



TECHNICAL DESCRIPTION

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Portable temporary short-circuiting and earthing equipment for LV underground link boxes

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Portable temporary short-circuiting and earthing equipment for LV underground link boxes.

1. SCOPE

This technical description specifies the technical requirements, tests and packaging of the portable temporary short-circuiting and earthing equipment applicable to incoming or outgoing cables of LV underground link boxes. This portable device is used by the technical personnel, prior to performing dead line works on LV underground grids. It achieves the short-circuiting and earthing of a section of the LV underground feeder, the protection of workers against dangerous situations (e.g. energising of the line by a customer's emergency generator) and simultaneously acts as a warning sign preventing inadvertent mishandling on the LV underground link box, when dead line work are in progress.

2. KEY - WORDS

Portable equipment, Short-circuiting and earthing, LV underground link box, LV fuse base, Blade type earthing cartridge, Insulating handling rod 230 (400)V.

3. OPERATING CONDITIONS

3.1. Environmental conditions

- Installation

The equipment should be suitable for outdoor use even in rainy conditions. While not in use, it shall be stored in vehicle's cupboards or in the warehouses of the distribution units. Until its first use, it shall be stored in covered warehouses.

- Climatic conditions

The operating and storage climatic conditions shall be the following:

- Maximum ambient air temperature 40°C with a 24 hour mean value not exceeding 35°C
- Minimum ambient air temperature: -20 °C
- Humidity: 20% up to 96%
- Altitude: The majority of LV facilities are located at an altitude lower than 1000m above sea level.
- Special conditions: The equipment shall be suitable for use in areas with severe corrosion (powder/salt/industrial pollutant deposits, presence of moisture/water/ice).

3.2. System characteristics

The equipment is intended for use in three-phase distribution networks of nominal voltage 230 (400) V, frequency 50 Hz, where direct earthing or neutral grounding is applied (TT or TN according IEC 60364).

4. STANDARDS & SPECIFICATIONS

The following standards have been taken into account in the present description:

- IEC Publication 61230:2008 "Live working - Portable equipment for earthing or earthing and short-circuiting".
- IEC Publication -60269-2:2013+AMD1:2016 CSV "Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application).
- IEC Publication 61138:2007, "Cables for portable earthing and short-circuiting equipment" on the Annex of 1: 1995.
- Technical Description EDF-SPS No 41/1979 "Dispositif de Mise a la terre et en court-circuit".
- EN 60900:2020 "Hand tools for live working up to 1000 V a.c. and 1500 V d.c.".
- IEC 60060-1:2010 "High voltage test techniques - Part 1: General definitions and test requirements".
- Technical Description HEDNO DD-286/07.12.18 "LV blade type fuses".
- Technical Description GR-249/22.04.83 "LV underground link boxes".
- PPC Technical Specification TK 02.01/11.11.87 "Sampling plans and procedures for inspection by attributes".

The latest revision of the above-mentioned standards will be considered. The requirements of the present description will prevail, if they conflict with the requirements of the international standards in the above paragraph.

5. DESCRIPTION

The short-circuiting and earthing equipment for LV underground link boxes shall consist of the following components:

5.1. Earthing cartridges

The device shall contain three (3) blade type earthing cartridges in the format of the attached drawing 1 or similar.

During its use each earthing cartridge will be inserted by means of an insulating handling rod (see paragraph 5.4) into a relevant LV fuse base of the link box (size 3 according IEC 269-2-1), instead of its blade type link. The handling of the earthing cartridges (safe holding and sticking into the fuse base contacts) by means of the above-mentioned insulating rod, shall be performed in a simple and safe manner.

One side of the earthing cartridge, the one in contact with the live side of the LV fuse base, will be made of a synthetic insulating(eg thermoplastic) material, red or orange in color, of extremely high mechanical strength and resistant to abrasion.

The other side of the cartridge, which will be in contact with the dead side of the fuse base and will be earthed, shall be metal, preferably made of brass.

The connection between these two sections of the cartridge shall be firm and of extremely high mechanical strength. For this connection an insulated metallic section may be provided at the middle of the length of each cartridge.

The dielectric strength of the earthing cartridge, that is the insulation level between its live insulating side on the one hand, especially the part that is inserted into the fuse base contacts, and on the other hand its earthed metal side, shall be equal to the relevant insulation level of link box in which it is fitted: 2.5 kV, 50 Hz, for 1 min.

The cartridge should be designed in a manner that excludes the involuntary short-circuiting of the live side with the dead side of the LV fuse base of the link box (e.g. the distance between any metal parts, which may touch the fuse base while operating, shall be less than 70 mm).

In addition, the middle part of the cartridge that will not be inserted into the sockets of the fuse base, will have an increased thickness (at least 10 mm) and/or have a guard of suitable height (at least 10 mm) on each end, so that the involuntary insertion into the fuse base contacts is avoided.

5.2. Short-circuiting and earthing cables - Connecting cluster

The device shall contain the following:

- Three (3) short-circuiting cables for the interconnection of the earthing cartridges. These cables shall bear compression cable lugs at their ends and screws in the format of drawing 2 or similar. After the fitting of the cartridges on the relevant LV fuse bases of the link box, the screw at the end of each short-circuiting cable shall be tightened on the relevant earthing cartridge, by means of the insulating handling rod.
- One (1) earthing cable for the connection of the short-circuiting cables with the earth clamp (see paragraph 5.3). The earthing cable shall bear the earth clamp at its bottom end.

The compression cable lugs and the screws at the end of the short-circuiting and earthing cables shall be fully insulated except the part of their internal surface that provides their electrical connection with the earthing cartridges and the link of neutral of the LV underground link box. The design of the equipment shall exclude the involuntary contact of the operator with the above-mentioned non insulated internal surface.

The dielectric strength between the above-mentioned non insulated surface and the rest of the insulated parts, which the operator may touch, shall be at least: 2,5 kV, 50 Hz for 1 min.

The short-circuiting and earthing cables shall be made from flexible multistrand copper conductor, with transparent colorless insulation according to IEC 61138, section of 25 mm² with lengths: a=250 mm, b=200 mm, c=200 mm and d=250 mm, as indicated in drawing 2.

- One (1) insulated, preferably waterproof, connecting cluster for the interconnection of all the short-circuiting cables among with the earthing cable (see drawing 2).

At each cable's entry point to its compression lug, a transparent insulating tube (e.g. moulded PVC) of suitable length and thickness shall be provided so that the excessive bending of the cable and the humidity penetration are avoided. This tube shall cover the cable and the end of the lug.

The dielectric strength of the connecting cluster and that of the tubes at the entry point of each cable to its lug shall be equal to the relevant insulation level of the short-circuiting and earthing cables : 1 kV, 50 Hz for 5 min.

5.3. Earth clamp

The equipment shall contain one (1) earth clamp having a configuration as shown in the attached drawing 2 or similar, suitable for connection on a 6mm width rectangular link bar. The clamp shall bear a suitable screw for its holding and tightening on a bar using the insulating handling rod.

The clamp shall be fully insulated except from its internal surface and the screw, that provides the electrical connection between the clamp and the neutral link bar of the LV underground link box.

The dielectric strength of the earth clamp's insulating material shall be: 1 kV, 50 Hz, 5 min.

The clamp shall have the smallest possible dimensions, in order to be convenient for the confined space of the internal of LV underground link box. Specifically, the available free space for the earth clamp is 50 X 60 X 60 mm, where (see drawing 3):

- 60 mm is the free height between the upper horizontal side of the neutral link and the bottom of the cover of the link box.
- 60 mm is the free length of the neutral link, that is the distance between the attachments (prongs) for the replacement handle (detail X of figure 1(I) of IEC 269-2-1: 1996).
- 50 mm is the free dimension which is vertical to the longitudinal axis of the neutral link, meaning the free distance between the separating walls (from insulating material) on both sides of the link.

The longitudinal axis of the neutral link divides this above-mentioned distance of 50 mm in equal parts.

5.4. Insulating handling rod

The equipment will include one handling rod, 30cm in length approximately, made from an insulating material suitable for the electric and mechanical conditions that would be exposed to during operation. Furthermore the material shall be flame retardant.

The rod shall bear at its ends a suitable configuration:

- For the handling (insertion-pulling out) of the earthing cartridges from the LV fuse bases.
- For the handling (untightening-tightening) of the heads of the screws of the short-circuiting cables and for the handling (disconnection-tightening) of the earth clamp.

At each working end, the rod shall bear a handle made of an anti-slipping material having a length of about 120 mm and a perimetric hand guard of 5 mm height at least (see drawing 4).

The dielectric strength of the rod, that is the insulation level between each working end and the handle at its other end shall be equal to the relevant insulation level of the hand tools for live working up to 1000 VAC (EN 60900): 10 kV, 50 Hz for 3 min.

5.5. Ensuring of the locking of the miscellaneous elements within the end of the insulating handling rod

The locking of the following elements within the end of the insulating handling rod is necessary for the safe and handy operation of the equipment: 1) the heads of the screws at the ends of the short-circuiting cables, 2) the earthing cartridges (if their locking is not of screwing type) and 3) the screw of the earth clamp.

In order to ensure this locking a proper locking arrangement shall be provided either at the end of the insulating handling rod (e.g. spring-loaded balls) either/and on the head of the screws (e.g. elastic ring of suitable diameter).

5.6. Short duration current strength

The equipment should withstand, without the appearing of damage, rated current (r.m.s.) $I_r = 4,9$ kA for time of $t_r = 1$ s.

5.7. Mass

The total mass of the equipment's components inside their casing shall not exceed 8 kg.

5.8. Construction robustness

All parts of the equipment shall be of extremely strong construction, in order to resist the heavy conditions of outdoor use. The synthetic insulating material of the earthing cartridge shall have extremely high mechanical strength against abrasion wear. The insulating handling rod, the earth clamp and all the screw connections shall be excessively robust, so that they withstand without deforming the tightening forces applied by the operator.

5.9. Screw connections

Concerning the electrical connections of the short-circuiting and earthing cables to the earthing cartridges, the connecting cluster and the earth clamp compression cable lugs shall be used, which should be permanently fitted at the ends of the cables. Solder type connections shall not be accepted. The connections shall be protected against loosening. In case simple screws and nuts are used, they shall always be combined with a non-slip element, e.g. spring lock washers.

5.10. Anticorrosion protection

The anticorrosion protection of the metal surfaces shall be ensured, during the entire operating lifetime of the equipment. The nickel or tin or zinc plating of the steel surfaces is necessary. The tinning of the brass surfaces is recommended.

6. TESTS

6.1. Type tests

Type tests shall be carried out at the beginning of the execution of a contract, and it is possible to be repeated, at the absolute discretion of the Organization, whenever during the execution of the contract.

At the absolute discretion of HEDNO, is the possibility of acceptance of type tests certificates from an accredited test laboratory by an independent private or public testing laboratory accreditation entity.

The type tests are the following:

6.2.1 Robustness test

A number of 2 specimens (equipment) is required for this test.

To check the robustness of the connection of the earthing cartridges, the connecting cluster and the earth clamp with the short-circuiting and earthing cables, a tensile force shall be applied on 3 connections of each specimen (randomly chosen). The tensile force shall be gradually increased so that it reaches a value of 250 daN into 10 s. The application of the force is maintained for 30 s and afterwards it is ceased.

No fracture, permanent deformation or loosening of the connections should be observed.

To check the robustness of the construction of the earthing cartridges, the screws of the short-circuiting cables and the insulating handling rod, the handiness of the equipment as well as the smooth operation of the screwed connections on each one of the above 2 specimens are carried out :

- 100 complete handlings (insertion-pulling out) of 2 earthing cartridges (randomly chosen) on a fuse base of size 3, according IEC 269-2-1.
- 100 complete handlings (tightening - untightening) of the screws of the short-circuiting cables on an earthing cartridge.

These handlings shall be carried out with a simple and easy way. During these handlings the operation of the screws shall be smooth. Furthermore, after the above handlings no part or section of the earthing cartridges, the screws and the insulating handling rod should appear to be damaged (e.g. wearing of the insulating material, permanent deformation or fracture of a screw or of the insulating handling rod).

To check the reliability of the locking of the miscellaneous elements of the paragraph 5.5 within the end of the insulating handling rod, the screw of the earth clamp, of one earthing cartridge and the screw at the end of one short-circuiting cable of each specimen shall be fitted successively into the insulating handling rod.

A force shall be applied on the earth clamp or on the screw' s compression cable lug or on the earthing cartridge along the dismantling direction.

The force shall be gradually increased so that a value of 5N is reached into 2s and shall be maintained for 1 min.

No disassembly of the locking shall be observed in any case.

Furthermore, a checking for the robustness of the earth clamp in the format of drawing 2 shall be carried out. For this purpose, 10 consecutive connections-disconnections of the earth clamp of each specimen on a 6mm wide rectangular bar shall be carried out. The tightening torque shall be twice the value given by the manufacturer. In case we do not have this information, the maximum likely value to be applied in practice shall be used.

During these handlings the operation of the screw connections shall be smooth. In addition, after the above tests no part or section of the earth clamp should appear to be damaged (e.g. permanent deformation or fracture).

6.2.2 Short-circuit withstand current test

A number of 2 specimens (equipment) is required for this test.

The earthing cartridges of each specimen shall be inserted into size 3 fuse bases (according to the IEC 269-2-1), by means of the insulating handling rod of the equipment. The earth clamp of each specimen shall be tightened on a 6mm wide rectangular link bar, applying a tightening torque that follows the manufacturer's instructions. The given torque, however, should be in agreement with the most likely value to be applied in practice. Maximum tightening torques for some typical clamps are given in Table 5 of IEC 61230.

The test shall be carried out according to paragraph 6.6 of IEC 61230, with $I_r=4,9\text{kA}$ r.m.s and $t_r=1\text{s}$. The test shall be carried out line to line and line to earth for the 2 specimens respectively.

The test shall be considered successful if the requirements of IEC 61230 are satisfied and if after the test:

- The electrical continuity of the equipment is maintained. Any possible alterations (e.g. shearing, burning, "blacking") of the insulation of copper conductor shall not be considered as a criterion of failure of the test.
- No soldering of the earthing cartridges into the fuse bases is observed.
- The locking of the earthing cartridges into the fuse bases and of the earth clamp on the link bar are maintained. Although, any possible displacement of the earth clamp on the bar is permitted.

6.2.3 Dielectric strength test of the earthing cartridge

One (1) specimen (earthing cartridge) is required for this test.

The insulating end of the earthing cartridge, which during use may come in contact with the live side of the LV fuse base, shall be entirely covered (the wall of the thicker medium section of the cartridge and the guard (if exists) are included) with conductive tape or conductive paint.

Similarly all the bare (or insufficiently insulated) metal parts of the cartridge shall be entirely covered with another conductive tape or conductive paint.

A voltage of 2,5 kV r.m.s., 50 Hz shall be applied for a continuous period of 1 min between the above-mentioned conductive tapes or paints, according to IEC 60-1.

The test is considered successful if no electrical puncture, flashover or sparking occurs during the test period of 1 min.

6.2.4 Dielectric strength test of the insulating handling rod

One (1) specimen (insulating handling rod) is required for this test.

The one end of the insulating handling rod shall be entirely covered with conductive tape or a conductive paint.

Similarly, the body of the other side of the rod, the area usually touched by the user' hand (the guard is included) shall be entirely covered with another conductive tape or conductive paint.

A voltage of 10 kV r.m.s., 50 Hz shall be applied for a continuous period of 3 min between the above-mentioned conductive tapes or paints, according to IEC 60-1. The leakage current is measured throughout this 3 min period.

The test is considered successful if no electrical puncture, flashover or sparking occurs during the test period of 3 min and if the leakage current is less than 0,5 mA.

The same test shall be repeated for the other end of the rod.

6.2.5 Dielectric strength test on the connecting cluster, the tubes at the entry point of each cable to its lug and the earth clamp.

One (1) specimen (connecting cluster, tube and earth clamp) is required for this test.

A voltage of 1 kV r.m.s, 50 Hz, is applied continuously for a period of 5 min between two conductive tapes in touch with the internal and external surface of the specimens respectively, according to IEC 60-1. The test is considered successful if no electrical puncture appears during the test period of 5 min.

6.2.6 Tests on insulated Cu conductor

The tests shall be performed according to IEC 61138:1994 and its Annex 1:1995 depending on the used insulating material (Table 3 or 4 of the above IEC).

6.2.7 Strength test of marking

The test shall be performed according to paragraph 6.7. of I.E.C. 1230:1993.

6.2. Sample tests

In every delivery lot a random sample of equipment shall be taken, which will be subjected to the tests mentioned below. For these tests a simple sampling plan shall be carried out according to the technical description PPC TK 02.01/11.11.87, using special inspection level S-4, normal inspection and acceptable quality level AQL=2,5%.

6.2.1 Visual check

On each specimen of this sample, the conformity or declination from the terms of the present description concerning the dimensions and the technical features shall be checked, according to paragraph 5 of the present description.

6.2.2 Robustness test

The test of paragraph 6.1.1 of the present description shall be carried out.

6.2.3 Short-circuit withstand current test

The test of paragraph 6.1.2 of the present description shall be carried out.

7. LABELS - MARKING

A marking shall be engraved on the earthing cartridges, the earth clamp and the insulating handling rod (e.g. debossed or embossed figures) with the name or trade mark of the manufacturer.

The insulation of the flexible multistrand copper conductor shall bear, for every single meter of its length, a marking for the name or trade mark of the manufacturer, the cross-section of Cu



conductor in mm² and the double triangle symbol.

Figures of 6 mm high and 3 mm width at least are preferable (figures "1" and "I" are excepted).

Moreover, on the external surface of each casing and on two opposite sides of each wooden frame-box (see paragraph 8), the name or trade mark of the manufacturer, the year of manufacture and the following label shall be written in indelible characters in Greek language:

ΦΟΡΗΤΗ ΣΥΣΚΕΥΗ ΠΡΟΣΩΡΙΝΗΣ
ΒΡΑΧΥΚΥΚΛΩΣΗΣ ΚΑΙ ΓΕΙΩΣΗΣ
ΥΠΟΓΕΙΩΝ ΚΙΒΩΤΙΩΝ ΖΕΥΞΗΣ ΚΑΛΩΔΙΩΝ ΧΤ
Κ.Υ. : 4600011516

Furthermore, the following label shall be written on each wooden frame-box in Greek language: "ΑΡΙΘΜΟΣ ΣΥΜΒΑΣΗΣ/ΕΤΟΣ:(Αριθμός της σύμβασης)/(Ετος)".

The above-mentioned markings shall be distinct and indelible (taking into consideration the operation conditions of the equipment and its casing).

8. PACKAGING

All the components of each set of equipment shall be fully enclosed in a metal or synthetic case. The various components shall be immobilized in this case.

The case shall bear a durable and adequate handle for transportation purposes. It shall be of extremely strong construction, in order to endure the heavy conditions of transportation and use. All external and internal metal surfaces of the case shall be painted with an adequate treatment against corrosion.

Each case shall be accompanied by an instruction manual for use and maintenance of the contained equipment. It is preferable, the instructions to be indelibly written on a label glued on the internal surface of the cover of the case. Alternatively, the instructions should be written on a leaflet placed inside a waterproof envelope fixed at the internal surface of the cover of the case. The instructions for use and maintenance shall be in accordance with the requirements of paragraph 5.9. of I.E.C. 61230: 1993. The instructions shall be written in Greek language.

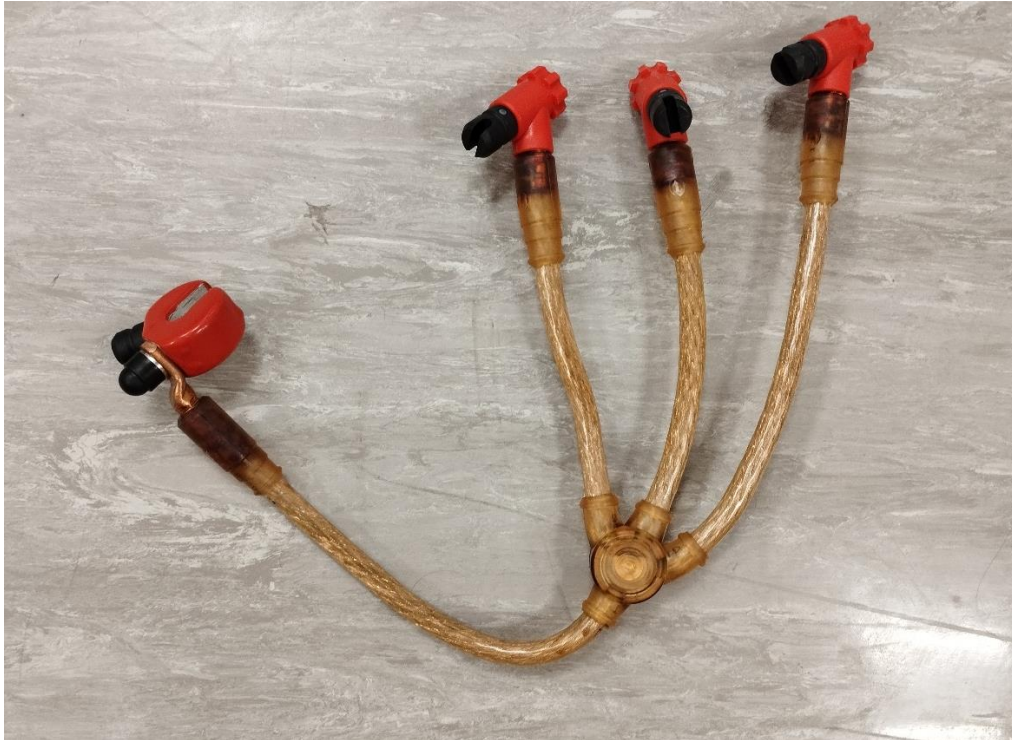
The sets of equipment shall be packed in groups inside wooden frame-boxes. Those frame-boxes shall be of adequate strength and protection for transportation and stack conditions up to 2,5 m height.

9. ANNEXES-DRAWINGS

- Drawing 1: Earthing cartridge



- Drawing 2: Short-circuiting and earthing cables - Earth clamp



- Drawing 3: LV underground link box



- Drawing 4: Insulating handling rod

