Portable Temporary Short-Circuiting And Earthing Equipment For Feeders of LV Switchboards

CONTENTS

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1. SCOPE

The scope of this description is to determine the technical requirements, tests and packing instructions for the portable temporary short-circuiting and grounding equipment destined to be fitted at the feeders of LV switchboards. This portable equipment is used, by the technical staff prior to the performance of dead line works on LV networks. With it the short-circuiting and grounding of the whole or of a section of the LV feeder is achieved, assuring the protection of workers against dangerous situations (e.g. energizing of line by customers' s emergency generators) and simultaneously it acts as a warning sign preventing the execution of involuntarily faulty handling on the LV switchboard, when dead line works are in progress.

2. KEY WORDS

Portable equipment, Short-circuiting and earthing, LV Switchboard, LV Fuse base, Earthing cartridge of blade type, Insulating handling rod, 230 (400) V.

3. OPERATING CONDITIONS

3.1. Ambient conditions

The equipment shall be suitable for outdoor operation even during rainfall. In case it is not in use, it shall be stowed in vehicle's cupboards or in storage compartments. Until its first use, it shall be stored in suitable warehouses.

- Ambient conditions

The climatic conditions of operation and storage shall be the following:

- Maximum ambient air temperature 40 °C with a mean value measured over a period of 24 hours which shall not exceed 35 °C
- Minimum ambient air temperature: -25 °C
- Humidity: between 20% and 96%
- Special conditions: The equipment shall be suitable for work under the following environment conditions: powdery/salt/industrial deposits, presence of condensation/rain/frost.

3.2. Electrical system characteristics

The equipment shall be used on LV three phase systems 50 Hz, 400 V (line to line), where direct (TT) or neutral earthing (TN) is applied (according to IEC 60364).

4. STANDARDS & SPECIFICTIONS

In the present description, the following codes and standards have been considered:

- 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 IEC 61138:2007 "Cables for portable earthing and short-circuiting equipment"
- Technical description by EDF-SPS No 41/1979 "Dispositif de Mise a la terre et en court-circuit".
- EN 60900:2020 "Hand tools for Iive 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".
- IEC 62475:2010 "High-current test techniques - Definitions and requirements for test currents and measuring systems"
- HEDNO technical description no. DD-403/07.12.20 «1, 2 and 4-feeder LV switchboard".
- HEDNO technical description no. DD-407/07.12.20 «5, 8 and 12-feeder LV switchboard".
- HEDNO technical description no. DD-286/07.12.18 «LV Blade type fuses".
- PPC technical description no. TK 02.01/11.11.87 "Sampling plans and procedures for inspection by attributes ".

The requirements given by the present description shall prevail when there is a contradiction between them and the requirements given by the standards referred to the above paragraph.

5. DESCRIPTION

The equipment shall consist of the following components:

5.1 Earthing cartridges

The device shall be furnished with three (3) earthing cartridges of blade type in accordance with the layout as shown in the attached drawing 1 or similar.

During its use each earthing cartridge shall be inserted by means of an insulating handling rod (see paragraph 5.1.4) into the relevant LV fuse base (size 1 or 2 according IEC 60269-2-1) instead of its blade type fuse-link. The handling of the earthing cartridges (holding and sticking into the fuse-base contacts) by means of the above-mentioned insulating rod shall be achieved in a simple and safe manner.

The side of the earthing cartridge which is inserted into the live side of the LV fuse base shall be manufactured from an insulating synthetic (e.g. thermoplastic) material, of red or orange color and of ultra-high mechanical strength against friction.

The other side of the earthing cartridge which is inserted into the inactive side of the LV fuse base and is grounded shall be metallic, preferably brass.

The connection of the two sides (sections) of the cartridge shall be firm and of ultra-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, i.e. the insulation level between its insulating live side and especially of its section which is inserted into the fuse base contacts and its earthed metallic side, shall be equal to the relevant insulation level of the switchboard at which the cartridge is fitted: 2,5 kV, 50 Hz for 1 min.

The cartridge shall be of such a design that will prevent the involuntary short-circuiting of the live side with the inactive side of the fuse base, via the cartridge (e.g. the distance between any metallic parts, which during use may touch the fuse base, shall be less than 70 mm).

Furthermore, the middle section of the cartridge, which is not inserted into the fuse-base contacts, shall have an increased thickness (10 mm at least) or/and shall be equipped on its both sides by one guard of suitable height (10 mm at least), so that its involuntary insertion into the fuse base contacts to be avoided.

5.2 Short-circuiting and earthing cables - Connecting element

The device shall be furnished with the following items:

- Three (3) short-circuiting cables for the interconnection of the earthing cartridges. These cables shall bear compression cable lugs and screws at their ends, in the shape depicted on of drawing 2 or similar. After the fitting of each cartridge on the relevant LV fuse base of the switchboard, 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.
  The compression cable lugs and screws at the end of the short-circuiting cables shall be fully insulated except of the part of their internal surface that provide their electrical connection on the earthing cartridges. 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 insulated parts, with which the operator may come in contact shall be at least: 2,5 kV, 50 Hz for 1 min.

- One (1) earthing cable for the interconnection of the short-circuiting cables with the earth clamp (see paragraph 5.1.3). The earthing cable shall bear at its down end the earth clamp. The short-circuiting and earthing cables shall be from extra flexible multistrand copper conductor, having a section of 25 mm2 with transparent colorless insulation according to IEC 61138, with lengths: a = 200 mm, b = 500 mm, c = 800 mm and d = 850 mm, as is indicated at drawing 2.

- One (1) waterproof insulated connecting cluster for the interconnection of the short-circuiting cables between them and the earthing cable (see drawing 2).

- At the entry point of each cable to its compression lug a transparent colorless insulating tube (e.g. molded PVC) of suitable width and length shall be provided so that the kinking of the cable and the humidity penetration to be avoided. This tube shall cover the cable and the terminal 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 device will be furnished with one (1) earth clamp configured as shown in the attached drawing 3 or similar, suitable for the connection onto conductors of circular cross-section up to 70 mm2 and onto rectangular bars up to 20 mm width. The clamp shall bear a screw for its holding by means of the insulating handling rod of paragraph 5.1.4 or another insulating handling rod and for its tightening on a conductor or a bar by the same rod. Alternatively, it shall bear a wing nut for its tightening on a conductor or a bar by hand.

The clamp shall have small dimensions as soon as possible so that to be convenient for the confined space of the internal of the LV switchboard. The disconnection of the earth clamp from the earthing conductor shall not be possible.

5.4 Insulating handling rod

One (1) insulating handling rod, of a length of about 30 cm, made of an insulating material suitable for the electric and mechanical conditions to be exposed during use. 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 (disconnection-tightening) of the heads of the screws of the short-circuiting and earthing cables and for the handling (disconnection -tightening) of the earth clamp (if bears such a screw).

At each one working end, the rod shall bear a handle made of 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 working end, shall be equal to the relevant insulation level of the hand tools for live working up to 1000 V AC (EN 60900): 10 kV, 50 Hz for 3 min.

5.5 Fastening of the miscellaneous elements of the equipment into the end of the insulating handling rod

The fastening of the following elements into the insulating handling rod is necessary for the safe and handy operation of the equipment: 1) of the screw heads at the ends of the short-circuiting cables 2) of the earthing cartridges (if their arrangement is not as per screwed type) and 3) of the earth clamp screws (if it bears such a screw).

In order to achieve fastening, a suitable fastening array 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 (i.e. elastic ring of suitable diameter).

5.6 Short circuit current withstand capability

The device's short circuit current withstand capability shall be suitable for a maximum current value (r.m.s.) Ir = 4,9 kA for a duration of tr = 1 s.

5.7 Weight

The total weight of the equipment, including its case shall not exceed 8 kg.

5.8 Device robustness

All the components of the equipment shall be of extreme strength in order to resist to heavy outdoor use. The insulating synthetic material of the earthing cartridge shall have ultra-high mechanical strength against friction. The insulating handling rod, the earth clamp and all the screwed connections shall be of extra high strength in order to resist forces applied by its operator without causing any deformity.

5.9 Bolted/screwed connections

The electrical connections of the short-circuiting and earthing cables to the earthing cartridges, to the connecting cluster and to the earth clamp shall be of compression type (i.e. compression cable lugs permanently fitted at the ends of the cables). Soldered type connections shall not be accepted. The connections shall be protected against accidental loosening. Single screws or nuts, if used, shall always be combined with lock washers, that positively prevent slippage or rotation.

5.10 Anti-corrosion surface protection

The anticorrosion protection of the metallic surfaces shall be assured under the conditions of outdoor use, during its whole service life. All steel surfaces must be zinc plated. All aluminum/bronze surfaces must be tin plated.

6. TESTS

6.1 Type tests

Type tests shall be carried out at the beginning of the Contract, and it is possible to be repeated whenever needed by HEDNO during Contract execution.
At HEDNO' s discretion there is the possibility of acceptance of type tests certificates concerning temporary short-circuiting and earthing equipment of the same type and quality and of the same rated current and rated time with the equipment offered, issued by HEDNO laboratories or by any other recognized laboratories. These certificates are necessarily submitted by the supplier together with his technical proposal.
In every event HEDNO reserves the right to check up at its own laboratories by appropriate tests whichever or all the certificate tests.

The type tests are the following:

6.1.1 Robustness test

Two specimens will be deployed for test execution.

In order to check robustness of the connection of the earthing cartridges, of the connecting cluster and of the earth clamp to the short-circuiting and earthing cables, a traction force shall be applied on 3 randomly selected connections of each specimen. The traction force shall be gradually increased in such a pace that a value of 250 daN can be reached in 10 seconds. The force is applied for 30 s and is ceased immediately afterwards.

No fracture, permanent deformation or loosening of the connections is permitted.

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

- 100 complete handling maneuvers (insertion-pulling out) of 2 earthing cartridges (taken at

random) on a fuse base of size 2, according to IEC 60269-2 and 60269-1.

- 100 complete handling maneuvers (tightening - loosening) of the screws of short-circuiting cables on one earthing cartridge.

These handling shall be carried out in a simple manner. During handling, the operation of the screwed connections shall be smooth and effortless. Furthermore, after the handling is complete, no waste of the specimens is permitted (i.e. waste of insulating material, permanent deformation or loosening or fracture of a screw or of 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 0,5 daN to be reached into 2 s. The application of the force is maintained for 1 min and afterwards it is ceased.
The test shall be considered passed if the assembly does not come apart.

Furthermore, a check for the robustness of the construction of the earth clamp of drawing no. 3 shall be carried out. For this reason, 10 operations of connection-disconnection of the earth clamp of each specimen on a 10 mm width rectangular bar are carried out. The tightening torque shall be twice the value that is given by the manufacturer. If not possible, the maximum value likely to be applied in practice shall be used.
During these handling the operation of the screwed connections shall be smooth. Furthermore, after the above test no waste of the earth clamp is permitted (e.g. permanent deformation or fracture).

6.1.2 Short-circuit current withstand test

Two specimens are required for this test.

- The earthing cartridges of each specimen shall be inserted into size 2 fuse bases (according to the IEC 60269-2-1), by means of the insulating handling rod of the specimen.
- The earth clamp shall be tightened onto a 10 mm width rectangular bar. The tightening torque shall be equal to the manufacturer's instructions. The given value shall, agree with the value likely to be applied in practice. Maximum values for some typical clamps are given at Table 5 of IEC 61230.
- The test shall be carried out according to the paragraph 6.6 of IEC 61230 with Ir=4,9 kA r.m.s and t r=1 s. The test shall be carried out line to line and line to earth for the 2 specimens respectively.

  The test shall be regarded as successful if the requirements of IEC 61230 are met and if after the test:

- The electrical continuity of the specimens is maintained. Should possible alterations appear (e.g. shearing, burning, color degrading) on the insulation of copper conductor, these shall not be considered as a failure criterion of the test.
- No soldering of the earthing cartridges onto the fuse bases is observed.
- The attachment of the earthing cartridges onto the fuse bases and of the earth clamp on the bar are maintained. The-possible- displacement of the earth clamp on the bar is permitted.

6.1.3 Dielectric strength test on the earthing cartridge

One (1) specimen (earthing cartridge) will be 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 existing- are included) with a conductive tape or a conductive paint.

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

The test shall be carried out applying a voltage of 2,5 kV r.m.s., 50 Hz, which shall be maintained for a period of 1 min between the above-mentioned conductive tapes or paints, according to IEC 60060-1.

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

6.1.4 Dielectric strength test on 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 a conductive tape or a conductive paint.

Likewise, the body of the rod in the places usually touched by the user' hand (the guard is included) shall be entirely covered with another conductive tape or conductive paint.

The test shall be carried out applying a voltage of 10 kV r.m.s, 50 Hz, which shall be maintained for a period of 3 min between the above-mentioned conductive tapes or paints, according to IEC 60060-1. The leakage current is measured.

The test is successful if no electrical puncture, sparkover or flashover 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.

6.1.5 Dielectric strength test on the connecting cluster and on the tubes at the entry point of each cable to its lug

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

The test shall be carried out applying a voltage of 1 kV r.m.s, 50 Hz, which shall be maintained for a period of 5 min between two conductive tapes which shall be in touch with the internal and external surface of the specimens respectively, according to IEC 60060-1.

The test is successful if no electrical puncture occurs during the test period of 5 min.

6.1.6 Insulated copper conductor tests

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

6.1.7 Marking durability test

The test shall be performed according to paragraph 6.7. of I.E.C. 61230: 1993.

6.2 Sample tests

In every partial delivery an individual and random sample of equipment shall be taken and the following tests shall be carried out. For these tests a simple sampling plan shall be carried out according to the PPC technical description TK 02.01 using special inspection level S4 for normal

inspection and acceptable quality level AQL=2,5%.

6.2.1 Visual check

On each one specimen of the sample its conformity or declination from the terms of the present description concerning the dimensions and the technical features is checked according paragraphs 5.1, 5.2, 5.4, 5.5, 5.6 and 5.7 of the present description.

6.2.2 Robustness check

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

6.2.3 Short-circuit current withstand test

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

7. LABELS AND MARKING

A marking with carved or embossed characters shall be visible both on the earthing cartridges and on the earth clamp, bearing the name or trade mark of the manufacturer.

The insulation of the flexible multistrand copper conductor shall bear at each one 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 required (characters "1" and "I" are excepted). Moreover, on the external surface of each case 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 Greek language:

ΦΟΡΗΤΗ ΣΥΣΚΕΥΗ ΠΡΟΣΩΡΙΝΗΣ

ΒΡΑΧΥΚΥΚΛΩΣΗΣ ΚΑΙ ΓΕΙΩΣΗΣ

ΑΝΑΧΩΡΗΣΕΩΝ ΚΙΒΩΤΙΩΝ ΑΣΦΑΛΕΙΩΝ ΧΤ

Κ.Υ. : 4600011504

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

The markings mentioned above shall be distinct and indelible (taking into consideration the heavy conditions of outdoor use).

8. PACKING

All the components of each equipment shall be furnished fully enclosed in a permanent metallic or synthetic case. The components of each equipment shall be firmly fixed inside the case.

The case shall bear a strong and adequate hand-grip for transportation purposes.

It shall be of extremely strength to resist to the heavy conditions of transportation and use.

All external and internal surfaces of the metallic case shall be painted after an adequate treatment against corrosion.

Each case shall be accompanied by instructions for use and maintenance of the equipment placed in it. It is required, the instructions to be indelibly written on a label glued at the internal surface of the cover of the case. Alternatively, the instructions should be furnished with a leaflet placed inside a water proof envelope fixed permanently at the internal or the cover of the case.

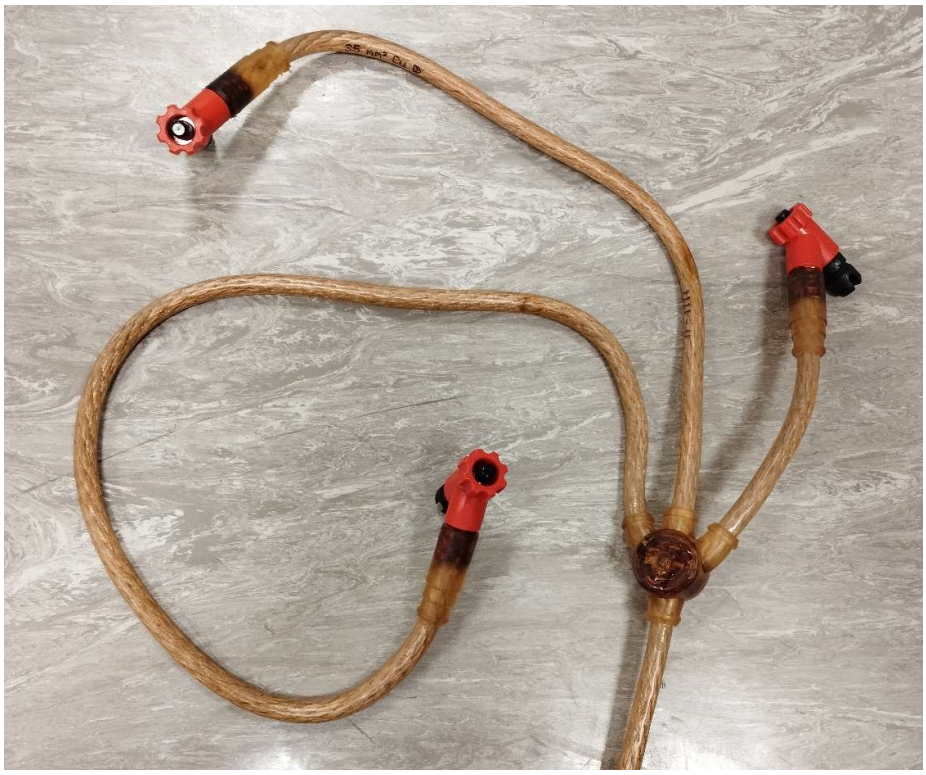
The instructions for use and maintenance shall be in accordance with the requirements of paragraph 5.9. of I.E.C. 61230: 1993 and shall be written in Greek language.

Upon receipt the equipment shall be delivered in wooden frame-boxes of adequate strength and safety 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



- Drawing 3: Earth clamp

- Drawing 4: Insulating handling rod