SLOVENSKI STANDARD
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Splošni postopek preverjanja učinkovitosti zaščitnih ukrepov za električno opremo po popravilu

General procedure for verifying the effectiveness of the protective measures of electrical equipment after repair

Allgemeines Verfahren zur Überprüfung der Wirksamkeitder Schutzmaßnahmen von Elektrogeräten nach der Reparatur

Procédure générale visant à vérifier l'efficacité des mesures de protection des équipements électriques après réparation

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17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Contents

European foreword

This document (EN 50678:2020) has been prepared by CLC/TC 85X "*Measuring equipment for electrical and electromagnetic quantities*".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2020-12-16
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2022-12-16

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Introduction

This standard intends to provide a general test procedure to verify the effectiveness of the basic protective measures for current-using equipment or appliances after they have been repaired, thus ensuring the safety of people using repaired equipment.

This standard may be considered to support compliance with the European Directive 2009/104/EU concerning the minimum safety and health requirements for the use of work equipment by workers at work.

In general, the test procedure for verification of products after repair is the responsibility of the related product technical committees. This document may be taken into consideration by product technical committees if they need to take into consideration modified or additional tests for verification after repairs for products falling within their scope.

1 Scope

This document specifies requirements for setting a uniform procedure to verify the effectiveness of the protective measures for current-using equipment or appliances after they have been repaired.

This procedure is applicable to current-using equipment or appliances with a rated voltage above 25 V AC and 60 V DC up to 1 000 V AC and 1 500 V DC, and currents up to 63 A, connected to final circuits. They may be either pluggable equipment type A connected or permanently connected.

This document is not intended to replace test covered by safety standards nor product standards, for example type tests, routine tests and acceptance tests.

This document assumes that the current-using equipment or appliances under consideration complies with its related product standard, has been introduced on the market, has been in use, has failed, and has then been repaired.

It intends to verify that operations for repairs have not jeopardized basic protective measures, for example to verify the continuity of the protective conductor, the withstand capability of the insulation or to verify that no metallic part is loose or is inadvertently inserted in the device.

This document does not apply to:

— recurrent tests defined in EN 50699;[1]

— devices and equipment that are part of the fixed electrical installations. For these, tests for verification after repair are covered by HD 60364-6;

— audio/video, information and communication technology equipment;

— uninterruptible Power Supply (UPS);

— charging stations for electro-mobility;

— power supplies;

— programmable Logic Controllers (PLC);

— power Drives;

— devices for EX-zones or for mining applications in general;

— products already covered by standards addressing similar topics such as:

  — medical equipment covered by EN 60601-1. For these devices, tests for verification after repair are covered by EN 62353;

  — arc welding equipment covered by EN IEC 60974-1. For these devices, tests for verification after repair are covered by EN 60974-4.

  — machinery covered by EN 60204-1. For these devices, EN 60204-1 applies.

[1] Under preparation. Stage at time of publication: prEN 50699:2019.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

HD 60364-6, *Low-voltage electrical installations — Part 6: Verification (IEC 60364-4)*

EN 61557 (series), *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC — Equipment for testing, measuring or monitoring of protective measures (IEC 61557, series)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Some of the definitions may differ from those in the product standards for type testing, as different test methods are used.

3.1
electrical safety
protection within an equipment which limits the effects of electrical current on a user or other individuals

Note 1 to entry: Safety is defined as freedom from unacceptable risk (refer to ISO 14971:2007, definition 2.24).

3.2
testing
visual control, measure and prove the electric equipment after repair to assure that equipment remains safe to use

3.3
repair
means for restoration of the intended function of the equipment

3.4
(electrically) skilled person
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

[SOURCE: IEC 60050-195:1998, 195-04-01]

3.5
electrical equipment
single apparatus using electrical energy and connected by plug or permanently connected to a final circuit of the distribution system

Note 1 to entry: Equipment includes those accessories as defined by the manufacturer that are necessary to enable the normal use of the equipment.

3.6
final circuit (of buildings)
electric circuit intended to supply directly electric current to current-using equipment or socket-outlets

[SOURCE: IEC 60050-826:2004, 826-14-03]

3.7
leakage current
current flowing from live parts of the equipment to earth

[SOURCE: IEC 60050-442:1998, 442-01-24 modified – the term has changed and a reference to the absence of an insulation fault has been removed]

3.8
touch-current
electric current passing through a human body or through an animal body when it touches one or more accessible parts of electrical equipment not connected to protective earth

[SOURCE: IEC 60050-195:1998, 195-05-21 modified – the wording of the definition has been narrowed to electrical equipment not connected to protective earth]

3.9
protective conductor current
electric current which flows in a protective conductor and is frequency weighted according to the characteristics of the human body

[SOURCE: IEC 60050-826:2004, 826-11-21, modified – the wording of the definition has been expanded.]

3.10
residual current

vectorial sum of the currents flowing in the live conductors of the mains circuit of the equipment and frequency weighted according to the characteristics of the human body

[SOURCE: IEC 60050-442:1998, 442-05-19 modified – the wording of the definition has been expanded]

3.11
insulation resistance
resistance under specified conditions between two conductive elements separated by insulating materials

[SOURCE: IEC 60050-151:2001, 151-15-43]

3.12
protective bonding resistance
resistance between any accessible conductive part, which has to be connected for safety purposes to the protective earth terminal, and the

— protective terminal of the mains plug, or

— protective terminal of the equipment inlet, or

— protective terminal permanently connected to the supply mains,

resistance between protective earth terminals at each end of a detachable power supply cord, extension leads and multi-way adapters

3.13
SELV
electric system in which the voltage cannot exceed the value of extra-low voltage:

— under normal conditions and

— under single fault conditions, including earth faults in other electric circuits

Note 1 to entry: SELV is the abbreviation for safety extra-low voltage.

[SOURCE: IEC 60050-826:2004, 826-12-31]

3.14
PELV
electric system in which the voltage cannot exceed the value of extra-low voltage:

— under normal conditions and

— under single fault conditions, except earth faults in other electric circuits

Note 1 to entry: PELV is the abbreviation for protective extra-low voltage.

[SOURCE: IEC 60050-826:2004, 826-12-32]

3.15
permanently connected equipment
equipment that can only be electrically connected to or disconnected from the mains by the use of a tool

3.16
pluggable equipment type A
equipment that is intended for connection to the mains via a non-industrial plug and socket outlet or via a non-industrial appliance coupler, or both

Note 1 to entry: Examples are plugs and socket-outlets covered by standards such as IEC/TR 60083 and EN 60320-1.

3.17
current-using equipment
electric equipment intended to convert electric energy into another form of energy, for example light, heat, mechanical energy

[SOURCE: IEC 60050-826:2004, 826-16-02]

3.18
hazardous-live-part
live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-826:2004, 826-12-13]

4 Requirements

Tests after repair shall only be performed by an electrically skilled person.

Additional requirements (e.g. for the mechanical safety or for fire protection) according to the requirements from the product safety standard shall be considered.

If testing the equipment requires additional knowledge or additional test and test equipment, for example equipment for microwaves, tests shall be done according to the instructions of the manufacturer.

All tests shall be performed in such a manner that the risk for testing personnel or other individuals shall be reduced by appropriate protective measures.

If not otherwise stated, all values for current and voltage are the RMS values of an alternating, direct or composite voltage or current.

The applicable tests as listed in Clause 5 shall be used to advise that:

— there are no visible faults on safety related parts, which are accessible by the user, and

— by the intended use of the equipment, no hazard for the user or the environment originates.

The electrically skilled person who is responsible for the test shall decide if additional tests are required to meet the protective measures.

The electrically skilled person may decide that, for equipment that is connected to the distribution system with fixed and protected wiring and is not intended to be hand-held during operation, the test is carried out according to this standard and/or according to HD 60364-6.

The test procedure shall be interrupted, and the equipment shall be disconnected from mains and marked as failed, if it is found that during the test:

— reduced safety levels are present due to damage or from unintended use, and/or

— functional hazards could occur.

5 Tests

5.1 General

5.1.1 General test conditions

The tests may be performed at the ambient temperature, humidity and atmospheric pressure present at the location of testing. The operational limits of the test equipment and the equipment under test (EUT) shall be considered.

The test equipment shall be tested according to the test steps in 5.1.2 to 5.1.5, as long as it is possible with the EUT. The sequence of testing shall be as defined in this standard.

For schematics of test sequences, see Annex B.

Each individual test shall be passed before proceeding to the next test.

If it is not possible to perform a certain test step, an electrically skilled person shall decide if the safety of the EUT can be confirmed without the test step or by other means.

NOTE 1 Manufacturer's instructions on tests to be performed after repair can be considered as other means.

The values in this standard shall be used unless the product standard specifically provides in-service limits in which case the product standard limits shall be used.

NOTE 2 If other external equipment is connected to the EUT, for example via data connectors, measured values will be for the total system including the external equipment or accessories. If the external equipment is disconnected from the mains but remains connected to the EUT, measurements can still be influenced such that it is not possible to correctly access the safety of the EUT.

If it is obvious that the EUT is contaminated by dust or moisture, it is allowed to clean the EUT and/or the EUT is allowed to dry before starting the tests.

5.1.2 Visual inspection

Visual inspection shall be performed according to 5.2.

5.1.3 Test of the protective measures against electric hazards

Test of the protective measures against electric hazards shall be performed according to 5.3 to 5.8.

— Confirmation of the effectiveness of the protective bonding to all accessible conductive parts connected for safety reasons to protective earth according to 5.3.

— Confirmation of the effectiveness of the insulation by measuring the insulation resistance between live parts and accessible conductive parts:

  — connected to protective earth (primarily on class I equipment) according to 5.4;

  — protected by double or reinforced insulation and not connected to protective earth (primarily on class II equipment but also on class I equipment) according to 5.4;

  — protected by SELV/PELV according to 5.4.

— Confirmation of the compliance with the limits for the leakage currents by measuring of:

  — the protective conductor current according to 5.5;

  — The touch-current of accessible conductive parts not connected to protective earth, if applicable, according to 5.6.

NOTE 1 The measurement of leakage current can be omitted on extension leads, detachable power cables, multiple socket-outlets without electrical parts between live conductors and protective earth.

NOTE 2 In general this standard does not address the measurement of DC leakage currents.

— Confirmation of the compliance with the requirements for the protective measure SELV/PELV by measuring the output voltage, if the output voltage is accessible according to 5.7.

— Confirmation of the compliance with the limits for the leakage currents produced by a floating input with a rated input voltage above 50 V AC or 120 V DC according to 5.8.

— Confirmation of the compliance of the polarity of mains plug wiring according to 5.11.

5.1.4 Confirmation of the compliance of additional protective measures

Confirmation of the compliance of additional protective measures shall be according to 5.9.

5.1.5 Documentation and evaluation of test

The documentation and the evaluation of the tests shall be according to Clause 6.

5.2 Visual inspection

The visual inspection shall take place to detect external defects and, if possible, to determine the qualification of the suitability of the equipment for the environment.

Special attention shall be paid to the following (if any):

— any damage or contamination;

— all cables and connectors fulfil the requirements of their intended use;

— condition of the mains plug and the mains connectors and conductors;

— defects of the strain relief of the mains supply cord;

— defect of the mains lead cleat;

— condition of anchorage, cable clip, accessible fuse insert;

— damage of the housing and protective cover that may give access to live or dangerous moving parts;

— signs of overload or overheating or unintended use;

— signs of improper change;

— signs of contamination, corrosion and improper aging;

— contamination, blockage of cooling inlets;

— condition of air filter;

— density of container for water, air, or other medium, condition of pressure control valve;

— usability of switches, control and setup equipment;

— readability of all safety relevant markings or symbols, of the ratings and of the position indicators;

— all fuses accessible from the outside are complying with the data given by the manufacturer (rated current, characteristics);

— the integrity of mechanical parts;

— assess the relevant accessories together with the equipment (e.g. detachable or fixed power supply cords tubing);

— defect due to over-bending of cords, cables, hoses and tubing.

NOTE It is appropriate to determine during the visual inspection, if accessible conductive parts, that have to be tested according to 5.3 to 5.8, are present.

5.3 Measurement of protective bonding resistance

The integrity of the connection between:

— the protective earth terminal of the equipment (where applicable contact on the mains plug) and

— each accessible conductive part intended to be connected to the protective earth. Additional confirmation is needed for all parts that are visible during repair.