



LOVAG
TEST INSTRUCTION IEC/EN 60439-4 Ed. 2.0

LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES -

**PART 4: PARTICULAR REQUIREMENTS FOR ASSEMBLIES FOR CONSTRUCTION SITES
(ACS)**

This test instruction is based on the following standards:

General Rules:

IEC 60439-1: 1999

EN 60439-1: 1999

Specific Requirements:

IEC 60439-4 ed. 2.0 (2004)

EN 60439-4 (2004)

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

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

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PREAMBLE

The tests shall be carried out after the reference standard(s) have been studied, since this Test Instruction only provides details on certain specific points.

All references to clauses of IEC 60439-1: 1999 are preceded by the letter "G".

For convenience in the use of this Test Instruction, the paragraphs are numbered according to the clauses in the Standard IEC 60439-4

Yellow highlighting indicates modification made since the preceding updated version.

1. GENERAL

Refer to standard and G1

2. DEFINITIONS

Refer to standard and G2

3. CLASSIFICATION OF ASSEMBLIES

Refer to standard and G3

4. ELECTRICAL CHARACTERISTICS OF ASSEMBLIES

Refer to standard and G4

5. INFORMATION TO BE GIVEN REGARDING THE ASSEMBLY

Refer to standard and G5

6. SERVICE CONDITIONS

Refer to standard and G6

7. DESIGN AND CONSTRUCTION

Refer to standard and G7

G7.3 Temperature rise

Attention is drawn to the Note at the end of the first paragraph, which states that:

"The temperature rise of an element or part is the difference between the temperature of this element or part measured in accordance with Sub-clause 8.2.1.5 and the ambient air temperature outside the ASSEMBLY."

i.e. External Ambient

The note in **TABLE 2** for Built-in components states that the temperature rise for built-in components will be:

“In accordance with the relevant requirements for the individual components, if any, or, in accordance with the manufacturer's instructions, taking into consideration the temperature in the ASSEMBLY”.

That is, the internal ambient of the assembly shall be considered as being relevant to the temperature rise for the component under consideration.

The relevant requirements for the individual component shall be the relevant international standard for the component.

Where the terminals of the built-in component are also the terminate for external insulated conductors the lower of the two temperature rise values shall be applied i.e. the difference between the specified temperature for the terminals of the built-in component and the internal ambient of the assembly or 70K whichever is the lower value.

Where applicable, the allowable temperature rise of built-in components and bus-bars, conductors and insulating materials etc shall be specified by the manufacturer and detailed in the test report.

7.2 Enclosure and degree of protection

7.2.1.1 The degree of protection provided by an ACS against contact with live parts, ingress of solid bodies and liquid is indicated by the designation IP... according to IEC 60529. The degree of protection of all parts of the ACS shall be at least IP44, with all doors closed and all removable panels and cover plates fitted.

Ventilation and drainage holes shall not reduce this degree of protection.

NOTE In Spain wiring rules (RD 842/2002) require a minimum degree of protection of IP45 for enclosures, switchgear and controlgear, socket-outlets and other installation elements intended for outdoor construction sites.

The degree of protection for an operating face inside a door shall be not less than IP21 provided that the door can be closed under all conditions of use. Where the door cannot be closed the degree of protection for the operating face shall be at least IP44.

G7.5 Short-circuit protection and short-circuit withstand strength.

G7.5.4 Coordination of short-circuit protective devices. (SCPD'S)

If the test circuit incorporates SCPDs, the report shall detail the SCPDs used for test i.e. manufacturer's name and reference, rated current, rated voltage and type of device. In

addition, the short-circuit rating of the SCPD shall be stated where this differs from that of the associated connection of the ASSEMBLY.

G7.7**Internal separation of ASSEMBLIES by barriers or partitions**

This clause details differing 'Forms' of separation. However, since the forms of separation is the subject of agreement between the manufacturer and user and not included in the list of classification (Clause G3) or required to be marked on nameplates (Clause G5), reference to the 'Form' type shall not be made in the test report.

8.**TEST SPECIFICATIONS****G8.1****Classification of tests****G8.1.1****Type tests (see Sub-Clause 8.2)**

Add to the list of type tests:

h) verification of mechanical strength (8.2.101)

i) verification of resistance to corrosion (8.2.102)

G8.2**Type tests**

Table 7 has been modified: the verification of mechanical strength by test (sub-clause 8.2.1001) and the verification of resistance to corrosion by test (sub-clause 8.2.102) have been inserted.

G8.2.1**Verification of temperature-rise limits****G8.2.1.1****General**

i) The test shall be carried out at the values of rated current in accordance with sub-clause G8.2. 1.3 with the apparatus of the ASSEMBLY installed.

ii) Where heating resistors are utilized the test report shall detail the precautions taken to make the test representative. For example, the basis on which the power dissipation has been determined shall be recorded in the test report.

G8.2.1.2**Arrangement of the Assembly**

Refer to **G8.2.1.2**

The ASSEMBLY shall be arranged for test in accordance with the manufacturer's instructions and the test arrangement shall be detailed in the test report.

G8.2.1.3 Temperature-rise test using current on all apparatus.

The test report shall detail the combination of circuits used for test, the diversity factor and details of external conductors. The Notes 1 and 2 are applicable and if utilized shall be stated as being so in the test report.

G8.2.1.3.1 For values of test current up to and including 400A

Refer to G8.2.1.3.1

G8.2.1.3.2 For values of test current higher than 400A but not exceeding 800A

Refer to G8.2.1.3.2

G8.2.1.3.3 For values of test current higher than 800A but not exceeding 3150A

Refer to G8.2.1.3.3

G8.2.1.3.4 For values of test current higher than 3150A

Refer to G8.2.1.3.4

G8.2.1.4 Temperature-rise test using resistors with an equivalent power loss.

Refer to G8.2.1.1.4

G8.2.1.5 Measure of temperatures

The positions at which measurements are made and the method of temperature measurement shall be detailed in the test report.

G8.2.1.6 Ambient air temperature

Refer to G8.2.1.6

G8.2.1.7 Results to be obtained

Refer to G8.2.1.7

The results of the measurements taken shall be detailed in the test report.

G8.2.2 Verification of dielectric properties

Refer to G8.2.2

8.2.2.1 General

The second paragraph of G8.2.2.1 is not applicable

G8.2.3 Verification of the short-circuit withstand strength

Refer to G8.2.3

G8.2.3.2.1 Test arrangements

Refer to G8.2.3.2.1

All parts of the ASSEMBLY which may affect the results of the test or be affected by the test shall be fitted for the test e.g. enclosure covers, withdrawable outgoing units etc and this shall be stated in the test report.

Where such fitments are not incorporated on equipment provided for test the results of any relevant tests shall not be utilized for the assignment of ratings.

G8.2.3.2.2 Performance of the test: General

Refer to G8.2.3.2.2

Unless otherwise agreed, the test supply conductors shall be connected to the input terminals of the ASSEMBLY.

Where an ASSEMBLY incorporates a built-in component e.g. a circuit breaker and the interconnections to this device are to be included in the test report, then the device shall be closed for test as in normal service.

G8.2.3.2.3 Testing of the main circuits

Refer to G8.2.3.2.3

The requirements of Sub-clause G7.5.5.1.2 are considered to be fulfilled when the conductors including any joints in the conductors between the main bus-bars and the supply side of a single functional unit, including the connections to the unit, are adequately and individually insulated and/or adequately shrouded phase-to-phase and phase to earth.

For the test to Sub-clause G8.2.3.2.3(c) the standard requires the value of the short-circuit current to be the same as that for the main bars. This shall be taken to relate to the magnitude of rms and peak currents including the associated duration, and to the bus bars to which the interconnections are made, notwithstanding the designations of figures D1, D2 and D3 of Appendix D.

For the test to Sub-clause G8.2.3.2.3 (d) the standard requires the value of test current to be 60% of the phase-to-phase current and to be also agreed between the manufacturer and user if different to this. For the purposes of testing the term 'phase current' shall be taken to mean the rated short-time withstand, rated prospective short-circuit withstand, rated conditional short-circuit or rated fused short-circuit current as applicable, assigned to the associated main bus-bars.

The relationship between the peak and rms current for the test to Sub-clause G8.2.3.2.3(d) shall be as in [Table 5](#). The value of the rms test current, its peak and duration, shall be stated in the test report. The test applies to the main bus bars, bus bars, conductors connecting the bus bars to the outgoing circuit and the outgoing circuits. The term "including and joint" shall be taken to mean "including any joints" as in sub-clause G8.2.3.2.3 (b).

The Standard, Sub-clause G8.2.3.2.3(b), details the precise requirements for the positioning of the short-circuit point related to prospective short-circuit current tests on the main bus-bars, but does not make this reference for such tests on outgoing circuits (Sub-clause G8.2.3.2.3(a)) or interconnections (Sub-clause G8.2.3.2.3(c)).

For the purposes of testing, the connection requirements of Sub-clause G8.2.3.2.3(b) do not apply to the tests of Sub-clause G8.2.3.2.3(a) and (c).

The distance from the calibration point to the relevant short-circuit point(s) shall, however, be detailed within the test report.

Tests on a neutral bar to Clause G8.2.3.2.3(d) shall not be included in a Certificate unless tests on the main bus-bar to Clause G8.2.3.2.3(b) are also included.

The requirements of clause G8.2.3.2.3(b) concerning the length of bus bar to be tested are not absolutely clear. Until such time as the standard has been amended to clarify these requirements, the sentence:

"If the length of the bus bars of the ASSEMBLY is less than 1.6m then the short-circuit shall be established at the end of these bus bars"

is to be interpreted as:

"Where the design of the ASSEMBLY is such that the length of bus bars to be tested is less than 1.6m and cannot be extended to meet this requirement, then the complete length of bus bar shall be tested, the short-circuit being established at the end of these bus bars".

G8.2.3.2.4

Value and duration of the short-circuit current

[Refer to G8.2.3.2.4](#)

The rated short-circuit currents or short-time withstand currents may be any recognized value provided the Certificate Front Sheet clearly indicates the associated peak factor which in turn must be at least that specified in [Table 5](#) for the relevant short-circuit rating.

For ASSEMBLIES incorporating short-circuit protective devices, whether these be in the incoming circuit or elsewhere, the test voltage shall be applied for a time sufficiently long to enable the short-circuit protective device to operate to clear the fault and, in any case, for not less than 10 cycles.

For ASSEMBLIES not incorporating short-circuit protective devices the specified time may be any value provided this is a direct multiple of 0.05s and the requirements of Sub-clause G8.2.3.2.3 are met.

The standard requires the rms value of the rated short-time withstand current to be determined from the oscillogram, For testing purposes the rated peak withstand current (see Sub-clause G4.4) shall also be determined from the oscillogram. Values determined thus shall be used to verify the assigned ratings.

The standard does not specify any tolerance for the short-circuit, or short-time withstand currents, nor does it indicate the degree of current imbalance which is acceptable during the test. For testing purposes the following conditions shall apply:

- The average of the three phase currents shall be not less than the rated value and the current in any one phase shall not deviate from this average value by more than 15% of the average, unless the deviation is caused by the equipment under test.

Note 1 implies that a shorter or longer test period is permissible, in accordance with the formula $I_2t = \text{Constant}$; that the peak value may be less than the rated peak withstand current; that it is only necessary to attain the rms value of short-time withstand current in one phase and that the minimum period for such a test is 0.1s.

For testing purposes these options may be adopted providing the following criteria are met:

- a) The formula $I_2t = \text{Constant}$, is utilized for periods up to a maximum of 3s (see the note incorporated in Sub-clause G7.5.2.1.2).
- b) The peak value is not less than the rated peak withstand current.
- c) The average value of the three phase currents shall be not less than the rated value for at least 0.1s after current initiation and the current in any one phase does not deviate from this average value by more than 15% of the average over this period unless the deviation is caused by the equipment under test.
- d) The option is utilized for specified times in excess of 0.1s.

Note 2 permits the peak withstand current test and the short time withstand test to be made separately under certain conditions.

For testing purposes this option may be adopted provided the following criteria are met:

- a) The laboratory has made reasonable effort to achieve the rated values during one and the same test.
- b) The time during which the short-circuit is applied for the peak withstand current test shall be not less than **three cycles**.
- c) All other requirements within the standard and this test instruction are complied with.

The final paragraph of Sub-clause G8.2.3.2.4 requires the dynamic and thermal stresses to be verified with a prospective current at the supply side of the specified protective device. Clause G8.2.3.2.3 details requirements for the positioning of the short-circuit and prospective current calibration points.

The calculated value of the prospective current, obtained during the proving test, shall be not less than the rated prospective short-circuit current, the test being performed at a supply voltage not less than 1.1 times the rated operational voltage of the ASSEMBLY.

G8.2.3.2.5

Results to be obtained

Refer to G8.2.3.2.5

Apparatus incorporated in the ASSEMBLY and intended to provide isolation shall be checked for compliance with the conditions prescribed in the relevant specification.

Additionally after the test of Clause G8.2.3.2.3 (a) and tests incorporating short-circuit protective devices, the tested equipment shall be capable of withstanding the dielectric test of Sub-clause G8.2.2, at a value of voltage for the after test condition prescribed in the relevant standard for the appropriate short-circuit test, as follows:

- 1) between all live parts and the frame of the ASSEMBLY.
- 2) between each pole and all other poles connected to the frame of the ASSEMBLY.

If tests 1 and 2 above are conducted, they shall be carried out with any fuses replaced and with any switching device closed.

G8.2.4

Verification of the effectiveness of the protective circuit.

G8.2.4.1

Verification of the effective connection between the exposed conductive parts of the ASSEMBLY and the protective circuit.

Refer to G8.2.4.1

As no value is specified in the IEC Standard, the measured resistance should be less than $50V/I_a$, where I_a is the value (in amps) of the current, which operates the overload current protection within a time of not more than 5 seconds.

According to Note 2 of Sub-clause G8.2.4.3, the resistance of the protective circuit under test shall be measured, before and after each test i.e. between the incoming terminal of the protective circuit and the outgoing terminal of the protective conductor of the circuit concerned.

Verification of the requirements of Clause G8.2.4.1 on ASSEMBLIES coming within the requirements of Sub-clause G8.2.3.2 shall not be included within a Certificate unless Verification of the short-circuit strength of the protective circuit by the test of Sub-clause G8.2.4.2 is also included.

G8.2.4.2 Verification of the short-circuit strength of the protective circuit by test.

Refer to G8.2.4.2

G8.2.4.3 Results to be obtained

Refer to G8.2.4.3

After the test, check that no possible damage is liable to hinder the correct operation of the ASSEMBLY, and measure again the resistance of the protective circuit using the same method and the same instruments as before the test; the value of the measured resistance shall be less than $50V/I_a$.

G8.2.5 Verification of clearances and creepage distances.

Refer to G8.2.5

The standard requires that clearances and creepage distances comply with the values specified in Sub-clause G7.1.2 which, in turn requires that the apparatus forming part of the ASSEMBLY shall have distances complying with those specified in their relevant specifications.

Where the relevant specification details that such requirements are "under consideration" and a client requested verification to clause G8.2.5 the following statement shall be made on the test report:

"Verification of the requirements of clause G8.2.5 is not possible since the requirements of the relevant specification are 'under consideration'".

The test report may detail the minimum clearance and creepage distance measured before and after short-circuit tests.

In any event, verification of the clearance and creepage distance shall not be included within the test report without the inclusion of verification of clause G8.2.2 - Dielectric properties and clause G8.2.3 - short circuit withstand strength.

G8.2.6 Verification of mechanical operation

Refer to G8.2.6

G8.2.7 Verification of degree of protection

Refer to G8.2.7

The standard permits unspecified adaptations to be made to the requirements of IEC Publication 60529 to suit the particular type of ASSEMBLY.

For the purposes of Certification, adaptations to the requirements of IEC Publication 60529 are not permitted.

8.2.101 Verification of mechanical strength

Refer to standard 8.2.101

8.2.102 Verification of resistance to corrosion

Refer to standard 8.2.102