



**LOVAG**  
**TEST INSTRUCTION IEC/EN 60439-5 Ed. 2.0**

**LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES**

**Part 5: Particular requirements for assemblies for power distribution in public networks**

This test instruction is based on the following standards:

General Rules:

IEC 60439-1: Ed. 4.0 (1999) + A1 (2004)

Specific Requirements:

IEC 60439-5 Edition 2.0 (2006)

EN 60439-5 (2006)

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.

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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 the General Rules are preceded with the letter G.

For convenience in the use of this Test Instruction, the paragraphs are numbered according to the clauses in the standard IEC/EN 60439-5.

Modifications made since the preceding updated version are indicated by a vertical line in the margin.

## 4. ELECTRICAL CHARACTERISTICS OF ASSEMBLIES

### 4.101 Rated current (of SCDB or CDC)

The rated current of an SCDB or CDC is that stated by the manufacturer as the rated current of the incoming circuit. If there is more than one incoming circuit, the rated current of that SCDB or CDC is either the arithmetic sum of the rated currents of all incoming circuits that are intended to be used simultaneously or the rated current of the main phase bus-bars, whichever is the lower value. This current shall be carried without the temperature rise of the individual part exceeding the limits specified in 7.3 when tested according to 8.2.1.

## 7. DESIGN AND CONSTRUCTION

### 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 G8.2.1.5 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 terminals 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.

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

### G7.5.4 Co-ordination of short-circuit protective devices. (SCPD'S)

If the test circuit incorporates SCPD's, the report shall detail the SCPD's 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**

**8.1 Classification of tests**

Such assemblies shall be capable of meeting all the relevant requirements and tests specified in Table 7 of IEC 60439-1 under TTA column heading and additional tests in Table 7 of this standard.

Where tolerances are not specified in this standard the values are to be regarded as nominal.

Where necessary to suit their particular network parameters, users may specify more onerous or additional test requirements.

**G8.2 Type Tests**

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

**G8.2.1.1 General**

i) 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, 2 and 3 are applicable and if utilized shall be stated as being so in the test report.

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

Refer to G8.2.1.1 and paragraph G8.2.1.1 i) of this instruction.

**G8.2.1.5 Measurement 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 temperatures**

Refer to the paragraph G8.2.1.5 of this instruction.

**G8.2.1.7 Results to be obtained**

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

**G8.2.3 Verification of the short-circuit withstand strength****G8.2.3.2.1 Test arrangements**

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**

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**

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, not withstanding 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 purpose of testing the term "phase-to-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 shall be as in Table 4. 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 details the precise requirements for the positioning of the short-circuit point related to prospective short-circuit current tests on the main bus-bars in Sub-clause G8.2.3.2.3(b), but does not make this reference for such tests on outgoing circuits in Sub-clause G8.2.3.2.3(a) or interconnections in 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.

#### **G8.2.3.2.4 Value and duration of the short-circuit current**

Refer to G8.2.3.2.2

The rated short-circuit currents or short-time withstand currents may be any recognised value provided the Certificate Front Sheet clearly indicates the associated peak factor which in turn must be at least that specified in Table 4 for the relevant short-circuit rating.

For ASSEMBLIES incorporating short-circuit protective devices, whether these are 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 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 provided 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 utilised 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 100ms.
- 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 devices. 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**

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

**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 G2.1.1.2

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 subclause G8.2.4.2 is also included.

**G8.2.4.3 Results to be obtained**

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 tests; the value of the measured resistance shall be less than  $50V/I_a$ .

**G8.2.5 Verification of clearances and creepage distances.**

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 in 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 G.8.2.6

**G8.2.7 Verification of degree of protection**

The standard permits unspecified adaptations to be made to the requirements of IEC Publication 60529: 1989 to suit the particular type of ASSEMBLY.

For the purposes of Certification, adaptations to the requirements of IEC Publication 60529: 1989 are not permitted.

**G8.2.8 EMC tests**  
Refer to G.8.2.8

**8.2.101 Verification of Mechanical Strength**

The tests shall be carried out at an ambient temperature between 10 °C and 40 °C. The ambient temperature during test shall be recorded in the test report in terms of temperature (°C).

With the exception of the test of 8.2.101.2.1, a new sample ASSEMBLY may be used for each of the independent tests. If the same sample ASSEMBLY is used for more than one test of 8.2.101, the compliance check for the second numeral of the degree of protection (IP code) need only be applied when the tests on that sample have been completed.

All tests shall be carried out with the ASSEMBLY fixed at its normal service mounting and where appropriate, added support at normal ground level as indicated in Figures 104a, 104b, 106a, 106b, and 109.

With the exception of the test of 8.2.101.3 of this standard, the door(s) of the ASSEMBLY, if applicable, shall be locked at the commencement of the test and remain locked for the duration of the test.

Refer to 8.2.101

**8.2.101.1.1 Verification of Resistance to static load**

Test listed in a) sub-clause shall be carried out on all types of SCDB-CCO (substation cable distribution board - outdoor cable connected), SCDB-TMO (substation cable distribution board - outdoor transformer mounted) and CDC (cable distribution cabinet) except the wall-mounted recessed type

Test listed in b) sub-clause shall be carried out on the wall-mounted recessed type of CDC.

Refer to 8.2.101.1.1

**8.2.101.1.2 Verification of Resistance to shock load**

The test shall apply to all ground-mounted types of SCDB-CCO, SCDB-TMO and CDC.

Refer to 8.2.101.1.2

**8.2.101.1.3 Verification of Resistance to torsional stress**

The test shall apply to all ground-mounted types of SCDB-CCO, SCDB-TMO and CDC.

Refer to 8.2.101.1.3

**8.2.101.2 Verification of impact force withstand**

Refer to 8.2.101.2

**8.2.101.2.1 Test applicable to SCDB-CCO, SCDB-TMO and CDCs designed for operation at ambient temperatures of between 40 °C and –25 °C**

Test 1 shall be carried out at an ambient air temperature between 10 °C and 40 °C after the ASSEMBLY has been kept within these temperatures for not less than 12 h.

Test 2 shall be carried out at an ambient air temperature between 10 °C and 40 °C immediately after the ASSEMBLY has been kept at a temperature of –25 (plus 0°C minus –5°C) for a period of not less than 12 h.

The ambient temperature during test, the storage temperature and the storage time shall be recorded in the test report in terms of temperature (°C) and hours (h).

Refer to 8.2.101.2.1

**8.2.101.2.2 Test applicable to SCDB-CCO, SCDB-TMO and CDCs designed for operation in an arctic climate**

The tests shall be carried out at an ambient air temperature between 10 °C and 40 °C immediately after the ASSEMBLY has been kept at a temperature of –50 (plus 0°C minus –5°C) for a period of not less than 12 h.

The ambient temperature during test, the storage temperature and the storage time shall be recorded in the test report in terms of temperature (°C) and hours (h).

Refer to 8.2.101.2.2

**8.2.101.3 Verification of mechanical strength of doors**

The test applies to all types of SCDB-CCO, SCDB-TMO and CDC having a door(s) hinged on a vertical edge of the enclosure.

Refer to 8.2.101.3

**8.2.101.4 Verification of resistance to axial load of metal inserts in synthetic material**

The test only applies to all types of ASSEMBLY when threaded metal inserts are provided to retain the mounting plate or switchgear and controlgear supports in place.

Refer to 8.2.101.4

**8.2.101.5 Verification of resistance to axial load of metal inserts in synthetic material**

The test only applies to all types of SCDB-CCO, SCDB-TMO and CDCs.

Test 1 shall be carried out at an ambient air temperature between 10 °C and 40 °C after the ASSEMBLY has been kept within these temperatures for not less than 12 h.

Test 2 shall be carried out at an ambient air temperature between 10 °C and 40 °C immediately after the ASSEMBLY has been kept at a temperature of –25 (plus 0°C minus –5°C) for a period of not less than 12 h.

The ambient temperature during test, the storage temperature and the storage time shall be recorded in the test report in terms of temperature (°C) and hours (h).

Refer to 8.2.101.5

**8.2.101.6 Verification of Mechanical Strength of the base**

The test is applicable to a CDC only.

Refer to 8.2.101.6

**8.2.102 Verification of resistance to abnormal heat and flame****8.2.102.1 Verification of resistance to abnormal heat**

One representative specimen of each of the insulating materials taken from enclosures, barriers and other insulating parts, including devices and components, shall be subject to a hot ball test in accordance with IEC 60238.

Refer to 8.2.102.1

**8.2.102.2 Verification of category of flammability**

Representative specimens of each of the materials of enclosures, barriers and other insulating parts shall be subjected to a flammability test in accordance with test method A– horizontal burning test – of IEC 60695-11-10.

Compliance is checked by inspection that each set of specimens can be classified to category HB40 criteria a) or b) in accordance with 8.4.2 of IEC 60695-11-10.

Refer to 8.2.102.2

**8.2.102.3 Dry heat test**

The complete ASSEMBLY shall be placed in an oven, the internal temperature of which is raised to (100 ± 2) °C over a period of 2h to 3h and maintained at this temperature for 5h.

The ambient temperature during test, and the times shall be recorded in the test report in terms of temperature (°C) and hours (h).

Refer to 8.2.102.3

**8.2.103 Verification of corrosion and ageing resistance**

When the corrosion resistance properties and projected life, as agreed between manufacturer and user, can be confirmed by reference to ISO 9223, the tests detailed herein need not be performed.

In all other cases the corrosion resistance of each design of ASSEMBLY shall be verified by the following tests.

All the test parameters (e.g temperature, humidity, duty cycle, times, saline solution concentration, etc. etc.) shall be recorded in the test report.

**8.2.103.1 Internal parts, including devices and components**

Refer to 8.2.103.1

**8.2.103.2 External parts manufactured from synthetic materials or metals which are entirely coated by synthetic material**

Refer to 8.2.103.2

**8.2.103.3 External parts manufactured from solid metal, with or without metallic or synthetic material protective coating**

Refer to 8.2.103.3