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 parallel or in serial. 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. Parallel 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 cross-section up to 400 mm$^2$ /diameter up to 29 mm), or WT-3, WT-3/A, WT-3/B (for the cross-section up to 840 mm$^2$ /diameter up to 42 mm),
- for flat bus-bars WT-P, WT-P/A or 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 pole 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 poles as 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. For parallel version, with two-, three-, four- and five clamps there is an insulated 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 insulated middle connector minimises dangers for user’s life during exploitation of the earthing device and during short-circuit keeps heat emission to a minimum.

All clamps are made of aluminium or brass alloy. The screw terminated with a knob allows controlling the jaw’s pressure. The pressure of the jaws equals approximately 1 kN (for WT-2 clamp). 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 pole for earthing devices installation 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 pole and the ZU manipulating catch on round conductors situated both above and below the lineman (e.g. from the shelf of pole).

The WT-3/B clamp is designed to snap in the head of an insulating pole (the insulating pole 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 poles. The WT-P/A clamp on flat bus-bars is designed to be snapped into the head of insulating pole (the insulating pole must be mounted).

For the rated current $I_{r1}$ and rated time $t_r = 1\, \text{s}$ conductors of the earth device have the cross sections according to 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 $I_{r1}$ [kA] for rated time $t_r = 1, \text{s}$</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 [MA$^2\text{s}$]</td>
<td>16 42 81</td>
<td>169 342 625 992</td>
</tr>
<tr>
<td>Cross section of earthing device conductor [mm$^2$]</td>
<td>16 25 35</td>
<td>50 95 120 150</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type</th>
<th>U1</th>
<th>L [m]</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>U2 – U5</td>
<td>L [m]</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>L$_1$ [m]</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Following an adequate agreement, 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.

For the single-clamp devices it is possible to provide them with conductor lengths $L$ from 0.1 m up to 24 m, graded as above.

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.

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>Minimal 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.

The choice of the earth device for different rated currents and times specified in Polish Standard PN-EN 61230:2011, 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 case of silicone insulation of cable

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)

A unit package makes a protective cover made of coated waterproof fabric.
DENOTATION OF VERSIONS OF THE U EARTHING DEVICES

I. U1 SINGLE-CLAMP PORTABLE EARTHING DEVICE

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

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

- **S** section of the earthing device conductors [mm$^2$] (as per table I)

- **(B)** denotation of kind of the earth clamp

- **(SI)** optional, silicon insulation of conductor instead of standard PVC insulation

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$^2$ and WR-2z earth clamp:

   $U1-O-WT-2-16-25/1-120-(WR-2z)$

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 WR-2z earth clamp and silicon insulation of wire:

   $U1-O-WT-3-8-31,5/1-150-(WR-2z)-(SI)$

3. Portable, single-clamp earthing device for flat bus-bar (WT-P clamp) with earth conductor $L = 3$ m long and rated current $I_{r1} = 9$ kA, made of copper line with section $35$ mm$^2$, with WR-K25 earth clamp:

   $U1-P-3-9/1-35-(WR-K25)$

4. Portable, single-clamp earthing device for flat bus-bar (WT-2/A clamp) with earth conductor $L = 4$ m long and rated current $I_{r1} = 13$ kA, made of copper line with section $50$ mm$^2$, with WR-8 earth clamp:

   $U1-P-WT-2/A-4-13/1-50-(WR-8)$
II. U2-U5 PORTABLE MULTI-CLAMP EARTHING DEVICE

UX-A-L/L₁-I/t-S-B-C-(SI)

where:

\[\begin{align*}
X & \quad \text{number of line clamps: 2, 3, 4 or 5} \\
A & \quad \text{type of line clamp (the same as for single-clamp earthing devices)} \\
L & \quad \text{length of earth conductor } L = 0.1 – 24 \text{ m (recommended standardised lengths of conductors as per table II)} \\
L₁ & \quad \text{length of the short-circuiting conductor } L = 0.1 – 24 \text{ m (recommended standardised lengths of conductors as per table II)} \\
I & \quad \text{rated current } I₁ \text{ [kA] at time } t₁ = 1 \text{ [s] of the short circuiting conductors and the earth conductor (as per table I)} \\
S & \quad \text{sections [mm}^2\text{]} \text{ of the short-circuiting and earth conductors of the earth device (as per table I)} \\
B & \quad \text{way of wire connection:} \\
& \quad \text{I – insulated middle connector} \\
& \quad \text{S – serial clamp connection} \\
C & \quad \text{type of earth clamp (WR-2z, WR-3, WR-4, WR-K25, WR-7 or other)} \\
(SI) & \quad \text{optional, silicon insulation of conductor instead of standard PVC insulation}
\end{align*}\]

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 \(L₁ = 1.6\) m long and rated current \(I₁ = 6.5\) kA, made of copper line with section \(25\) mm\(^2\), with WR-2z earth:

\[\text{U5-WT-2/B-5/1,6-6,5/1-25-(I)(WR-2z)}\]

2. Portable, three-clamp earthing device for **round** conductors (WT-3/A clamp) with earth conductor \(L = 3\) m long, short circuiting conductors \(L₁ = 1\) m long and rated current \(I₁ = 31.5\) kA, made of copper line with section \(150\) mm\(^2\) with WR-2z earth clamp and silicon insulation of wire:

\[\text{U3-O-WT-3/A-3/1-31,5/1-150-(I)(WR-2z)-(SI)}\]

3. Portable, three-clamp earthing device for **flat** bus-bars (WT-P clamp) with earth conductor \(L = 5\) m long, short circuiting conductors \(L₁ = 3\) m long and rated current \(I₁ = 25\) kA, made of copper line with section \(120\) mm\(^2\), with (S) serial type connection, with WR-7 earth clamp:

\[\text{U3-P-5/3-25/1-120-(S)(WR-7)}\]

4. Portable, three-clamp earthing device for **flat** bus-bar (WT-2/A clamp) with earth conductor \(L = 8\) m long, short circuiting conductors \(L₁ = 5\) m long and rated current \(I₁ = 13\) kA, made of copper line with section \(50\) mm\(^2\), with WR-8 earth clamp and silicon insulation of wire:

\[\text{U3-P-WT-2/A-8/5-13/1-50-(I)(WR-8)-(SI)}\]
III. U2-U5 PORTABLE LIGHT MULTI-CLAMP EARTHING DEVICE

\[ UxL-A-L/1-t-S/1-t-S_1-B-C-(SI) \]

where:

- **UxL** denotation of the light portable earthing device with the number of line clamps:
  \[ X = 2, 3, 4 \text{ or } 5 \]
- **A** type of line clamps (the same as for single-clamp earthing device)
- **L** length of the earth conductor \( L = 0.1 \text{ – 24 m} \) (recommended standardised lengths of conductors as per table II)
- **L_1** length of the short-circuiting conductor \( L = 0.1 \text{ – 24 m} \) (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)
- **S** section of the earth conductor \([\text{mm}^2]\) (as per table I)
- **I_1** 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 \([\text{mm}^2]\) (as per table I)
- **B** way of wire connection:
  - **I** – insulated middle connector
  - **S** – serial clamp connection
- **C** type of earth clamp (WR-2z, WR-3, WR-4, WR-K25, WR-7 or other)
- **(SI)** optional, silicon insulation of conductor instead of standard PVC insulation

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.

**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 \( 25 \text{ mm}^2 \), short circuiting conductors \( L_1=2 \) m long and rated current \( I_1 = 9 \) kA, made of copper line with cross section \( 35 \text{ mm}^2 \), 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:**

- WTO-10/01 U portable earthing device.
U PORTABLE EARTHING DEVICE

WT-3 Clamp

WT-2 Clamp

WT-P Clamp

WR-2z Clamp

U1 Earth clamp

U2-U5 Earth clamp
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 pole head)

WR-7 Earth clamp

WR-K25 Earth Clamp
(for flat bus bars, round conductors and
ball type terminals)

WR-4 Earth clamp
(for railways)

WR-3 Earth clamp (for railways)
CLAMPS OF U PORTABLE EARTHING DEVICE

WT-2 Line clamp
for round conductors with cross section
up to 400 mm² (29mm diameter)
Standard version

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

WT-2/B Line clamp (for round conductors, flat bus-bars, for latch in the head of UDI pole)
„B” version
CLAMPS OF U PORTABLE EARTHING DEVICE

WT-3 Line clamp
for round conductors with cross section up to 840 mm² (42mm diameter)
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 pole head)
„B” version

WR-2z Earh clamp