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INTERNATIONAL STANDARD

AMENDMENT 2

Railway applications – Fixed installations – DC switchgear – Part 6: DC switchgear assemblies

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IEC 61992-6:2006-02/AMD2:2020-05(en)

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FOREWORD

This amendment has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

The text of this amendment is based on the following documents:

CDV	Report on voting
9/2542/CDV	9/2584A/RVC

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

This amendment was elaborated to provide guidance to the requirement of 6.6.3, Internal arcing, that gas or vapour escaping under pressure does not endanger operating staff.

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3 Terms and definitions

Replace the text of Clause 3 by the following:

For the purposes of this document, the terms and definitions given in IEC 61992-1 and the following 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

3.1
internal arc
arcing within a switchgear assembly arising from a fault between active parts and/or between active parts and other conductive parts

3.2
rated short-circuit current under internal arcing conditions
I_{Narc}
current, during the test duration of 150 ms, indicating the maximum allowable value of sustained short-circuit current at the terminals of the incoming unit for which the requirements of this test specification are fulfilled

Note 1 to entry: The value is the maximum value of the prospective sustained short-circuit current.

3.3
compartment under test
compartment of a switchgear assembly which is subject to an internal arc test

6.6.2 Internal arcing

Add the following at the end of 6.6.2:

A manufacturer may assign a rated short-circuit current under internal arcing conditions I_{Narc} to the equipment. Requirements are given in Clause B.2.

8.2 List of the applicable tests

Add the following at the end of, and after, Table 2:

Internal arc test	Type	8.3.9

Routine and type tests are mandatory tests if related characteristics are assigned to the equipment.

8.3 Performance of tests

Add the following new subclause after 8.3.8:

8.3.9 Internal arc test

The internal arc test is a type test and shall be performed if a rated short-circuit current under internal arcing conditions (I_{Narc}) is assigned to the equipment. The test shall be performed according to the procedure specified in Annex B. The criteria for successful passing are given in Clause B.5.

Add the following new Annex B after Annex A:

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Annex B
(normative)

Method for testing under conditions of arcing due to an internal fault

B.1 Purpose of the test

Annex B applies to metal-enclosed DC switchgear assemblies - hereinafter called assemblies - used in indoor stationary installations.

The test procedure described below is intended:

– to assess the ability of the assembly to limit the risk of personal injury,

– to verify the effectiveness of the design in protecting persons,

in case of an internal arc.

The testing conditions take into account that assemblies are installed in areas restricted to authorized personnel.

NOTE This is equivalent to accessibility class A of IEC 62271-200:2011.

B.2 Characteristics – Rated short-circuit current under internal arcing conditions (I_{Narc})

If a rated short-circuit current under internal arcing conditions I_{Narc} is assigned by the manufacturer to the equipment the value shall be equal to the rated earth fault current I_{Ncwe}. The peak of the short-circuit current value is conventionally assumed to be 1,42 times the prospective sustained short-circuit current (fault of negligible impedance).

NOTE The current level during internal arcing depends on the earthing of the switchboard frame (see IEC 61992-7-1:2006, 6.5.7). High fault currents can be expected where the switchboard frame is:

– directly connected to the return circuit as shown in IEC 61992-7-1:2006, 6.5.7, Figure 4b, or

– connected to substation earth as shown in IEC 61992-7-1:2006, 6.5.7, Figure 4a, and a voltage limiting device is installed between substation earth and the return circuit.

Lower fault currents can be expected where the bedding resistance of the track and the earth resistance limit the fault current.

B.3 Test arrangements

B.3.1 Test specimen

The test shall be carried out on representative samples. In case of an assembly with a continuous main busbar, consisting of extensible (modular) standalone units, the test specimen shall consist of minimum two units connected together as in service.

The following points shall be observed.

– The test shall be carried out on a test specimen not previously subjected to an arcing test or on a specimen cleaned and prepared accordingly. The specimen and the equipment in it may be repaired or replaced before each test.

NOTE Degradation of insulation due to carbonisation or moderate erosion of metal parts is not necessarily considered to render a unit unsuitable for a further test.

– The test specimen shall be placed in an open area and shall be fixed by its designed means.

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– Vertical indicators shall be installed all around.

– A ceiling shall be located at a distance of (200 ± 50) mm from the upper part of the test specimen unless differently stated by the manufacturer.

  If a test specimen includes a roof according to the following specification, and as shown in Figure B.1, it shall be tested with the roof installed and an additional ceiling is not required. The roof:

  - covers the top surface completely, and
  - is of a protection degree of IPX1 or higher, and
  - is mounted at minimum distance d_c to the top of the assembly of no more than 200 mm.

– The test specimen shall be fully equipped. Earthing and bonding shall be as for normal service.

– Mock-ups of internal components are permitted provided that:

  - they have the same volume and shape as the original items,
  - similar external materials, with any metallic external material is earthed in a similar manner to normal service.

– All doors and covers provided are closed.

– The test specimen shall be earthed at the earthing point provided.

– Secondary devices need not be installed if inside a separate compartment for control circuits. Means for wiring from the control compartment to the compartment under test shall be installed.

B.3.2 Test circuit

A typical diagram of the test circuit is shown in IEC 61992-1:2006/AMD1:2014, Figure A.1, with typical calibration and characteristics shown in IEC 61992-1:2006/AMD1:2014, Figure A.2. The supply source S feeds a circuit comprising adjustable resistors R, adjustable reactors L and the test object A.

If the supply source is not a generator, then the minimum converter pulse number shall be 6 with a minimum supply frequency of 50 Hz.

The test current produced by the test circuit shall have a peak current with the characteristic illustrated as calibration 1 in IEC 61992-1:2006/AMD1:2014, Figure A.2.

NOTE If the waveform of the test current is in accordance with the one illustrated as calibration 1, RMS value of the test current is approximately equal to the value of the prospective sustained short-circuit current (I_{Narc}).

B.3.3 Voltage

The applied voltage of the test circuit shall be equal to the rated voltage U_{Ne}.

B.3.4 Duration of the test

The test duration shall be 150 ms.

B.4 Test procedure

B.4.1 Supply circuit

The test sample is connected and supplied corresponding to the normal service arrangement. The earthing of the enclosure is to be connected to the negative conductor of the supply source.

Infeed and earth connection shall be to the same switchgear panel.

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Any device (for example, protection relay or direct overcurrent release) that may automatically trip the circuit before the end of the prospective duration of the test shall be made inoperative or ineffective during the test.

If compartments or functional units are equipped with devices intended to limit the duration of the arc itself by other means (for example, by transferring the current to a metallic short circuit), they shall be made inoperative or ineffective during the test.

B.4.2 Arc initiation

Each compartment containing main supply voltage shall be tested in a typical configuration. Tests with each of the following locations for arc initiation shall be performed:

– main busbar to closest earthed part;
– cable connection to closest earthed part;
– circuit breaker or disconnector to closest earthed part.

The compartment under test and inside the point of initiation shall be located at the furthest point, downstream in the current path from the supply.

NOTE 1 It is assumed that the most onerous conditions are met by using the furthest point downstream.

An additional test on the main busbar shall be performed in the panel next to the panel under test if an open busbar system without or with reduced segregation is used.

NOTE 2 This test is to verify that a possibly different footpoint does not lead to a hazard.

Circuit breakers shall be and remain closed during the tests.

Compartments containing main supply voltage and protected by fuses need to be tested as follows.

– Compartments which contain fuses have to be tested once upstream of the fuse nearest to the operators wall.
– Compartments which are protected by type-tested current-limiting fuses external to the compartment shall be tested with the fuse type that causes the highest cut-off current (let-through current). The actual duration of the current flow will be controlled by the fuses.
– A compartment needs not to be tested if the circuit is protected by a fuse external to the compartment with a rated current of not more than 60 A.

The arc shall be initiated by means of a bare copper ignition wire connected between live part and nearest earthed part.

The copper ignition wire shall have a maximum cross-section with regard to the test current as given in Table B.1 but not smaller than 0,75 mm^2.

Table B.1 – Sizes of the copper ignition wire

Test current (RMS value) kA	Wire size mm^2
≤ 25	0,75
> 25 ≤ 40	1,0
> 40	1,5

The ignition wire shall be connected to points without solid insulation. Insulation shall not be destroyed, removed or punctured when the ignition wire is connected.

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B.4.3 Indicators

B.4.3.1 General

The indicators to be used are pieces of black cotton cloth so arranged that their cut edges do not point towards the test unit. Care should be taken in mounting the indicators to ensure that they do not ignite each other. This can be achieved by fitting them, for example, in a mounting frame of steel sheets (see Figure B.2).

The indicator dimensions shall be about 150 mm × 150 mm. Black cretonne (cotton fabric approximately 150 g/m^2) shall be used for the indicators.

The indicators shall be evenly distributed, arranged in a checkerboard pattern, covering 40 % to 50 % of the area (Figure B.3).

B.4.3.2 Fitting of the indicators

Indicators shall be fitted vertically on all sides of the assembly.

They shall be placed, up to a minimum height of 2 000 mm ± 50 mm and a distance of 300 mm ± 15 mm from the assembly, facing all points where gas is likely to be emitted (e.g. joints, inspection windows, doors) (refer to Figure B.4).

The indicators that are fitted vertically to the assembly are measured from:

– the height from the bottom of the assembly, disregarding any item not part of the assembly (e.g. transport facilities);
– the distance from the surface of the assembly, disregarding protruding elements not expected to influence the evacuation of hot gases (e.g. handles or transport facilities).

If a test specimen includes a roof indicators shall be placed as shown in Figure B.1.

B.4.4 Repetition of the test

A test shall be repeated when the arc extinguishes within the first half of the full intended test duration without being ignited again. The same point of initiation shall be used as for the first test. A further repetition is not required.

B.5 Assessment of the test

The following criteria are used to assess the characteristics under arcing conditions.

Criterion 1:

– Correctly secured doors, covers, etc., do not open.
– Deformations are accepted, provided that no part comes as far as the position of the indicators on every side. The assembly does not need to comply with its IP code after the test. To extend the acceptance criterion to an installation mounted closer to a wall than the indicators during test, the permanent deformation shall be less than the intended distance to the wall.

Criterion 2:

– No fragmentation of the enclosure occurs.
– No ejection of fragments or of other parts of the switchgear of an individual mass of 60 g or more occurs.

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– Objects of an individual mass of 60 g or more falling to the floor in the immediate vicinity of the switchgear are accepted (this means between the switchgear and the indicator rack).

Criterion 3:

– Arcing does not cause holes by burning through the external surfaces up to a height of 2 000 mm.

NOTE Holes in the enclosure, which are created after the duration of test by other effects than burning through caused by the internal arc, are disregarded.

Criterion 4:

– The indicators arranged vertically do not ignite (indicators ignited as a result of paint or stickers burning are excluded from this assessment).

Criterion 5:

– The enclosure remains connected to its earthing point. Visual inspection is generally sufficient to assess compliance. In case of doubt, the continuity of the earthing connection shall be checked.

B.6 Test report

The following information shall be given in the test report:

a) rating of the tested assembly;
b) description of the tested assembly with a drawing showing the main dimensions, details relevant to the mechanical strength, the arrangement of the pressure relief system (e.g. flaps and ducts if any) and the method of fixing the assembly to the floor and the walls;
c) arrangement of the test connections and the point(s) of initiation of the arc(s);
d) point and method of initiation of the internal fault;
e) for the prospective and the test current:
   – prospective sustained short-circuit current;
   – peak prospective value of the short-circuit current;
   – test duration;
   – Joule integral;
   – arc energy;
f) oscillograms showing currents and voltages;
g) assessment of the test results for personal protection against each of the criteria 1 to 5 of Clause B.5;
h) photographs, before and after test:
   – assembly by its own on the test stand including the external surface(s) of the compartment(s) under test;
   – assembly with the arrangement of the indicators and ceiling (if any);
   – earthing connection;
   – location of arc initiation.

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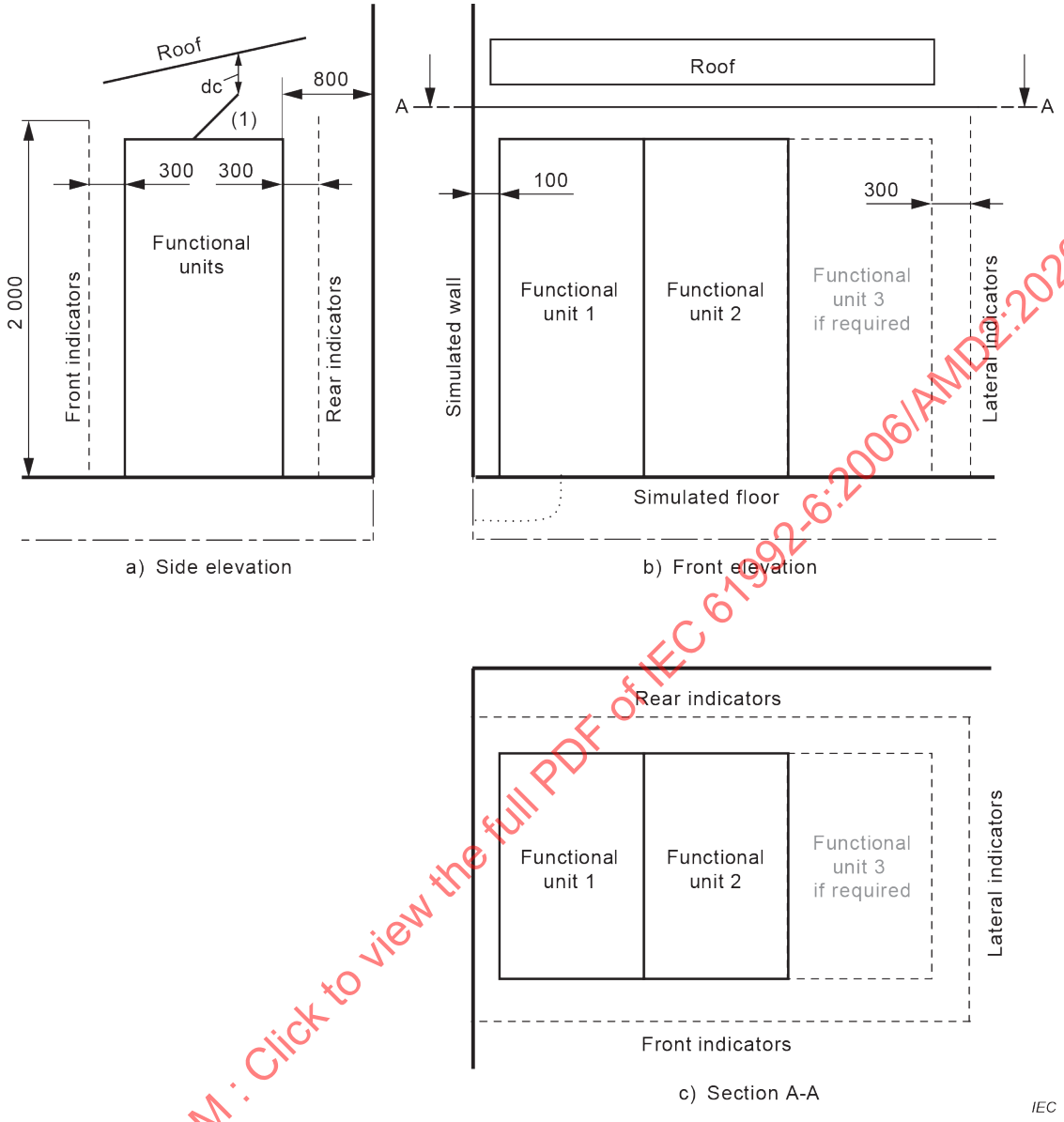
Dimensions in millimetres



Key

(1) open pressure relief flap

d_c distance to ceiling

Figure B.1 – Room simulation and indicator positioning, functional unit fitted with roof

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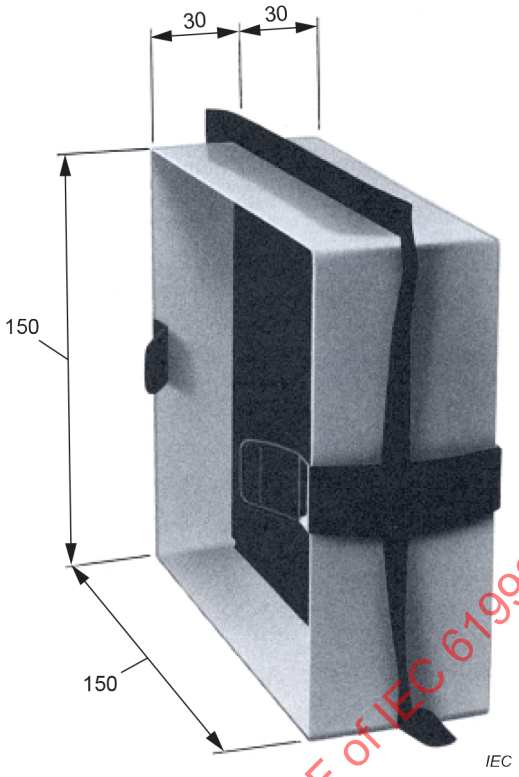
Dimensions in millimetres



NOTE Exposed edges of the indicator material may be tapped or covered.

Figure B.2 – Mounting frame for vertical indicators

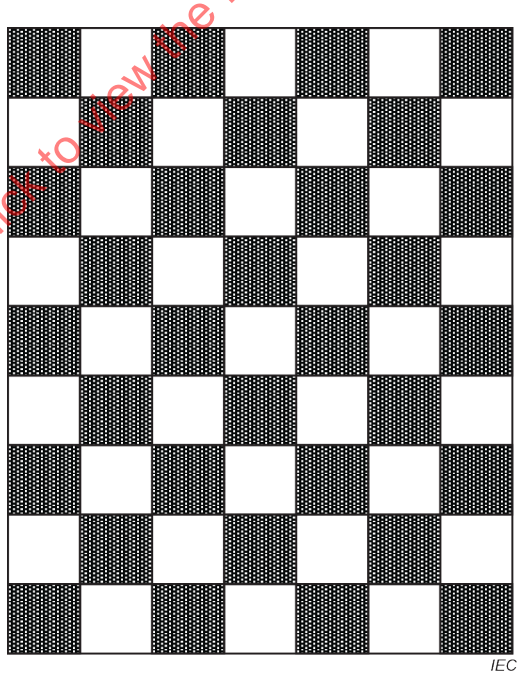


Figure B.3 – Indicators arranged in a checkerboard pattern

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