fitted with articulated joint on a steel bolt. Rotation of the bolt causes the clamping or releasing the jaws of the clamshell. The tip of the screw is adapted to snap it into the head of the UDI-B stick.

The unit package of the clamshell makes protective cover made of coated waterproof fabric.

Net weight: 1.2 kg.

Reference documents:
WTO-13/01 ChM Clamshell
The ChM/BM clamshell is designed for installing and removing fuse cartridges – sizes: 1, 2, 3. The arms and clamp jaws of the clamshell (made of plastic of high mechanical strength) are fitted with articulated joint on a steel bolt. Rotation of the bolt causes the clamping or releasing the jaws of the clamshell. The tip of the screw is adapted to snap it into the head of the UDI-B stick. The unit package of the clamshell makes protective cover made of coated waterproof fabric.

Net weight: 1.1 kg.

Reference documents:
WTO-10/09  ChM/BM Clamshell
The ChM/A clamshell is designed for installing and removing cylinder-shaped fuse cartridges with diameter around \( \varnothing \) 18 mm (mainly medium voltage). The arms and clamp jaws of the clamshell (made of plastic of high mechanical strength) are fitted with articulated joint on a steel bolt. Rotation of the bolt causes the clamping or releasing the jaws of the clamshell. The tip of the screw is adapted to snap it into the head of the UDI-B stick.

The unit package of the clamshell makes protective cover made of coated waterproof fabric.

Net weight: 1.1 kg.

Reference documents:
WTO-2/10  ChM/A Clamshell
The ChM/B clamshell is designed to pull tree's branches away from overhead lines. It can be used in lines up to 110kV rated voltage. Device has two metal spikes, which are screwed to arms. The arms and jaws of the clamshell (made of plastic of high mechanical strength) are fitted with articulated joint on a steel bolt. Rotation of the bolt causes the clamping or releasing the jaws of the clamshell. The tip of the screw is adapted to snap it into the head of the UDI-B stick.

The unit package of the clamshell makes protective cover made of coated waterproof fabric.

Net weight: 1.2 kg.

Reference documents:
WTO-5/10 ChM/B Clamshell
The KI-B insulating tongs are designed for installing and removing fuse cartridges, insulating shields, insulating barriers and the like in electrical equipment with rated voltage up to 10 kV or up to 30 kV.

The tongs consist of the following elements:
- the working part – tongs, made of impregnated beech wood, the jaws of which are profiled so that fuse cartridges with diameters 26 mm and 60 mm are easily and firmly grabbed;
- the handle – containing insulating and grabbing part separated with the limiter.

Due to the specific shape of the tongs, be extremely careful - while using the tongs - not to approach other live parts of the device.

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Type</th>
<th>KI-10-B</th>
<th>KI-30-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application for operating voltage [kV]</td>
<td>0-10</td>
<td>0-30</td>
</tr>
<tr>
<td>Rated voltage of insulating part [kV]</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Gross weight [kg]</td>
<td>1.8</td>
<td>2.3</td>
</tr>
</tbody>
</table>

A unit package includes a protective cover made of coated waterproof fabric.

Reference documents:
WTO-4/98  KI-B insulating tongs.
The rescue hooks are intended to take out a man or his limbs away from the live installation – it enables to undertake an immediate rescue action without the necessity of waiting for turning off the installation. The small HEM rescue hook enables to pull away limbs /arm or leg/ and may be used for the installations having appropriate rated voltage up to 1 kV. The big HED rescue hook enables moving of the entire person and may be used for the installations having appropriate rated voltage up to 30 kV. The hook is made of an epoxy-glass tube, commonly used as a material for insulating sticks. The length of the insulating part provides effective insulation of the rescuer during a rescue action. The limiter clearly separates the tube into a shank part and an insulating part. The hook tip shaped protected with a layer of insulating plastic allows proper handling the body or limb of the sufferer. The handle in the shank part enables easier manoeuvring with the hook and exerting adequate axial force during a rescue action. Due to the character of work (continuous readiness to work) the hook is not equipped with an unit package (a protective cover) and therefore during transportation it is protected against damage by means of packing paper.

Reference documents:
PN-EN 60832-1:2010 Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks.
WTO-7/02 HEM and HED rescue hooks.
The PI-45 insulating platform is used as an additional safety equipment for servicing indoor electrical equipment with voltage up to 45 kV.

The platform is made as a plastic moulded piece. The plastic is not a hygroscopic material and has very good insulating properties.

The adequately ribbed construction provides high mechanical strength. Widely spaced legs terminated with anti-sliding rubber washers provide stability during operation. The low weight of the platform and a convenient holder allow its fast relocation without excessive effort.

Rated voltage of insulation 45 kV.
Net weight: 4.05 kg.

Reference documents:
PN-92/E-04060 High-voltage test techniques. General definitions and test requirements.
PN-EN 60071-1:1999 Insulation coordination.
WTO-3/02 PI-45 insulating platform
PRK CAPACITOR’S DISCHARGER

The device is designed for discharging a battery of capacitors from static electricity. Its application is possible only together with the UDI insulating stick having appropriate rated voltage for network voltage. The device consists of the PRK head ended with a special hook. The hook makes it possible to touch the capacitors being discharged. The drainage conductor with the earth clamp is fixed to the PRK head. At the lower part of the head there is a holder designed for clamping it in the head of the universal insulating stick (UDI-B). The drainage conductor is made of copper cable coated with a flexible transparent plastic cover. Deflection elements protect the conductor against damage in the place of fastening.

ATTENTION: It is not permissible to use the PRK discharger as an earthing device (it does not meet requirements of the EN 61230:2008 Standard)

DENOTATION METHOD:

PRK-L-S

where:
L - length of drainage conductor [m] - as per table II or according to individual order.
S – cross-section of drainage conductor [mm²] - as per table I.

Denotation example:
The PRK electrostatic discharger, with the drainage conductor 5 meters long, made of copper cable with cross-section’ of 25 mm² with WR-2z clamp:

PRK-5-25-(WR-2z)

Reference documents:
WTO-7/08 PRK capacitor discharger.
The device is designed for discharging static electricity. There are four versions of the device: A, B, C and D. The versions A and B are supplied with probes driven into the earth – they are used in places where there are no stationary earth electrodes. In the versions C and D the drainage of electric charge follows the clamp tightened on to a stationary earth electrode. Versions A and C are equipped with the clamp that takes over the electrostatic charges. The clamp is suitable to fasten on elements 5 mm thick.

In the versions B and D (also after the clamps have been fastened) the drainage of static electricity from elements 20 mm thick is possible. An advantage of this solution is self-acting disconnection of the clamp in the cases when the object being subject of drainage moves (e.g. a car or wagon) and one forgot to disconnect the device.

The drainage conductor is made of copper cable coated with flexible cover made of transparent plastic. Deflection elements protect the conductor against damage in the place of fastening.

The cross section of the drainage conductor is given in table I.

<table>
<thead>
<tr>
<th>Cross-sections of drainage conductor [mm²]</th>
<th>16</th>
<th>25</th>
</tr>
</thead>
</table>

ATTENTION: It is no permissible to use POES discharger as an earthing device (it does no meet requirements of the PN-EN 61230:2011 Polish Standard)

Recommended lengths of the drainage conductors are given in table II.

<table>
<thead>
<tr>
<th>Lengths of the earth conductor [m]</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
</table>

On special request it is possibly to supply the device with other conductor length.

DENOTATION METHOD:

POES/X-L-S

where:
X – version of the device: A, B, C, or D
L – length of the drainage conductor [m] - as per table II or the other length according to individual order.
S – cross-section of the drainage conductor [mm²] - as per table I.

Denotation example:

Electrostatic discharger, version B with the drainage conductor 5 meters long, made of copper cable with cross-section of 25 mm².

POES-5-25

In the D version the denotation is:

POES/D-5-25

A unit package includes a protective bag made of coated waterproof fabric.
POES ELECTROSTATIC DISCHARGER

A Version

B Version

C Version

D Version
PWP INSTRUMENT FOR POTENTIALS EQUALIZATION

The PWP instrument is designed for fast, easy and reliable connecting central heating pipes, water, sewage and gas pipes, on which there is need to equalize voltage potentials (up to 1 kV) during repair and maintenance works, e.g. exchange gas-meter, water-meter, heating-meter and so on.

Instrument consists of two clamps with holder up to 1 kV and conductor of 16 mm² cross-section which is a copper cable coated with a flexible transparent plastic cover. Deflection elements protect the conductor against damage in the fastening place. Clamps are so designed to easy fasten them on the pipes we want to equalize potentials, even in the case when the pipes are covered with thick layer of paint.

ATTENTION: The PWP instrument in any case shall not be used as an earthing device or short-circuiting device it does not fulfill the requirements of the PN-EN 61230:2011 (IEC 61230:2008) standard.

Recommended lengths of the potential equalizing conductor are given in table.

<table>
<thead>
<tr>
<th>Conductor length [m]</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
</table>

On special request it is possibly to supply the device with other conductor length.

DENOTATION METHOD:

PWP-L-16

where:

L – length of the conductor equalizing potentials [m] - as per table or the other length according to individual order.

Example of denotation:

Instrument for potentials equalization supplied with the conductor 3 m long, made of copper cable 16 sq. mm cross-section:

PWP-3-16

A unit package includes a protective bag made of coated waterproof fabric.

PWP INSTRUMENT FOR POTENTIALS EQUALIZATION

1. Clamp
2. Hand limiter Holder
3. Conductor
ADAP Instrument for connecting portable generator unit to the network

ADAP adapter is used to connect portable generator unit to the grid section 0.4 kV by power fuses bases. ADAP adapter enables quick connection of the unit to the network in the case of repairs / installation jobs. Adapter is manufactured in two versions:
- For power fuses bases sizes: 1, 2, 3;
- For power fuses bases sizes: 00, 000.

Installation of the clamps in bases is by means of:
- Insulating casing with IP20 protection with rails connecting, which brought the wires from the generator;
- Copper conductors insulated with silicone ended with phase clamps (sizes: 1, 2, 3, or 00, 000);
- Grounding conductor ended earth clamp.

DENOTATION METHOD: ADAP-A-L/L1-S-(C)

Where:
A - BM00/A or BM123/A (depends on bases size),
L - the earth conductor length,
L1 – the phase conductor length,
S – cross-section [mm²] of the device conductors,
C - denotation of earth clamp (e.g. WR-7).

Denotation Examples: ADAP-BM123/A-1,5/1,5-3x35-(WR-7)

Reference documents:
WTO-2/13 ADAP adapter for low voltage power fuses bases
PORTABLE POST INSULATOR  PIW

Portable post insulator is used as an additional protective equipment in installation with rated voltage up to 110 kV or 220 kV. It is used for electrical insulation of supported line from the ground. The insulator is made of epoxy-glass tube filled with polyurethane foam of high mechanical and electrical strength and a base made of plastic material. It is colored in orange. Isolator is designed for indoor and outdoor use.

<table>
<thead>
<tr>
<th>Napięcie znamionowe izolacji [kV]</th>
<th>110</th>
<th>220</th>
</tr>
</thead>
<tbody>
<tr>
<td>L [mm]</td>
<td>1600</td>
<td>2650</td>
</tr>
</tbody>
</table>

The maximum load: 5 kg
Net weight: ~6 kg

Reference documents:
PN-EN 60855: 1999  Insulating tubes filled with polyurethane foam and rods for live working.
WTO-1/14  Portable post insulator  PIW
Diagnostic Camera "Hawkeye" is used to visual inspection of overhead lines and equipment up to 36kV in the live line maintenance technology from the ground. Diagnostic camera cooperates with a telescopic insulating stick TDI-B, by means of which is elevated to the height of 10m above ground level. Using camera "Hawkeye" and the telescopic stick one can easily and quickly evaluate the condition of networks, insulators or circuit breakers and perform photographic documentation of installed devices without turning off the power. The signal from the camera is transmitted digitally in a wireless way to a portable device (tablet) with suitable application that provide real-time view. Camera enables the infrared illumination, capture of images and user’s control on position of the camera in two planes (left-right, up-down).
Mass: ~2,3 kg.
The PPW-B height measuring instrument is designed for determination of the distance from the earth to any point or subject being at the height from 3.1 up to 8.9 m. It can also be used for measuring the height of traction conductors over rail tracks. Because the instrument mates with the UDI-30-B universal insulating stick equipped with appropriate plug (the plug different than in the standard UDI) the instrument can be used for height measurement of electrical conductors with voltage smaller or equal to 30 kV a.c. if the conditions of the Operating Manual are fulfilled.

The device consists of five moving telescopic segments. The upper segment is ended with special head designed for fixing with a band clip to the foot of the UDI-30-B insulating stick. In the head of the stick the ZP manipulating catch made in the shape of fork – to make easier contact with the conductor.

At the lower segment of the instrument a level is fixed for adjusting the vertical position as well as a measuring tape, which has scale marks to read the distance from the foot of the instrument or head of running rail to the element the height of which is to be determined.

Parameters of the height measuring instrument:
Rated voltage 30 kV.
Length of the disassembled instrument approx. 1.85 m.
Range of measurement approx. 8.9 m.
Gross weight approx. 6 kg.

A unit package makes a protective cover made of coated waterproof fabric.

Reference documents:
PN-EN 60832-1:2010  Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks.
PN-EN 61235:1999  Live working. Insulating empty tubes for electrical purposes.
PN-EN 60855:1999  Insulating tubes filled with polyurethane foam and rods for live working.
WTO-1/03  Height measuring instrument.
RPK LINE POSITION FIXER

RPK position fixer is designed for keeping insulating distance between overhead lines which are close to each other; it works with wires diameters from 16 to 70 mm². Device prevents phase-to-phase short-circuit. It’s made of plastic, dimensions: length: ~ 450 mm, high: 45 mm, depth: 25 mm. After RPK mounting the span between lines will be fixed at around 430 mm.

The device don’t have a protective cover.

Net weight: 0.1 kg,


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The diagram illustrates the dimensions of the RPK position fixer: length ~ 450 mm, high 45 mm, depth 25 mm, with a span between lines fixed at approximately 430 mm.
PZOS INSTRUMENT FOR KNOCKING OFF ICE OFF OVERHEAD LINES

PZOS instrument is designed to knock off ice which is on the overhead lines during winter season. It can be also used to other lines (a.e. teletechnical). Device co-operates with insulating stick with UDI head: TDI-B, UDI-B or TDO-B. During the work user stands on the earth or platform and operates with insulating stick with proper rated voltage. Device is manufactured from fiber-glass stick ended with UDI fitting.

The device don’t have a protective cover.

Net weight: 0.2 kg

Reference documents:
WTO-1/10 PZOS device.
POG BRANCH CUTTER

The device is designed for cutting branches with are close to the overhead lines. Its application is possible only together with the UDI-B universal insulating stick having appropriate rated voltage for network voltage. User of device operates from ground level. POG device consists of a holder designed for clamping it in the head of the UDI-B stick, shears and spring mechanism with the tie. This tie is made of string, which length is 9.3 m, so user can operate from ground level. The tie is ended with grip, on which string is wound, operator can adjust length of unreel string using notch. Device works with branches with diameter up to 35 mm.
Net weight: 1 kg

Reference documents:
WTO-3/11  POG device for cutting branches.
PDG SAW FOR BRANCH CUTTING

PDG Saw is designed for cutting tree’s branches which are close to overhead lines or other uninsulated electric devices which working voltage up to 110kV. Device works with conjution with UDI insulating stick. Saw has fitting which provide mounting in UDI stick’s head.

Length: $L = 540$ mm
Net weight: 0.4 kg

Reference documents:
WTO-1/11 PDG Saw.
ChDG CLAMSHELL FOR PULLING AWAY TREE’S BRANCHES

ChDG clamshell is designed for pulling tree’s branches away from overhead lines which working voltage is up to 110kV. Device is made of steel with galvanic cover. It’s shaped clamp alike which is screwed on branch. Device has fitting which provide mounting in UDI stick’s head. It’s screwed/unscrewed by rotation of insulating stick.

The unit package of the clamshell makes protective cover made of coated waterproof fabric.

Net weight: 0.65 kg.

Reference documents:
WTO-2/11 ChDG Clamshell.
PDWZ DEVICE FOR UNMOUNT LIGHT-BULBS

PDWZ device is designed for unscrew and screw light-bulbs in high halls without ladder - bulb type 400W, bulb diameter 120mm (np.: Venture 400W/C/V/PS/4K or equivalent). Device consists of four moving arms with pad made of soft gum. Arms are pressed to bulb with the springs. Device has fitting which provide mounting in UDI-B or TDI-B stick.

A unit package includes a protective cover made of coated waterproof fabric.

Net weight: 1 kg
ZP DEVICE FOR MOUNTING FIREFLYS™

ZP device is an installation tool designed to fix Fireflys™ (KS70, KS75) systems on overhead lines from ground level without switching off the power. Firefly is a clearly visible "scarecrow" which diverts the birds, preventing them from colliding with the overhead lines etc. The rotational speed of the Firefly increases effectiveness. Easy to move when bird activity changes with the seasons. The ZP installation tool consists of fitting which provide mounting in UDI or TDI stick and two springs – first (hook alike) is for demount Firefly, second (with two arm) is for fixing Firefly on line.

Net weight: 0.3 kg.

Reference documents:
WTO-9/09 ZP installation tool for fireflys.

ZP DEVICE FOR MOUNTING FIREFLYS™
Manipulating catches co-operate with UDI-B or TDI-B insulating stick and are fastened in its quick clamping head. When working with particular catch one should use the stick for a voltage equal to the rated voltage of the equipment, at which the work is performed.

Following catches are manufactured:

1. ZO manipulating catch is designed for operating isolator switches not equipped with power drive. It can also work in conjunction with TDO stick. It is made of a structural steel protected with anticorrosive electrolytic coating.

2. ZU manipulating catch is designed for installing and removing portable earthing devices. Its construction allows to install a line clamp on a conductor by hanging it on the rod - deflected upwards – fastened to the side surface of the catch and then fastening it by putting the hook type tip of the catch through the hole in the knob of the clamp and tightening it. The catch is made of a structural steel protected with anticorrosive electrolytic coating.

3. ZL manipulating catch is designed for installing and removing portable snap earthing devices, set directly in the ground. Its design prevents from falling the earthing device down to the ground when unseised from the clamp.

4. ZN manipulating catch is designed for open and close reclosers.

ZO, ZU, ZL, ZN manipulating catches do not have unit packages.

Net weight:
- Catch ZO – 0.20 kg,
- Catch ZU – 0.20 kg,
- Catch ZL – 0.22 kg,
- Catch ZN – 0.22 kg.
UI-S14 INSULATION HOLDER

UI-S14 insulation holder is designed to protect personnel from electric shock when operating with electrical equipment (e.g. fuse switch disconnectors) by isolating a person from live parts. The handle is designed for unscrewing / screwing of 14mm Allen screws. The tool is made of an insulating material - a glass-epoxy pipe, with a hexagon socket mounted at the end of the insulating part. The maneuver and tip are made of stainless steel. The glass epoxy pipe is filled with polyurethane foam, which has high mechanical and electrical strength. The holder has a grip zone limiter.

Insulation UI-S14 is designed to handle devices with voltage up to 1 kV.

Mass: 1,5 kg

The UI-S14 holder is denoted by CE mark.
BALL-TYPE AND BOLT TYPE TERMINALS (TAPS)

Ball type terminal is designed to mount portable earthing devices which special ball type clamps. Terminals are in two sizes: 20 and 25; both has two versions: with internal and external thread. They are installed on bars in order to determine place of portable earthing device mounting and to avoid current rail damage. Second type is bolt-type terminal.

Bolt type terminal is designed to mount U-S portable earthing device (or other). It’s installed on bars in order to determine place of portable earthing device mounting and to avoid current rail damage.

We produce two types of terminals (taps):

1. **TK** ball-type terminal made of copper, mounted on bars (bar’s width up to 6mm), it’s screwed to the bar with screw size 12. TK are produced in two dimensions: diameter – Ø20 (for rated current up to 25 kA, for time $t_r=1s$) i Ø25 (for rated current up to 31.5 kA, for time $t_r=1s$). Both sizes are produced in two versions: both has two versions: with internal and external thread.

Denotation of the TK terminals: **TK-20/12-PW, TK-25/12-PW, TK-20/12-PZ, TK-25/12-PZ**.

2. **US** type terminal is a bolt shaped, made of copper, mounted on bars - width up to 6mm (it’s possible to make bolt for thicker bar on special request); it’s screwed to bar, it can be applied up to $I_r=31.5$ kA rated current for $t_r=1s$.

A unit package includes a protective cover.

**TYPES OF TERMINALS (TAPS)**

**US** bolt type terminal

**TK-25/12-PW** ball type terminal and **TK-20/12-PW** (dimension in parenthesis)

**TK-25/12-PZ** ball type terminal and **TK-20/12-PZ** (dimension in parenthesis)
OP PORTABLE FENCE

The portable fence is used for protecting workplace at electrical power installations. The fence contains stands in the form of glass-EP tubes, founded on cast-iron bases, and chain links, mounted on the stands. The links are made from plastic, in white and red colour, which provides for the fence good visibility conditions, if the links are connected to one another alternately. The links may also be provided in colours other than specified above. 1.1 m of a chain may be obtained from 10 pcs of links. The number of stands depends on the planned length of the fence. Six stands together with bases make up the kit, which is packed in a wooden box with holders. The links may be ordered depending on the current needs.

The gross weight of the complete OP kit – 46.6 kg, weight of link 100 pcs - 1 kg.
OPL PORTABLE FENCE

OPL portable, light fence is used for protecting workplace at electrical power installations. The fence contains posts, bases and chain links. The posts are made of glass-EP bars, and are terminated with the metal sleeves at their bottom, used for connecting to the base. The cover plates on the posts allow fastening chain links or separating band on them.

The User may select two types of bases – laid and driven. Both bases are made from a galvanised, steel bar. The driven base is equipped with welded holder, used for driving the base in the ground and taking it out from the ground. In addition to that, a driving cap is added to the driven type bases, which, through being hammered with a rubber hammer serves deepening the base into the frozen or hard soil.

Six pins and six laid or driven bases make up the kit, which is packed in a bag made of coated, waterproof fabric.

1.1 m of a chain may be obtained from 10 pcs of links. The number of posts and bases depends on the planned length of the fence.

The links may be ordered depending on the current needs.

OPL PORTABLE FENCE

1. Stand
2. Stand base
3. Driven base
4. Chain link
1. INSULATING GLOVES

Five finger gloves having an anatomic shape are made of high quality latex on automatic line and electronically tested modern computer test-measuring workplace. It enables to gain high quality and repeatability of the technical parameters.

<table>
<thead>
<tr>
<th>TYPE OF GLOVE</th>
<th>ELSEC 2.5</th>
<th>ELSEC 5</th>
<th>ELSEC 10</th>
<th>ELSEC 20</th>
<th>ELSEC 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glove’s class according to PN-EN 60903+A11</td>
<td>00</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Alternating test voltage, effective value (kV)</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Min alternating withstand test voltage, effective value (kV)</td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Max alternating operating voltage, effective value (kV)</td>
<td>0.5</td>
<td>1</td>
<td>7.5</td>
<td>17</td>
<td>26.5</td>
</tr>
<tr>
<td>Max leakage current, effective value (mA)</td>
<td>&lt;12</td>
<td>&lt;12</td>
<td>&lt;14</td>
<td>&lt;16</td>
<td>&lt;16</td>
</tr>
<tr>
<td>Min glove’s thickness (mm)</td>
<td>0.5</td>
<td>1</td>
<td>1.5</td>
<td>2.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Min tensile strength (MPa)</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Min relative elongation at the moment of brake (%)</td>
<td>600</td>
<td>600</td>
<td>600</td>
<td>600</td>
<td>600</td>
</tr>
</tbody>
</table>

2. INSULATING MAT class II (up to 17kV AC and 25.5 kV DC)

The carpet is made of high quality rubber based on the natural caoutchouc. Dimensions of the carpet are: 750 x 750 mm x 6 mm thickness; 2 mm of the thickness makes anti-slip furrows. The carpet sides are cut under the angle of 45°. It enables to lie them down on overlap and making the carpets of any length. The carpet is tested with 20 kV test voltage. The producer assures 2 years term of warranty.

3. INSULATING MATTING class II (up to 17kV AC and 25.5 kV DC)

(sections from 2 to 8 running metres, width 1.1 m).

The matting is made of solid rubber as the roller 1100 m width and length from 2 to 8 m graded every 1 metre. The thickness is 6 mm; 2 mm of the thickness makes anti-slip furrows. The matting is tested with 20 kV test voltage. The producer assures 2 years term of warranty.

4. INSULATING LOW SHOES

15 kV insulating low shoes; two sizes: 3 – 312 mm inner length and 4 - 320 mm inner length

5. INSULATING OVERSHOES

1 kV insulating overshoes; two sizes: 3 – 312 mm inner length and 4 - 320 mm inner length
ADITIONAL PROTECTION – OTHERS

1. SAFETY HELMET
Uvex Airwing-E type safety helmet for electricians with face shield.
Safety helmet with eyeshade, industrial.

2. HEARING PROTECTORS
Ear-protectors.
Earplugs.

3. SAFETY GOGGLES
Anti-chip goggles.
Colourless goggles.

4. ACID RESISTING GLOVES
Five finger acid resisting gloves.

5. ACID RESISTING SUIT
Acid resisting suit.

6. HOLDER WITH IMPREGNATED LEATHER SLEEVE
The GPsHe holder is designed for the NH type fuse cartridges of sizes from 00 to 3. Two versions:
- without sleeve
- with impregnated leather sleeve
7. RSAK fitting for RSA Switch-Disconnector
Fitting co-operates with UDI universal stick for suitable voltage. It’s designed to open and close switch disconnectors RSA type.

8. FIRST-AID KIT
First-aid kit – medium size.
First-aid kits insert.
Labels for first-aid kit.

9. FIRE-EXTINGUISHER
Carbon-dioxide extinguishers, dry powder extinguishers – different weights of the extinguisher’s medium.

10. FIRE-EXTINGUISHING BLANKET
Made of fiberglass, dimensions: 200 x 150 cm.

11. INSTRUCTIONS (in polish)
General safety instruction.
Fire-fighting instruction.
First-aid instruction.

12. SAFETY TAGS (in polish)
Dimensions of the tags: 297 x 210 mm or 148 x 210 mm:
“Energised”
“Do not touch, electrical equipment”
“Do not switch on”
“Earthed”
“Work location”

13. CUPBOARDS FOR SAFETY EQUIPMENT
Two-doors cupboard, closed with YALE lock.
Dimensions: height 1.45 m – width 0.6 m – depth 0.5 m.

14. HANGERS FOR SAFETY EQUIPMENT
Hangers for portable short-circuiting and earthing devices and fo insulating sticks

Hangers for insulating sticks
15. OTHERS – safety equipment according to the client’s desire.

EQUIPMENT FOR LIVE-WORKING:
• Scissors for cut wires and cables,
• Tongs for deinsulating cables,
• Spanners, wrenches and knives for line-workers,
• Insulated Saws.

MEASUREMENT EQUIPMENT
• Wires and cables isolators,
• Clamp-on Meters,
• Installation’s parameter
• Multifunction Electrical Installations Meters
• Impedance loop, RCD, insulation resistance, earth resistance metres
• Thermal Imagers
EQUIPMENT-SET FOR EARTHING OVERHEAD LINES FROM GROUND LEVEL

Set is for earthing overhead lines from ground level without jib or climbing irons. Set consists of:
- U-SM (or U-SD in case of bigger wire’s diameter) snap-type portable earthing device; specification on page 74 (77) of this catalogue;
- TDI-B Telescopic insulating stick (or TDI/I-B, TDI/II-B in case of untypical wire’s high); specification on page 11;
- ZU and ZL manipulating catches for mounting portable earthing/short-circuiting device; specification on page 151;
- AOWN-5 voltage detector for checking presence of alternating voltage; specification on page 24.

EQUIPMENT-SET FOR CUTTING BRANCHES

Set is designed for cutting tree’s branches from ground level without jib or climbing irons. Set is provided with ChM/B clamshell to pull tree’s branches away from overhead lines. Set consists of:
- TDI-B Telescopic insulating stick (or TDI/I-B, TDI/II-B); specification on page 11;
- POG The device is designed for cutting branches with are close to the overhead lines; specification on page 146;
- PDG Saw for cutting branches, specification on page 147;
- ChDG Clamshell designed to pull tree’s branches away from overhead lines; specification on page 148;

ELECTROENERGETIC SAFETY EQUIPMENT FOR FIRE-FIGHTERS

- Wire Cutter stick;
- Cable Cutter;
- HEM-B i HED-B evacuation hooks; specification on page 134;
- DPPE-1 electric field detector; specification on page 30;
- ELSEC 2.5kV dielectric gloves; specification on page 156.

SAFETY EQUIPMENT SET FOR GAS, WATER AND HEATING INSTALLATORS

- PWP instrument for potentials equalization; specification on page 139;
- EAZYVOLT+ Compact low voltage indicator; specification on page 32;
- DPPE-1 electric field detector; specification on page 30;
- Bag for tools.

SET FOR LIGHT-BULB REPLACEMENT IN HIGH HALL

- TDI-B Telescopic insulating stick (or TDI/I-B, TDI/II-B); specification on page 11;
- PDWZ device for unmount light-bulbs; specification on page 149