

LOVAG TEST INSTRUCTION IEC/EN 60947-1 Ed. 5.1

CONDITIONS FOR TESTING LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR PART 1. GENERAL RULES

This test instruction is based on the following standards:

General Rules:

IEC 60947-1 Edition 5.0 (2007) + A1 (2011) EN 60947-1 (2007) + A1 (2011)

Specific Requirements:

IEC 60228 Edition 3.0 (2004)	EN 60228 (2005)
IEC 60695-2-10 Edition 1.0 (2000)	EN 60695-2-10 (2001)
IEC 60695-2-11 Edition 1.0 (2000)	EN 60695-2-11 (2001)
IEC 60695-11-10 Edition 1.0 (1999) +A1 (2003)	EN 60695-11-10 (1999) +A1 (2003)
IEC 60529 Edition 2.0 (1989) + A1 (1999)	EN 60529 (1991) + A1 (2000)
IEC 61180 Edition 1.0 (1992)	EN 61180-1 (1994)

It complies with this standard in all respects, and provides additional information ensuring a suitable degree of repeatability of the tests between the different test stations.

S. MANGANARO



Chairman of LOVAG Technical Committee

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Author: ACAE

The test instruction consist of pages dated as shown in the following check list:

Page	Date
1 to 14	2013-01-01

PREAMBLE

The tests shall be carried out after the reference standard(s) have been studied, since this test instruction only provides details on certain points. For convenience in the use of this test instruction, the paragraphs are numbered according to the clauses in the Standard IEC 60947-1.

PART 1:**GENERAL RULES****5.****PRODUCT INFORMATION****5.2****MARKING**

Assessment is made by inspection.

(Tests for checking compliance with requirements for indelibility and immovability of marking are under consideration.)

7.1**CONSTRUCTIONAL REQUIREMENT****7.1.2.1****General materials requirements**

The manufacturer shall specify which test method, 7.1.2.2 or 7.1.2.3, is to be used. Alternatively, the manufacturer may provide data from the insulating material supplier to demonstrate compliance with the requirements. In this case a certificate or report from the insulating material supplier shall be included in the LOVAG Test Report.

7.1.2.2**Glow wire testing**

The manufacturer shall indicate which methods, amongst a), b), c) and d) shall be used. The paragraphs a) and b) are preferred if dimensions of the insulating parts are large enough.

For small parts, as specified in IEC 60695-2-11, the relevant product standard may specify another test, but if there are not other specifications, the applicable paragraphs are c) and d).

7.1.5**Actuator****7.1.5.1****Insulation**

Compliance is checked by inspection and appropriate tests of 8.3.3.4. carried out also with reference to General Instruction LTI G5.

7.1.5.2**Direction of movement**

Compliance is checked by inspection.

7.1.6.1**Indicating means**

Compliance is checked by inspection.

7.1.6.2**Indication by the actuator**

Compliance is checked by operation.

- 7.1.7 Additional requirements for equipment suitable for isolation**
- 7.1.7.1 Additional constructional requirements**
Compliance is checked by tests of 8.2.5.
- 7.1.8.1 Constructional requirements**
Compliance is checked by inspection.
- 7.1.8.3 Connection**
Compliance is checked by inspection.
- 7.1.8.4 Terminal identification and marking**
Compliance is checked by inspection.
- 7.1.10 Provisions for protective earthing**
Compliance is checked by inspection
- 7.1.11 Enclosures for equipment**
Compliance is checked by inspection
- 7.2 PERFORMANCE REQUIREMENTS**
- 7.2.3 Dielectric properties**
Refer to Test Instructions for product standards.
- 7.2.3.3 Clearances**
Clearances are verified by impulse voltage test with the exception of case A values which may be verified by measurement according to annex G of the standard.
- 7.2.3.4 Creepage distances**
Creepage distances are verified by measurement, if practical, on the equipment.
If not practical, then creepage distances can be calculated from drawings.
- 7.3 ELECTROMAGNETIC COMPATIBILITY**
Refer to Test Instruction for product standards.

8.2 COMPLIANCE WITH CONSTRUCTIONAL REQUIREMENTS**8.2.1.1.1 Glow-wire test (on equipment)**

Refer to clauses 4 to 10 of IEC 60695-2-10 and IEC 60695-2-11, under the conditions specified in 7.1.2.2

8.2.1.1.2 Flammability, hot wire ignition and arc ignition tests (on materials)

Test a) Refer to the following paragraphs of IEC 60695-11-10:

- Test chamber: par. 6
- Test specimens: par. 7
- Conditioning: par. 8.1 and 9.1
- Method FH: par. 8.1 up to 8.5 (suitable for evaluating the burning rate)
- Method FV: par. 9.1 up to 9.5 (suitable for evaluating the extent of burning after extinction of the flame)

8.2.4 Mechanical and electrical properties of terminals

The measurement facilities (dimensions, torque) shall be linked to international units and standards, and their inspection shall be included in the platform quality plan. The measurement results shall be mentioned in the test report, with the values of the torques used clearly specified.

The sentence "aluminium terminals" means also "aluminium alloy terminals".

The sentence "aluminium conductors" means "aluminium conductors complying with the publication: IEC 60228".

8.2.4.3 Testing for damage to and accidental loosening of conductors (flexion test)

In this case, the word "sample" means a sample of a terminal, and not a sample of the complete device; this means that several tests can be carried out on the same device, according to the number of similar terminals.

8.2.4.5 Test for insert ability of unprepared round copper conductors having the maximum specified cross-section**8.2.4.5.1 Test procedure**

The device shall be fixed in such a way that the direction of penetration is vertically downwards.

8.2.4.5.2 Construction of gauges

Refer to standard. In addition the length of the part of the gauge, intended to keep in handle, shall be 25 mm in length and diameter 6,3 mm for gauges form B.

8.2.5 Verification of the effectiveness of indication of the main contact position of equipment suitable for isolation

8.2.5.2 Method of test

8.2.5.2.1 Dependent and independent manual operation

Using a torque measurement device for determination of the normal operation force necessary to open the contacts the value of the force F is calculated taking in to account the application point and it is acceptable to remove the handle so the torque measurement can be done directly on the shaft of the device under test. The measured force (F) shall be taken to be equal to the average value obtained from three consecutive tests.

In accordance with the standard, the contacts of the pole for which the test is deemed to be the most severe shall be kept closed. This pole shall be determined by evaluation of the construction. If this is not possible it is necessary to carry out a quick preliminary test on a separate sample to determine which one causes the most unfavorable distortion under the action of force ($3F$).

For practical reasons, it is acceptable to slightly change the point of application of the force, with respect to Figure 16 - Actuator test force - provided that the same application point is used for the measurement of F and for the application of the test force defined in table 17. It is also acceptable to add an intermediate support part (a screw for example) or a handle extension.

The operator should follow the manufacturers' instructions, if any, for application of table 17 and, only if there are not, makes himself the choice.

The choice of the line in table 17, which corresponds, to operation with one or two

fingers, or with one or two hands, shall be carried out by the operator according to the true practical possibility of operation, during normal utilization, which is materialized by the space available on the actuator. If there are several possibilities, the most unfavorable condition shall be used. Mention of this fact is made in the test report.

8.2.5.3 Condition of equipment during and after test

8.2.5.3.1 Dependent and independent manual operation

The indication of the open position shall not be wrongly given. In particular, if the system concerned has colored ranges, the color corresponding to the not-opening position shall not become invisible.

It is acceptable for the actuator mechanism to be distorted or broken, provided that:

- the manufacturer's locking mechanism cannot be operated while the strain is being applied,
- the position indicator does not show the open position when the strain is released.

8.3 PERFORMANCE

8.3.2 General test conditions

8.3.2.2.2 Tolerances on test quantities

See also General Instruction LTI G2.

8.3.2.4 Test reports

See also General Instruction LTI G1.

8.3.3.3 Temperature-rise

During the tests, the ambient air temperature shall be recorded during last quarter of the period; it shall be between + 10 °C and + 40°C and shall not vary more than 10 K.

In the case where the temperature-rise steady-state value is not reached within 8 hours, this shall be mentioned in the test report and the equipment shall be certified for eight-hour duty.

8.3.3.4 Dielectric properties

8.3.3.4.1 Type tests

1)

Any integral non-metallic enclosure of equipment intended to be used without an additional enclosure shall be covered by a metal foil connected to the frame or the mounting plate.

It is recalled that an integral enclosure is "an enclosure which forms an integral part of the equipment" (2.1.17), and that an enclosure is a part providing a specified degree of protection of equipment against certain external influences and a specified degree of protection against approach to or contact with live parts and moving parts" (2.1.16).

The test results will comply only if the degree of protection is higher or equal to IP2x or IPxxB (IEC 60529).

In order to ensure a suitable degree of repeatability of the tests between the different test stations, any device or any part of a device intended to be used without additional enclosure having a non-metallic enclosure and a degree of protection higher or equal to IP2x or IPxxB shall be considered by LOVAG as having an integral non-metallic enclosure. During the test of dielectric properties,

a metal foil shall be applied to all surfaces where these can be touched with the standard test finger.

This method is intended to check insulation co-ordination properties by dielectric tests and not to verify the IP degree of protection. Therefore it is not necessary to carry out tests with different cross-sections of conductor. Conventionally the appropriate maximum cross-section is taken. For circuit-breakers which can be fitted with a range of over-current releases the test shall be carried out with maximum and minimum overload releases and appropriate maximum cross-section for each overload.

Refer also § 7.2.3 of the standard.

Arrangement of metal foil

Some characteristic examples of arrangement of metal foil are given in the following figures.

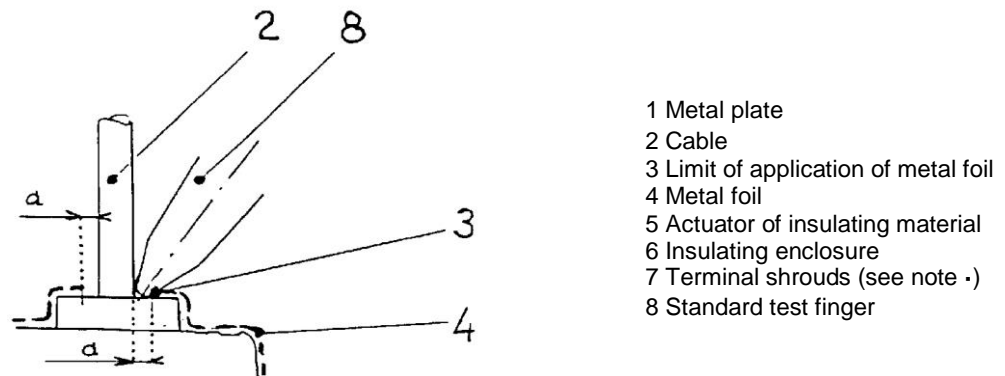


Fig.1

Use of the test finger for arrangement of the metal foil

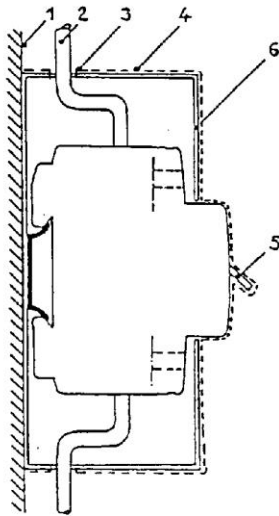


Fig.2

Device with a non-metallic projecting part
Intended to be use without additional
enclosure, inside a non-metallic enclosure

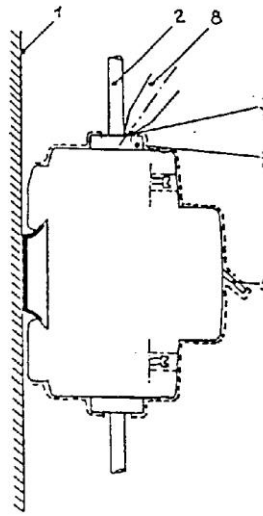


Fig.3

Device having an integral non-metallic enclosure

- 1 Metal plate
- 2 Cable
- 3 Limit of application of metal foil
- 4 Metal foil
- 5 Actuator of insulating material
- 6 Insulating enclosure
- 7 Terminal shrouds (see note .)
- 8 Standard test finger

If an integral enclosure may be opened by hand, the figure 2 also applied. Notes:

- ⌚ According to IEC 60529, Ed. 2.1 (2001), paragraph 3.1, note 2, terminal shrouds are considered as a part of the enclosure except when they can be removed without the use of a key or tool.
- ⌚ If the dielectric tests are carried out in an enclosure (total or partial), all the tests of sequence I shall be made with this enclosure.

8.3.3.4.1

Impulse withstand test

2)

These type tests apply to equipment for which the manufacturer has declared a value for the rated impulse withstand voltage U_{imp} .
The metal foil needs to be applied on accessible parts for the declared degree of protection.

8.3.3.4.1

Verification of impulse withstand voltage

2) a)

In order to check that there has been no unintentional disruptive discharge, it is necessary to connect an oscilloscope to the impulse generator.

This oscilloscope shall be used to measure the peak voltage, which is truly applied to the object, to check the waveform and the peak voltage (refer to IEC 61180 - 1).

Note: The distinction between a disruptive discharge and a discharge through over voltage suppressing means (OSM) is established by observation of the signal on the oscilloscope. The following waveforms may be obtained:



full wave
(satisfactory)



wave limited by OSM
(satisfactory)



wave chopped by discharge
on peak or on the front
(to be interpreted by
comparison with the
characteristics of gas surge
arrestors if any)

In all cases, it is preferable for the applicant, to specify whether the device is equipped with OSM so as to provide a better interpretation of the oscillogram.

8.3.3.4.1

Test voltages

2) b)

The actual test voltages are specified.

- in Table 12 in the case of phase-to-ground tests or phase-to-phase tests
- in Table 14 for additional tests voltage across the open contacts of equipment declared to be suitable for isolation.

The specified test voltages are normally voltages measured on the object, and not offload voltages of the generator.

The influence of the equipment under test on the waveshape, if any, is ignored. However when the voltage is to be applied on a device equipped with an OSM, it is necessary to adjust the off-load voltage of the generator. In this case, for the interpretation of the oscillograms, refer to Note of 8.3.3.4.1 2) a) above. By another way the energy contents of the test current shall not exceed the energy rating of the OSM.

8.3.3.4.1 Power-frequency withstand tests

3)

8.3.3.4.1 General conditions

3) a)

Refer to the product standard.

The dielectric tests at power frequency are carried out:
- as type tests for the verification of solid insulation -

The metal foil needs to be applied on accessible parts for the declared degree of protection.

8.3.3.4.1 Test voltages

3) b)

Refer to the product standard.

If not, the test voltages are specified in the standard IEC 60947-1: table 12A. The voltage applied to the device shall be maintained and, if necessary, readjusted during the test.

8.3.3.4.1 Application of test voltage

3) c)

Refer to the product standard.

The time duration of the test voltage shall be that of the product standard if different of 5 s.

Initial application of the test voltage shall not exceed 50% of the final test value with the test voltage being raised gradually to the final value within a period of a few seconds.

Main circuit

For the tests between each pole and the others, with the device closed, all control circuits, tripping circuits, etc....., which are normally energized between poles, may be disconnected and energized by a separate source.

Control circuits and auxiliary circuits

Each circuit is tested preferably according to item b) ii). ~~(see 7.3.2.1 — 2)a)~~

8.3.3.4.1**Results to be obtained**

3) d)

Refer to the product standard.

The test is declared to be non-satisfactory if the over current relay of the generator has tripped by manifestation of disruptive discharge.

8.3.3.4.1**Power-frequency withstand verification after switching and short-circuit tests**

4)

8.3.3.4.1**General conditions**

4) a)

Refer to the product standard.

The dielectric tests at power frequency are carried out as verification tests after other tests.

For auxiliary circuits, test is not necessary.

The test with the main contacts open is carried out according to the product standard. These tests shall be conducted as soon as possible after the preceding test but not exceeding 30 minutes and, where possible, without disturbing either the device or the test rig. However, for safety reasons for instance, the device under test may be displaced, without disturbance, towards the dielectric generator. The metal foil need not to be applied because this verification is already carried out with 8.3.3.4.1 3).

8.3.3.4.1**Verification of direct current withstand voltage**

6)

Until modification of the standard equipment for direct current is tested in alternating current as § 8.3.3.4.1 3) and § 8.3.3.4.1. 4).

8.3.3.4.1**Verification of creepage distances**

7)

Verification of impulse withstand voltage can confirm only measurements of clearances.

Minimum values of creepage distances may be determined on drawings and shall be measured on one sample.

In case of different material groups the required creepage distance should be defined according to the "least good" material.

The pro rata length of the materials can be added. The total length has to be equal or greater than the required distance for the "least good" material.

8.3.3.4.1**Verification of leakage current of equipment suitable for isolation**

8)

Refer to § 7.2.7 and to the product standard.

The leakage current shall be the greatest value indicated by an instrument measuring the r.m.s. value with a nominal setting time of at least 5 s.

8.3.4**Performance under short-circuit conditions****8.3.4.1.5****Calibration of the test circuit**

The Standard requires the calibration have to be carried out for a duration of at least 0,1 s.

A shorter duration is acceptable, provided that it is sufficient to permit the determination of the r.m.s. value of symmetrical current as well as the power-factor of the circuit.

The making instant should be chosen in the way that the peak current value in one phase achieves the necessary value corresponding to the power factor and r.m.s. current values as specified in table 16 of Standard.

In the case of permanent test platforms supplied by a generator, it is acceptable, for tests carried out at power approaching the maximum value of test platforms that the calibration was carried out at a voltage less than the test voltage.

This proposal allows prospective current determination to be made repeatedly without undue stress to the test platforms.

In any case, the prospective current tests shall not be made at a value of applied voltage less than 75% of the test voltage. The linearity characteristic of the generator has to be predetermined by measurements at periodic intervals.

Normal calibration interval of full test voltage calibrations for generator-energized permanent test platforms shall not be over a year according to the Quality plan of the Testing Laboratory.

Calibration is made before each series of tests to validate the measurement system. In the case of permanent test platforms calibrated at 75% of the test voltage, the last periodic full test voltage calibration records shall be also enclosed in the LOVAG Test Report.