

# Low-voltage switchgear and controlgear assemblies —

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

The European Standard EN 60439-5:2006 has the status of a  
British Standard

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## National foreword

This British Standard was published by BSI. It is the UK implementation of EN 60439-5:2006. It is identical with IEC 60439-5:2006. It supersedes BS EN 50300:2004 and BS EN 60439-5:1996, which are withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PEL/17, Switchgear, controlgear, and HV-LV co-ordination, to Subcommittee PEL/17/3, Low voltage switchgear and controlgear assemblies.

A list of organizations represented on PEL/17/3 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

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**Low-voltage switchgear and controlgear assemblies  
Part 5: Particular requirements for assemblies  
for power distribution in public networks  
(IEC 60439-5:2006)**

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à basse tension  
Partie 5: Règles particulières  
pour les ensembles pour réseaux  
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(CEI 60439-5:2006)

Niederspannungs-  
Schaltgerätekombinationen  
Teil 5: Besondere Anforderungen  
für Schaltgerätekombinationen  
in Energieverteilungsnetzen  
(IEC 60439-5:2006)

This European Standard was approved by CENELEC on 2006-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 17D/334/FDIS, future edition 2 of IEC 60439-5, prepared by SC 17D, Low-voltage switchgear and controlgear assemblies, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60439-5 on 2006-09-01.

This European Standard supersedes EN 60439-5:1996 + A1:1998 and EN 50300:2004.

The main change with respect to EN 60439-5:1996 is the inclusion of substation cable distribution boards (SCDBs). The title has therefore been amended.

In view of the fact that this publication should be read in conjunction with EN 60439-1:1999, the numbering of its clauses and subclauses correspond with the latter. The clauses of this standard supplement, modify or replace clauses in EN 60439-1.

Where there is no corresponding clause or subclause in this standard, the clause or subclause of the main document applies without modification.

Clauses, subclauses, figures and tables which are additional to those in Part 1 are numbered starting from 101.

The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical  
national standard or by endorsement (dop) 2007-06-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2009-09-01

Annexes ZA and ZB have been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 60439-5:2006 was approved by CENELEC as a European Standard without any modification.

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## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

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

#### 1 General

##### 1.1 Scope and object

###### *Replacement:*

Substation cable distribution boards (SCDBs) and cable distribution cabinets (CDCs) for power distribution in networks shall comply with all the requirements of IEC 60439-1 (1999) if not otherwise indicated hereinafter and shall also comply with the particular requirements contained in this publication.

This standard gives supplementary requirements for substation cable distribution boards (SCDBs) and cable distribution cabinets (CDCs), which are stationary, type-tested assemblies (TTA). They are used for the distribution of electrical energy in three-phase systems. Open-type ASSEMBLY are not covered by this standard.

Individual components, such as fuses and switching devices that comply with other standards, shall also comply with the supplementary requirements of this standard.

The object of this standard is to state the definitions and to specify the service conditions, construction requirements, technical characteristics and tests for SCDBs and CDCs. Higher performance and test levels may be required for particular networks, for example, those with meshed connections.

NOTE 1 If a CDC is equipped with additional equipment (for example meters), in such a way that the main function is changed considerably, then other standards may also apply as agreed between user and manufacturer (see 7.6).

NOTE 2 Where local regulations and practices permit, an SCDB or CDC according to this standard may be used in other than public networks.

SCDBs are suitable for installation in places where only skilled persons have access for their use; however, outdoor types may be installed in situations which may be accessible to the public.

SCDBs are connected to the low voltage terminals of distribution transformers by means of connecting bars, rods or cables.

CDCs are for outdoor installation in places which are accessible to the public, and where only skilled persons have access for their use.

##### 1.2 Normative references

*This subclause of Part 1 applies with the following additions:*

IEC 60068-2-11:1981, *Environmental testing – Part 2: Tests – Test Ka: Salt mist*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12+12-hour cycle)*

IEC 60238:2004, *Edison screw lampholders*

IEC 60269-1:1998, *Low-voltage fuses – Part 1: General requirements*

IEC 60439-1:1999, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*  
Amendment 1 (2004)

IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP code)*

IEC 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

ISO 3231:1993, *Paints and varnishes – Determination of resistance to humid atmospheres containing sulphur dioxide*

ISO 4628-3:2003, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Designation of degree of rusting*

ISO 4892-2:1994, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources*

ISO 6506-1:2005, *Metallic materials – Brinell hardness test – Part 1: Test method*

ISO 9223:1992, *Corrosion of metals and alloys – Corrosivity of atmosphere – Classification*

## 2 Definitions

*The definitions of Part 1 apply with the following additions and modifications:*

### 2.1.1.2

#### **partially type-tested low-voltage switchgear and controlgear assembly**

##### **PTTA**

Not applicable.

### 2.1.101

#### **cable distribution cabinet**

##### **CDC**

cubicle-type ASSEMBLY for outdoor installation which in use receives electrical energy via cables from one or more substation cable distribution boards (SCDBs), and distributes that energy through one or more cables to other equipment

NOTE This other equipment is not intended to consume electrical energy (see Figure 101).

### 2.1.101.1

#### **ground-mounted cable distribution cabinet**

cable distribution cabinet for installation at ground level on a foundation

NOTE The cabinet entries for external conductors are suitable for cables.

**2.1.101.2****pole-mounted cable distribution cabinet**

cable distribution cabinet for installation on a pole, on which a transformer is normally mounted, in an aerial network

NOTE The cabinet entries for external conductors are suitable for cables or insulated overhead line conductors.

**2.1.101.3****wall-mounted surface type cable distribution cabinet**

cable distribution cabinet for installation on the surface of a wall

NOTE The cabinet entries for external conductors are suitable for cable.

**2.1.101.4****wall-mounted recessed type cable distribution cabinet**

cable distribution cabinet for installation into a recess in a wall

NOTE 1 A CDC is not designed to support the portion of the wall above the CDC.

NOTE 2 The cabinet entries for external conductors are suitable for cables.

**2.1.102****substation cable distribution board****SCDB**

an ASSEMBLY for direct connection to one or more distribution transformers, incorporating one or more incoming circuits (disconnecter, switch disconnecter, circuit breaker, etc.) that are connected via busbars to one or more outgoing functional units (fuse disconnectors, fuse switch disconnectors, circuit breakers, etc.) so as to provide protection for, and a means of isolating and controlling, the outgoing circuits.

NOTE An SCDB is installed, operated and maintained solely by skilled persons.

**2.1.102.1****SCDB – indoor****SCDB-I**

substation cable distribution board (SCDB) for installation indoors, including all structural parts necessary to support busbars, functional units and other ancillary devices, necessary to complete the ASSEMBLY

**2.1.102.2****SCDB – outdoor cable connected****SCDB-CCO**

cubicle type substation cable distribution board (SCDB) for outdoor installation which is independently mounted and connected to the distribution transformer by means of cables

**2.1.102.2.1****SCDB-CCO – ground mounted**

SCDB-CCO suitable for outdoor installation at or slightly above ground level in a situation which may be accessible to the public

**2.1.102.2.2****SCDB-CCO – pole mounted**

SCDB-CCO suitable for outdoor installation above ground level on a pole



**2.1.102.3**

**SCDB – outdoor transformer mounted**

**SCDB-TMO**

cubicle type substation cable distribution board (SCDB) for outdoor installation, which is suitable for fixing to the low voltage flange of a distribution transformer

**2.1.102.3.1**

**SCDB-TMO – ground mounted**

SCDB-TMO which is suitable for fixing to the low voltage flange of a ground mounted distribution transformer

**2.1.102.3.2**

**SCDB-TMO – pole mounted**

SCDB-TMO which is suitable for fixing to the low voltage flange of a pole mounted distribution transformer

**2.2**

**constructional units of ASSEMBLIES**

**2.2.1**

**section**

Not applicable.

**2.2.2**

**sub-section**

Not applicable.

**2.3**

**External design of ASSEMBLIES**

**2.3.1**

**Open-type ASSEMBLY**

Not applicable.

**2.3.3.3**

**desk-type ASSEMBLY**

Not applicable.

**2.3.4**

**busbar trunking system**

**busway**

Not applicable.

**2.5**

**conditions of installation of ASSEMBLIES**

**2.5.4**

**movable ASSEMBLY**

Not applicable

**3 Classification of ASSEMBLIES**

*The third dash is not applicable.*

## 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 busbars, 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.

## 5 Information to be given regarding the ASSEMBLY

### 5.1 Nameplates

r) Not applicable

*Addition:*

u) rated current of an ASSEMBLY as defined in 4.101 .

Nameplates may be placed inside enclosures of the ASSEMBLY provided their intended place ensures good legibility and visibility when the door is open or the cover is removed.

NOTE Further information may be included by agreement between the user and the manufacturer.

### 5.2 Markings

*Add at the end of the subclause:*

It shall be possible to identify each functional unit in a clearly visible manner.

In the case of removable fuse-carriers which are specific to a fuseway, a label shall be placed on the fuse-carrier as well as on the fuse base, to avoid incorrect interchanging of the fuse-carrier.

## 6 Service conditions

### 6.2.8 *Addition:*

NOTE Exposure to traffic vibration is a normal service condition for ground mounted SCDBs and CDCs.

### 6.2.9 Installation in such a manner that the current-carrying capacity or breaking capacity is affected

*Addition:*

NOTE Recessing into a wall is not considered to be a special condition for a CDC.

#### 6.2.101 Exposure to heavy snowfall and snowdrift

For installations in regions where heavy snowfalls and snowdrift occur, which necessitate snow clearance by ploughing, subject to agreement between manufacturer and user, an arctic climate can be considered a normal condition; however, the lower temperature limit of -25°C may be applied (see 8.2.101.2.2).

## 7 Design and construction

### 7.1.1 General

*Replace the second sentence of the first paragraph:*

The insulating materials used for enclosures, barriers and other insulating parts shall have a resistance to thermal stress and flame retardant properties in accordance with 8.2.102.

*Add at the end of the second paragraph:*

The materials of coatings shall be subject to agreement between user and manufacturer and shall be sufficient to pass the appropriate tests of 8.2.103.

*Add at the end of the third paragraph:*

The mechanical properties of a SCDB-CCO, SCDB-TMO and CDC shall comply with 8.2.101.

Parts of the SCDB-CCO and CDC intended to be embedded in the ground shall withstand the stresses imposed on them during installation and normal service (see 8.2.101.6).

*Add the following paragraphs at the end of the subclause:*

Except in the case of an ASSEMBLY providing protection by total insulation, the frame or enclosure of the ASSEMBLY shall incorporate a suitable earth terminal of an appropriate size to provide a connection for an external protective conductor.

For an ASSEMBLY which is expected to feed overhead cable lines, outgoing units shall be designed in such a way that an attached cable(s) can be earthed at the termination(s).

#### 7.1.1.101 Marking of CDC as an obstacle to snow clearance

Where a ground mounted CDC is suitable for use in an arctic climate in accordance with 6.1.1.2 or alternatively, if required by the user, it shall be possible to mark it as an obstacle to snow clearance. Holders shall be provided, attached to the CDC, to accommodate marking rods and it shall be possible to install and make adjustments to the position of the marking rod from outside the CDC. The holders shall be constructed in a manner which ensures that the holder or marking rod will give way to a mechanical force before the transmitted force to the CDC enclosure reaches the value which would adversely affect the degree of protections (IP code).

#### 7.1.1.102 Ease of operation and maintenance

All parts of the ASSEMBLY shall, as far as practicable, be readily accessible and replaceable without excessive dismantling. The conditions for interchangeability of parts of the ASSEMBLY may be subject to an agreement between the user and the manufacturer.

The design shall be such that the cables can be readily connected from the front.

When an SCDB does not have a means of measurement incorporated, it shall be possible, by the use of a portable instrument, to readily and safely measure voltages in all phases of incoming units and on both sides of all current breaking and/or switch devices of outgoing units, also the current in one phase of all outgoing units. During this operation all live parts of

the SCDB shall be protected sufficiently to retain the required degree of protection in accordance with 7.2.1.5. Instructions concerning the procedure to be adopted shall be provided by the manufacturer.

If the ASSEMBLY is intended to be connected to a live reserve power, for example a standby generator, the switchgear connecting device shall be designed so that connection can be made with the live parts having a degree of protection of IP 10 according to IEC 60529.

Locking arrangements shall be provided on all ASSEMBLIES intended to be installed outdoors to secure the door(s) and prevent unauthorised access. The fixings of any covers etc. which are removable for installation or maintenance operations shall only be accessible while the door(s) are open.

### 7.1.3 Terminals for external conductors

**7.1.3.2** *Replace paragraphs 1 and 2 by the following paragraphs:*

In the absence of a special agreement between user and manufacturer, terminals shall be capable of accommodating cables having copper or aluminium conductors from the smallest to the largest cross-sectional area corresponding to the appropriate rated current (see Table A.1 of this standard).

The terminations for outgoing circuits shall be located so that adequate spacing is provided and to facilitate terminating the phase conductors of a cable irrespective of their lay.

Where specified by the user the incoming circuit shall be suitable for connection by means of either bare or insulated bars.

**7.1.3.5** Not applicable.

**7.1.3.6** *Add at the end of the subclause:*

By agreement between the manufacturer and the user, the CDC may be provided with openings for temporary connection of cables.

### 7.1.4 Resistance to abnormal heat and fire

*Replace the existing text:*

Abnormal heat and fire shall not adversely affect parts made of insulating material. The suitability of these parts shall be verified by test in accordance with 8.2.102.

## 7.2 Enclosure and degree of protection

**7.2.1.3** *Replace the existing text:*

When a CDC is fully-installed in accordance with the manufacturer's instructions, the enclosure shall have a degree of protection of at least IP34D according to IEC 60529.

**7.2.1.6** Not applicable.

## 7.3 Temperature rise

*Add at the end of the subclause:*

NOTE 2 Where necessary to suit their particular network parameters, users may specify more onerous test requirements.

## 7.4 Protection against electric shock

### 7.4.2 Protection against direct contact

*Add the following note after the title:*

NOTE Open type ASSEMBLIES are not covered by this standard.

*Delete the second paragraph.*

#### 7.4.2.2.1 *Add at the end of the subclause:*

Unless otherwise stated by the user, openings in a CDC designed for the temporary connection of cables shall have a degree of protection of IP23C according to IEC 60529 when the temporary cables are connected. See 7.1.3.6 of this standard.

#### 7.4.2.2.3 *Add at the end of item a):*

A reliable locking device shall be provided on outdoor enclosures which prevents access by unauthorized persons. Doors, lids and covers shall be so designed that, after they are locked, they do not open due to subsequent moderate ground settlement, nor due to traffic vibrations.

### 7.4.2.3 Protection by obstacles

Not applicable.

#### 7.4.3.2.1 Not applicable.

### 7.4.5 Operating and maintenance gangways within ASSEMBLY (see 2.7.1 and 2.7.2)

Not applicable.

## 7.6 Switching devices and components installed in ASSEMBLY

### 7.6.1 Selection of switching devices and components

*Add at the end of the first paragraph:*

Fuses shall comply with the general requirements of IEC 60269-1 or with the relevant national standard where it is an established practice for such use.

#### 7.6.1.101 Earthing and short-circuiting means

The outgoing units in an ASSEMBLY shall be so constructed that they can be earthed and short-circuited in a secure manner by means of a device(s) recommended by the manufacturer, which ensures the manufacturer's indicated degree of protection (IP code) is maintained for all parts of the assembly. This requirement is not applicable if it could cause a safety hazard arising from the system conditions and/or operational practice.

*Replacement:*

#### 7.6.5.1 Identification of the conductors of the main and auxiliary circuits

With the exception of the cases mentioned in 7.6.5.2, the method and the extent of identification of the conductors, for example by arrangement, colours or symbols, on the terminals to which they are connected or on the end(s) of the conductors themselves, shall be agreed between the user and the manufacturer and it shall be in accordance with the indications on the wiring diagrams and drawings. Where appropriate, the identification according to IEC 60446 shall be applied.

## 8 Test specifications

### 8.1 Classification of tests

Replace the note by the following new note:

NOTE Verification and tests to be performed on an ASSEMBLY are listed in Table 7 of IEC 60439-1 under TTA column heading and additional tests in Table 7 of this standard.

Add after the note:

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

**Table 7 – List of additional verifications and tests**

Addition:

Number	Characteristic to be checked	Clause number	Requirement
12	Mechanical strength:	8.2.101	Verification of:
12.1	Structural strength	8.2.101.1	Verification of:
12.1.1	Static load withstand	8.2.101.1.1	Static load withstand – type test
12.1.2	Shock load withstand	8.2.101.1.2	Shock load withstand – type test
12.1.3	Torsion stress withstand	8.2.101.1.3	Torsion withstand – type test
12.2	Impact strength	8.2.101.2	Verification of:
12.2.1	Impact force withstand	8.2.101.2.1	Impact resistance to steel ball – type test
12.2.2	Impact force withstand	8.2.101.2.2	Impact resistance to steel ball and force from hemispherical steel body – type test
12.3	Door strength	8.2.101.3	Withstand moment – type test
12.4	Metal insert strength	8.2.101.4	Resistance of metal inserts to axial load – type test
12.5	Resistance to mechanical shock impacts induced by sharp-edged objects	8.2.101.5	Impact resistance to sharp-edged objects – type test
12.6	Test of mechanical strength of the base	8.2.101.6	Resistance to force imparted by steel tube
Number	Characteristic to be checked	Clause number	Requirement
13	Insulating materials, enclosures and barriers:	8.2.102	Verification of:
13.1	Resistance to abnormal heat	8.2.102.1	Thermal stress – type test
13.2	Verification of flammability category	8.2.102.2	Flammability category – type test
13.3	Dry heat thermal stress test	8.2.102.3	Thermal stress – type test
14	Verification of resistance to corrosion and ageing	8.2.103	Verification of resistance to corrosion and ageing – type test
Tests 2, 3, 4, 7, 12.4, and 13.3 shall be conducted, in sequence, on the same sample; all other tests may be conducted on separate samples at the discretion of the manufacturer.			
Tests 12 and 14 do not apply for an indoor substation cable distribution board (SCDB-I).			

### 8.1.1 Type tests (see 8.2)

*Addition:*

- i) verification of mechanical strength (8.2.101);
- j) verification of resistance to abnormal heat and flame (8.2.102);
- k) verification of corrosion and ageing resistance (8.2.103).

## 8.2 Type tests

### 8.2.1 Verification of temperature-rise limits

#### 8.2.1.1 General

*Delete the last paragraph.*

8.2.1.3.4 Not applicable.

### 8.2.2 Verification of dielectric properties

#### 8.2.2.1 General

*Addition:*

NOTE Where necessary to suit their particular network parameters, users may specify higher test voltages

### 8.2.3 Verification of short-circuit withstand strength

#### 8.2.3.2.3 Testing of main circuits

*Add at the end of the subclause:*

For an ASSEMBLY subjected to these tests, the short-circuit current shall be supplied to the incoming circuit(s). Where more than one incoming unit is provided and each unit is supplied by a separate source, those intended to be used in parallel (maximum of three) shall be connected in parallel for the test. If the incoming circuits are protected by fuse-links, then they shall be fitted with fuse-links of the designed maximum rating for the test.

NOTE When the incoming circuits are supplied by the same source, where, for example, the ASSEMBLY is part of an energy distribution loop, two short-circuit tests should be carried out at the same short-circuit current level: one supplying the incoming circuits connected in parallel, the other supplying one of the incoming circuits.

### 8.2.9 Verification of resistance of insulating materials to abnormal heat and fire (glow-wire test)

Not applicable.

#### 8.2.101 Verification of mechanical strength

The tests shall be carried out at an ambient temperature of between 10 °C and 40 °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.

### 8.2.101.1 Verification of structural strength

#### 8.2.101.1.1 Verification of resistance to static load

a) The following tests shall be carried out on all types of SCDB-CCO, SCDB-TMO and CDC except the wall-mounted recessed type:

Test 1 An evenly distributed load of 8 500 N/m<sup>2</sup> shall be applied for 5 min to the roof of the enclosure (see Figure 102).

Test 2 A force of 1 200 N shall be applied for 5 min in turn to the front and back upper edges of the roof of the enclosure (see Figure 102).

b) The following test shall be carried out on the wall-mounted recessed type of CDC:

A load of 60 N shall be applied for 5 min to each sidewall of the enclosure in turn. The centre of the load shall be 20 mm from the edge of the sidewall under test and shall be spread over a circular area of 10 mm diameter.

Compliance for both a) and b) is checked by verification after the test that the degree of protection remains IP34D, and the operation of the door(s) and locking points are not impaired; also by verification that the electrical clearances have remained satisfactory for the duration of the tests and in the case of an ASSEMBLY having metallic enclosure, that no contact between live parts and the enclosure has occurred caused by permanent or temporary distortion.

#### 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.

A bag in accordance with Figure 103 containing dry sand and having a total mass of 15 kg shall be hung from an overhead support vertically above the surface under test and at least 1 m above the highest point of the ASSEMBLY.

Each test shall consist of one blow aimed at the upper part of each of the vertical surfaces of the ASSEMBLY which are visible when the ASSEMBLY is installed in its normal service position. Separate enclosures may be used for each of the test blows.

NOTE If the enclosure is of cylindrical form, the test should consist of three blows which should be positioned with an angular displacement of 120°.

A test shall consist of raising the lifting eye through a height of 1 m and allowing the sandbag to fall through a vertical arc to impact the approximate centre of the upper part of the surface of the ASSEMBLY under test (see Figures 104a and 104b).

Compliance is checked by verification after the test that the degree of protection remains IP34D, and the operation of the door(s) and locking points are not impaired; also by verification that the electrical clearances have remained satisfactory for the duration of the tests and, in the case of an ASSEMBLY having a metallic enclosure, that no contact between live parts and the enclosure has occurred caused by permanent or temporary distortion.



In the case of an ASSEMBLY having an insulating enclosure, if the appropriate conditions are satisfied, then damage such as small dents or small degrees of surface cracking or flaking are disregarded, provided that there are no associated cracks detrimental to the serviceability of the ASSEMBLY.

### 8.2.101.1.3 Verification of resistance to torsional stress

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

The test is carried out using a horizontally rotatable frame constructed from 60 mm × 60 mm × 5 mm angle iron, having vertical locations 100 mm long at the frame arm's extremities. The ASSEMBLY under test is rigidly fixed at its base and the frame closely fitted over it, so that the end locations of the frame arm are in contact with the roof and walls of the ASSEMBLY.

The ASSEMBLY, with the door(s) closed, shall have a torsional force of  $2 \times 1\,000$  N applied for 30 s as shown in Figures 105a and 105b.

Compliance is checked by verifying that the doors(s) remain closed for the duration of the test and by verification after the test that the degree of protection remains IP34D.

### 8.2.101.2 Verification of impact force withstand

#### 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

The test shall be carried out using impact apparatus in the form of a pendulum incorporating a 9 mm external diameter tube at least 1 m long. The pendulum shall be arranged to swing through a vertical arc.

Attached to one end is a solid steel ball of 2 kg mass, which shall be raised through a height of 1 m and allowed to drop and impact the surface of the ASSEMBLY under test, thus providing an impact energy of 20 J (see Figures 106a and 106b).

For each of the two tests detailed below, the test shall consist of one blow aimed at the centre of each of the vertical surfaces of the ASSEMBLY which are visible when it is installed in its normal service position. Separate enclosures may be used for each of the test blows.

NOTE If the enclosure is of cylindrical form, the test should consist of three blows which should be positioned with an angular displacement of 120°.

Test 1 shall be carried out at an ambient air temperature of 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 of between 10 °C and 40 °C immediately after the ASSEMBLY has been kept at a temperature of  $-25^{+0}_{-5}$  °C for a period of not less than 12 h.

Compliance is checked by verification after the test that the degree of protection remains IP34D, and the operation of the door(s) and locking points are not impaired; also by verification that the electrical clearances have remained satisfactory for the duration of the tests and in the case of an ASSEMBLY having a metallic enclosure, that no contact between live parts and the enclosure has occurred caused by permanent or temporary distortion. In the case of an ASSEMBLY having an insulating enclosure, if the appropriate conditions are satisfied, then damage such as small dents or small degrees of surface cracking or flaking are disregarded, provided that there are no associated cracks detrimental to the serviceability of the ASSEMBLY.

### 8.2.101.2.2 Test applicable to SCDB-CCO, SCDB-TMO and CDCs designed for operation in an arctic climate (see 6.1.1.2)

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  $-50^{+0}_{-5}$  °C for a period of not less than 12 h.

The test sequence shall be as follows:

Tests 1 and 2 involve applying a force of 1 500 N for 30 s to an earthed metal test body against the enclosure at the considered 10 weakest points. The test body shall be of spherical or hemispherical shape having a radius of 100 mm  $\pm$  3 mm and a surface hardness of HB 160 according to ISO 6506-1.

Test 1 shall be carried out on an empty SCDB-CCO, SCDB-TMO or CDC.

Test 2 shall be carried out on an ASSEMBLY containing equipment which provides the minimum clearances inside the enclosure. The enclosure shall be earthed and an a.c. voltage in accordance with 8.2.2.4 shall be applied between all live parts connected together and the enclosure for the duration of the test.

Test 3 shall be carried out on an empty enclosure using an impact apparatus as described in 8.2.101.2.1 of this standard but having a solid steel ball with an approximate mass of 15 kg. This striker element shall be raised through a height of approximately 1 m allowed to drop and impact the surface of the ASSEMBLY under test, to provide an impact energy of 150 J (see Figures 106a and 106b).

The test shall consist of one blow aimed at the centre of each of the vertical surfaces of the ASSEMBLY which are visible when it is installed in its normal service position. Separate enclosures may be used for each of the test blows.

NOTE 1 If the enclosure is of cylindrical form, the test should consist of three blows which should be positioned with an angular displacement of 120°.

Compliance for test 1 is checked by verification after the test that the degree of protection remains IP34D, and the operation of the door(s) and locking points are not impaired.

Compliance for test 2 is checked by verification that no puncture or flashover occurs.

Compliance for test 3 is checked by verification after the test that the degree of the protection is at least IP3X.

NOTE 2 For installations in regions where heavy snowfalls and snowdrifts occur, which necessitate snow clearance by ploughing, subject to agreement between user and manufacturer, an arctic climate can be considered a normal condition; however, the lower limit of -25 °C may be applied.

### 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.

The tests shall be carried out with the door(s) fully open and in contact with the designed restraint. A load of 50 N shall be applied at the top edge of the door perpendicular to the plane of the door(s) and at a distance of 300 mm from the hinged edge and maintained for 3 s. Unless the door(s) is(are) designed to be unhinged without the use of a tool for maintenance or operational use, the test shall then be repeated with the load increased to 450 N (see Figure 107).

Compliance is checked by verification that the door(s) has(have) not become unhinged and the operation of the door(s), hinges and locking points are not impaired by the application of a load of 50 N. In addition, compliance is checked by verification that the degree of protection remains IP34D after the door(s) has(have) been closed following the application of a load of 450 N. If the door(s) becomes(become) unhinged during the latter test, this is not regarded as a failure if it is possible to reinstall the same door(s) without the use of a tool.

**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.

The test shall be carried out on a representative specimen of each type and size of metal insert. Also, if there is a difference in the thickness of the profile of the material surrounding a particular insert, the test shall be repeated for this condition.

During the test the ASSEMBLY shall be fully supported on a platform.

A screw-eye shall be fitted to each insert under test and an axial force in accordance with Table 101 shall be applied for 10 s in an attempt to extract the insert from its anchorage.

Compliance is checked by inspection that the inserts remain undamaged and in their original position; and also that there is no cracking of the surrounding material forming the anchorage for the insert.

NOTE Small cracks, created by air bubbles that were visible before the test, but not affected by the application of the axial load, are ignored.

**Table 101 – Axial load to be applied to the inserts**

Size of insert	Axial load N
M4	350
M5	350
M6	500
M8	500
M10	800
M12	800

**8.2.101.5 Verification of resistance to mechanical shock impacts induced by sharp-edged objects**

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

The test shall be carried out using an impact apparatus as described in 8.2.101.2.1 of this standard but having a steel striker element with a mass of 5 kg and having the end profiled as shown in Figure 108. The striker element shall be raised through a height of 0,4 m and allowed to drop and impact the surface of the ASSEMBLY under test, thus providing an impact energy of 20 J (see Figures 106a and 106b).

Each test shall consist of one blow aimed at the considered weakest point on each of the vertical surfaces of the ASSEMBLY which are visible when the ASSEMBLY is installed in its normal service position. Separate enclosures may be used for each of the test blows.

NOTE If the enclosure is of a cylindrical form, the test should consist of three blows which should be positioned with an angular displacement of 120°.

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  $-25^{+0}_{-5}$  °C for a period of not less than 12 h.

Compliance is checked by inspection that cracks resulting from the blows are contained within a circle of a diameter not exceeding 15 mm. If the tip of the striker element has penetrated the enclosure of the ASSEMBLY, it shall not be possible to insert a gauge of 4 mm in diameter having a hemispherical tip, applied to the hole with a force of 5 N.

#### **8.2.101.6 Test of mechanical strength of the base**

This test is applicable to a CDC only.

The test shall be carried out with the CDC fixed to the base, in accordance with Figure 110 and the manufacturer's installation instructions. A mechanical force is transferred via a thick-walled steel tube, and shall be applied to the lowest part of the longest section of the CDC base which is beneath the ground surface when it is installed.

If the design of the base includes one or more permanent supports, the force shall be applied by means of a number of steel tubes. One tube shall be placed in the centre of each unsupported length. The individual forces  $F$  shall simultaneously be applied to each tube and shall be calculated according to the following formula:

$$F = 3,5 \text{ N/mm} \times L$$

where  $L$  is the unsupported length in millimetres.

The force(s) shall be applied for 1 min. After this period and whilst the force is still maintained, the degree of protection shall be verified.

If there is another section of the CDC base which is of similar length but has a different profile, the test shall be repeated on this section.

Compliance is checked by inspection that the base has not broken and by verification that the degree of protection of that part of the CDC and base which is normally above ground remains IP3XD.

#### **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.

The surface of the part to be tested shall be placed in the horizontal position and supported by a steel plate of at least 5 mm thickness and a ball of 5 mm in diameter shall be pressed against this surface with a force of 20 N.

The test shall be made in a heating cabinet at a temperature as stated below:

- parts supporting live components: (125 ± 2) °C
- insulating parts less than 6 mm distant from parts which may have a temperature rise in excess of 40 K: (100 ± 2) °C
- other parts: (70 ± 2) °C

NOTE 1 When agreed between the user and the manufacturer, test temperatures different from those stated above may be used.

After 1 h, the ball shall be removed from the sample which shall then be cooled within 10 s to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball shall be measured and shall not exceed 2 mm. When it is not possible to make the test on the complete equipment, the test shall be carried out on a suitable part taken from it of at least 2 mm thickness.

NOTE 2 The thickness of 2 mm can be obtained by using several layers.

When tests on materials are used, the sample shall have a thickness of at least 2 mm.

#### 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.

NOTE When agreed between user and manufacturer, other tests to check the resistance to fire of materials of enclosures, barriers and other insulating parts may be carried out.

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.

#### 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 2 h to 3 h and maintained at this temperature for 5 h.

Compliance is checked by inspection that there are no visible signs of deterioration. Deformation of protective covers manufactured from insulating materials is acceptable if they are more than 6 mm distant from parts which may have a temperature rise in excess of 40 K and do not support live components (see 8.2.102.1).

#### 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.

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

Internal parts, including devices and components, shall be tested to verify that they comply with the requirements of the damp heat cycling test of IEC 60068-2-30: Severity – temperature 55 °C, 6 cycles and variant 1.

At the end of the test the specimens are removed from the test chamber.

Compliance is checked by visual inspection. The parts tested shall not show rust, cracking or other deterioration. However, surface corrosion of the protective coating is allowed.

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

External parts manufactured from synthetic materials or metals which are entirely coated by a synthetic material shall be subject to the following test:

UV test in accordance with ISO 4892-2, method A; 17 cycles with Xenon lamp providing a total test period of 500 h; spray cycle 5-25.

Compliance for solid synthetic materials is checked by verification that the tensile strength and elongation have 70 % minimum retention.

The same samples of metal parts with protective coating of synthetic material shall then be subjected to the following test.

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

External parts manufactured from solid metal, with or without metallic or synthetic material protective coating, shall be subject to the following test:

The test consists of exposing test specimens first to a neutral salt spray atmosphere (NaCl concentration: 5 %) and then to a water-saturated sulphur dioxide-rich atmosphere (initial SO<sub>2</sub> concentration: 0,067% volume) under predetermined temperature and pressure conditions.

##### **8.2.103.3.1 Test apparatus**

The apparatus for the salt spray test essentially comprises a test chamber and spraying devices as described in IEC 60068-2-11.

The apparatus for the test in a water-saturated sulphur dioxide atmosphere comprises a hermetically-sealed enclosure containing a water-saturated sulphur dioxide atmosphere in which the test specimens and their supports are held. The enclosure shall be made from an inert material, have a capacity of (300 ± 30) l and comply with the enclosure described in ISO 3231.

##### **8.2.103.3.2 Test procedure**

The concentration of saline solution forming the salt atmosphere shall be 5 % ± 1 % by weight and the temperature of the test chamber shall be maintained at (35 ± 2) °C.

The water-saturated sulphur dioxide atmosphere is created by the introduction into the closed test chamber of sufficient sulphur dioxide to produce a concentration of 0,067 % by volume, either from a gas cylinder or by creating a specific reaction within the chamber (see notes 1 and 2).

The test comprises two identical 12 day periods.

Each 12 day period comprises

- 7 days (168 h) of exposure to a salt spray atmosphere;

- 5 days (120 h) of cycles consisting of 8 h exposure to water-saturated sulphur dioxide-rich atmosphere during which the temperature is raised to  $(40 \pm 3) ^\circ\text{C}$  and 16 h rest with the enclosure door open, giving a total of 40 h exposure 80 h rest.

After the twelfth day, test specimens are washed in demineralized water.

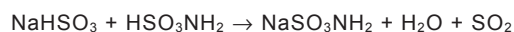
NOTE 1 The addition of 0,2 l of sulphur dioxide to a closed test chamber having a volume of 300 l will lead to a concentration of 0,067% by volume.

NOTE 2 Sulphur dioxide can be formed inside the test apparatus by treating sodium pyrosulphite ( $\text{Na}_2\text{S}_2\text{O}_5$ ) with a relatively strong acid, sulphamic acid ( $\text{HSO}_3\text{NH}_2$ ) which is the only solid mineral acid that is easy to conserve.

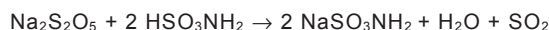
The method consists of dissolving excess sodium pyrosulphite in water, giving the following reaction:



A stoichiometric quantity of sulphamic acid is then added giving the following reaction:



The resulting overall reaction is

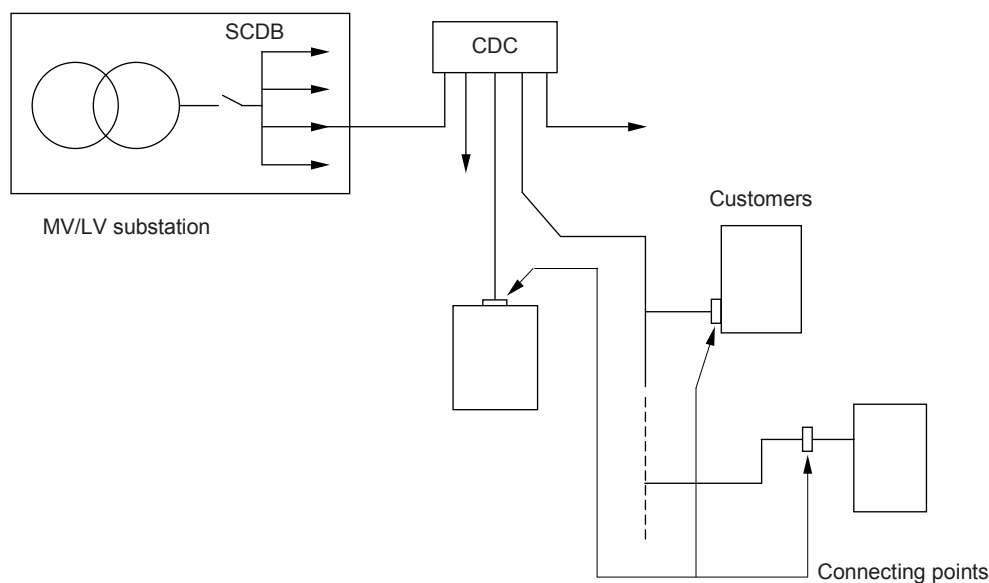


To obtain 1 l of  $\text{SO}_2$  under normal conditions of  $0 ^\circ\text{C}$  temperature and 760 mm Hg pressure, 4,24 g sodium pyrosulphite and 4,33 g sulphamic acid are required.

### 8.2.103.3.3 Test Verification

At the end of the test the specimens are removed from the test chamber.

Compliance is checked by visual inspection. The specimens tested shall not show rust, cracking or other deterioration. However, surface corrosion of the protective coating is allowed. In case of doubt, reference shall be made to ISO 4628-3 to verify that the samples conform to specimen Ri1.



IEC 916/06

Figure 101 – Typical distribution network



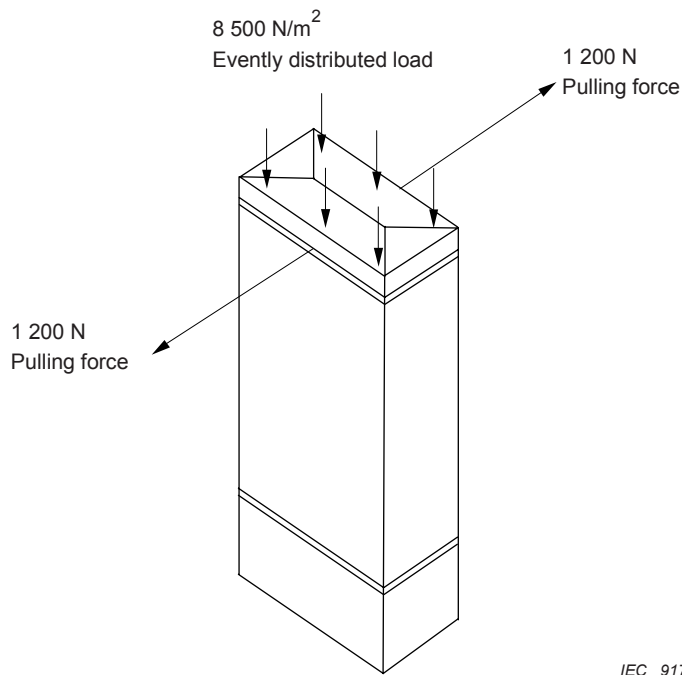


Figure 102 – Diagram of test to verify the resistance to static load

Dimensions in millimetres

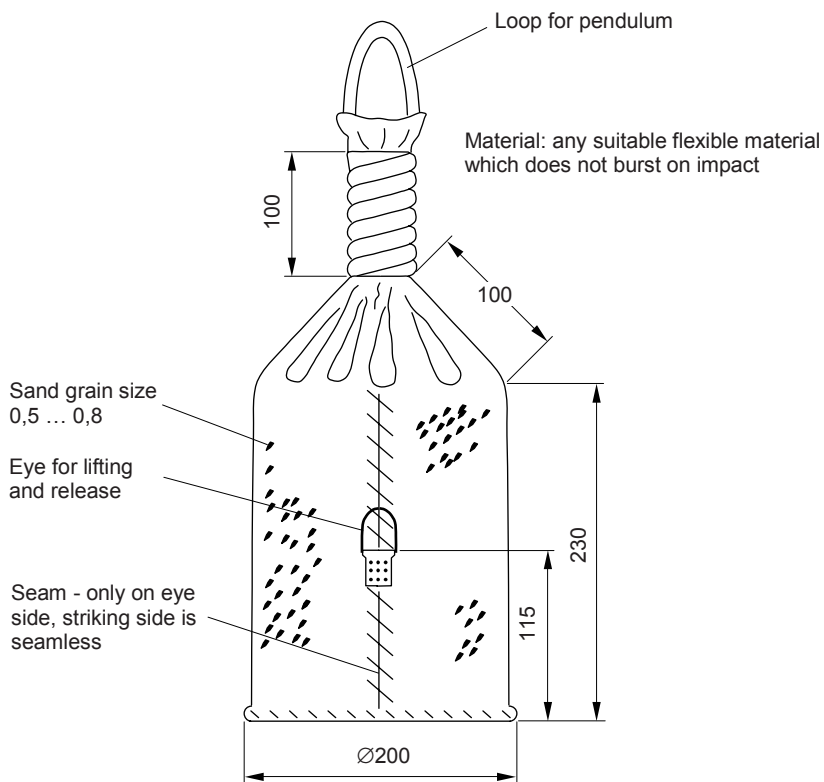
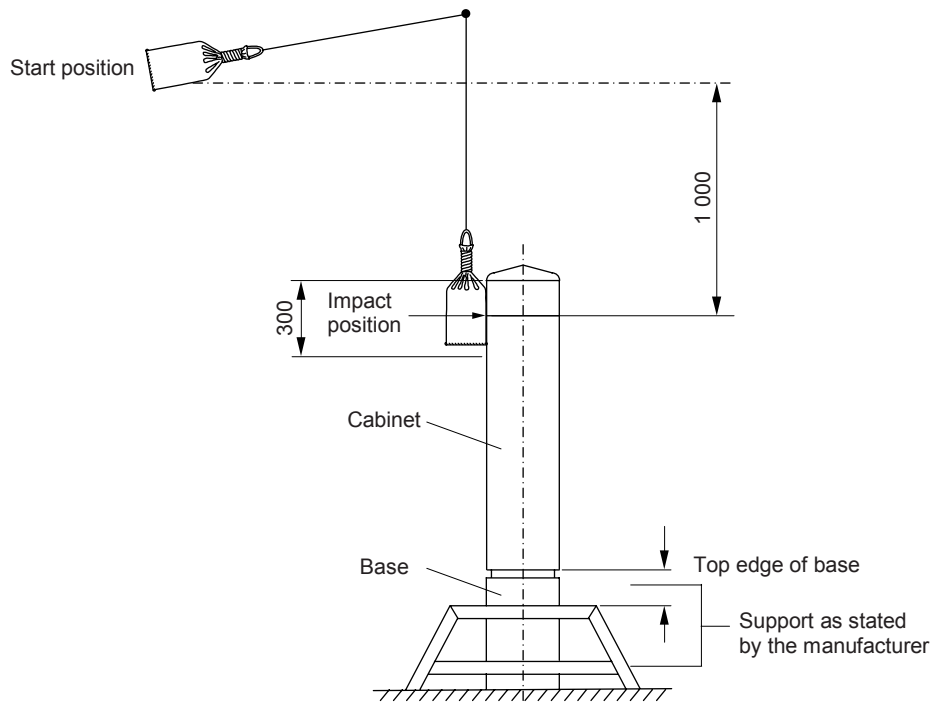


Figure 103 – Sandbag for test to verify the resistance to shock load



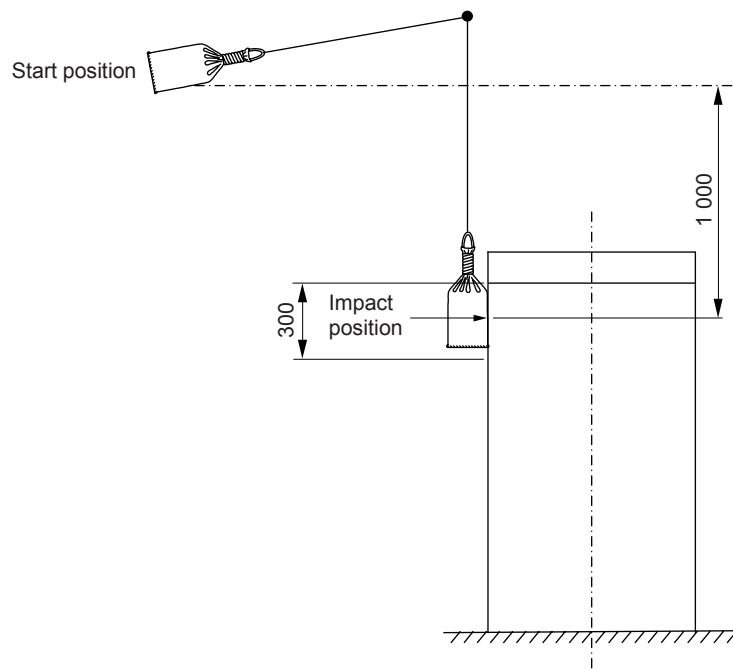
Dimensions in millimetres



IEC 919/06

Figure 104a – Diagram of test to verify the resistance to shock load of a CDC

Dimensions in millimetres

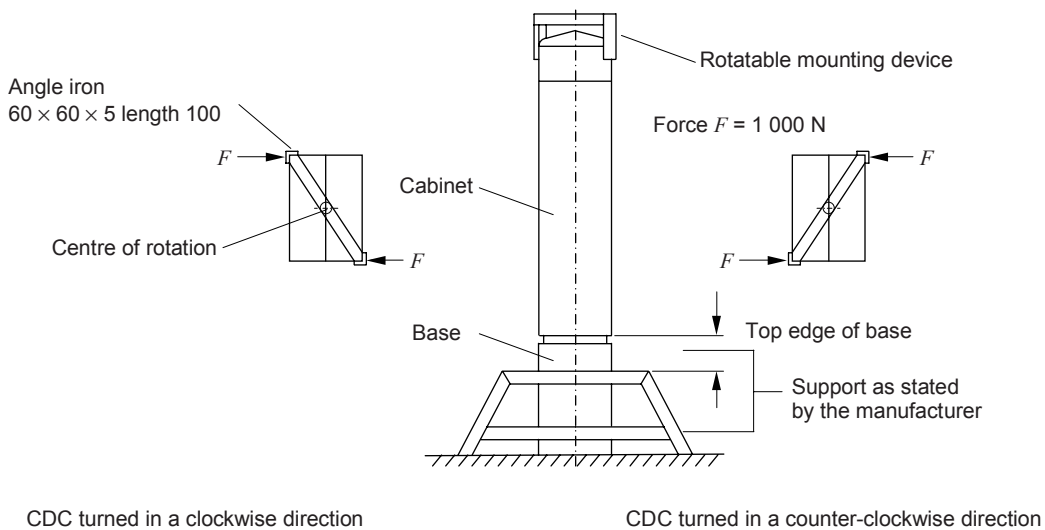


IEC 920/06

Figure 104b – Diagram of test to verify resistance to shock load of a SCDB-CCO

Figure 104 – Diagram of test to verify resistance to shock load

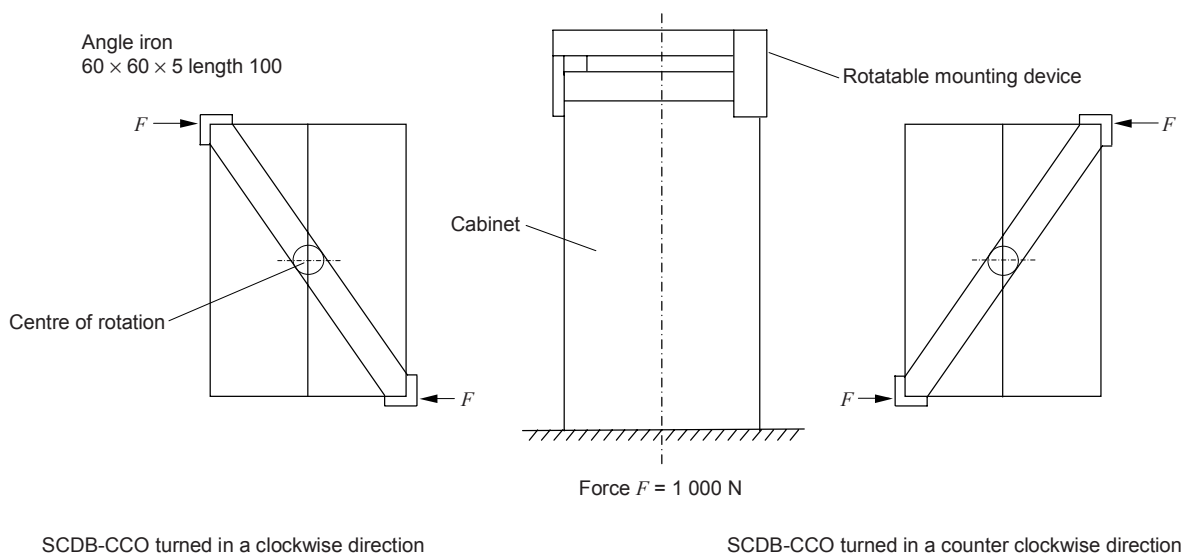
Dimensions in millimetres



IEC 921/06

Figure 105a – Diagram of test to verify the resistance to torsional stress of a CDC

Dimensions in millimetres

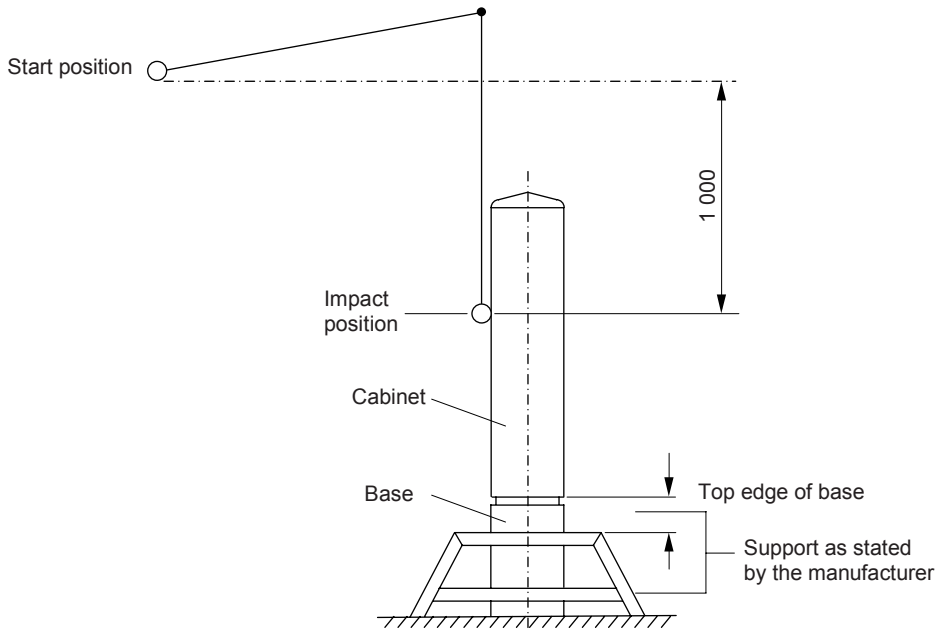


IEC 922/06

Figure 105b – Diagram of test to verify resistance to torsional stress of a SCDB-CCO

Figure 105 – Diagram of test to verify resistance to torsional stress

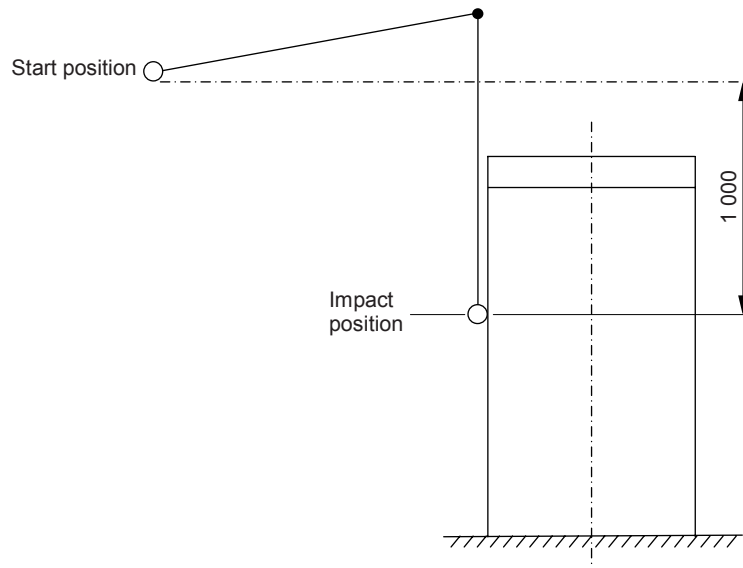
Dimensions in millimetres



IEC 923/06

Figure 106a – Diagram of test to verify impact force withstand for a CDC

Dimensions in millimetres

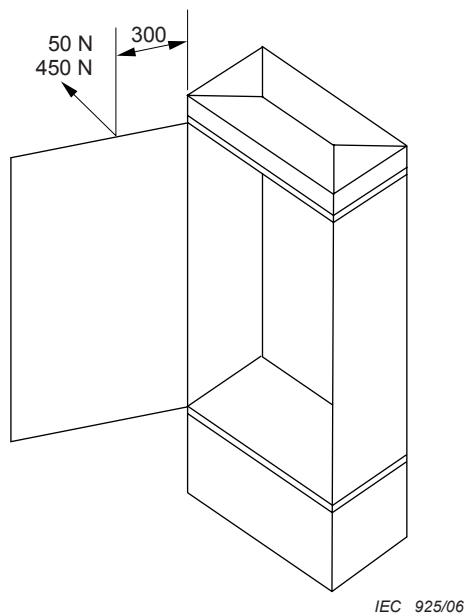


IEC 924/06

Figure 106b – Diagram of test to verify impact force withstand for a SCDB-CCO

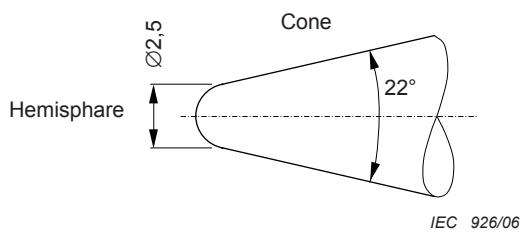
Figure 106 – Diagram of test to verify impact force withstand

*Dimensions in millimetres*

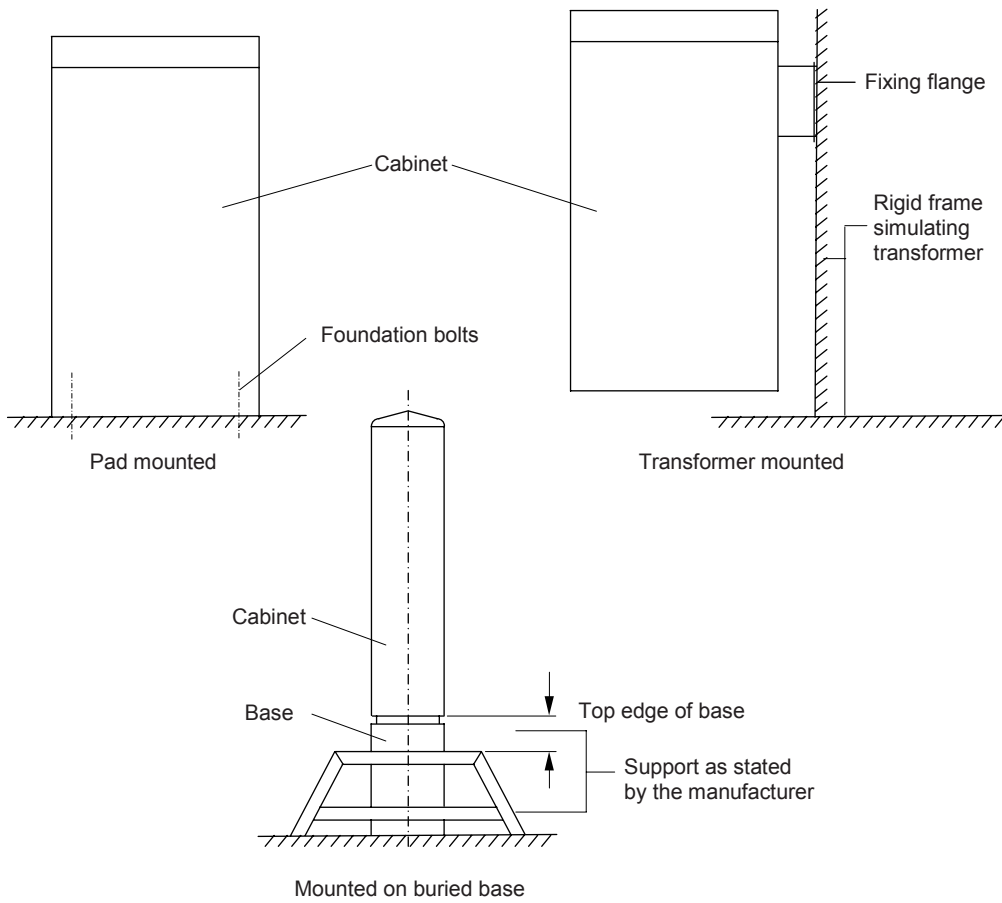


**Figure 107 – Diagram of test to verify the mechanical strength of doors**

*Dimensions in millimetres*



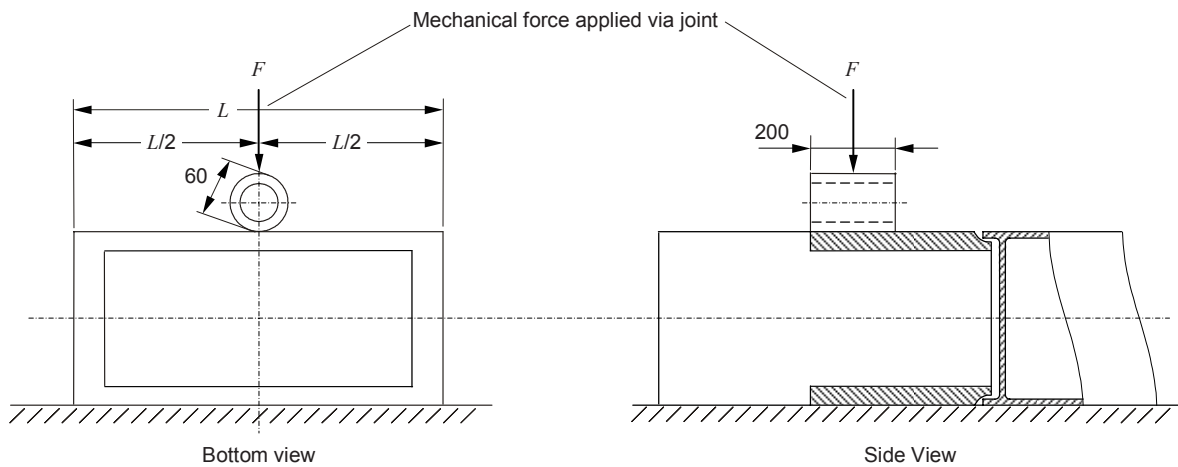
**Figure 108 – Striker element for test of resistance to mechanical shock impacts induced shar-edge objects**



IEC 927/06

Figure 109 – Typical enclosure arrangements for mechanical strength tests for a SCDB-CCO and SCDB-TMO

Dimensions in millimetres



IEC 928/06

Figure 110 – Typical test arrangement for mechanical strength of base

## Annex A (normative)

*Replacement:*

### Minimum and maximum cross-section of copper and aluminium conductors, suitable for connection

**Table A.1 – Minimum and maximum cross-section of copper and aluminium conductors, suitable for connection (see 7.1.3.2)**

Rated current A	Solid or stranded conductors (aluminium or copper) Cross-sections mm <sup>2</sup>		Flexible copper conductors Cross-sections mm <sup>2</sup>	
	Minimum	Maximum	Minimum	Maximum
6	0,75	1,5	0,5	1,5
8	1	2,5	0,75	2,5
10	1	2,5	0,75	2,5
12	1	2,5	0,75	2,5
16	1,5	4	1	4
20	1,5	6	1	4
25	2,5	6	1,5	4
32	2,5	10	1,5	6
40	4	16	2,5	10
63	6	25	6	16
80	10	35	10	25
100	16	50	16	35
125	25	70	25	50
160	35	95	35	70
200	50	150	50	95
250	70	150	70	120
315	70	240	95	185
400	70	240	95	185
500	70	300	95	240
630	70	300	95	240

NOTE 1 This table applies for the connection of one conductor per terminal.

NOTE 2 If the external conductors are connected directly to built-in apparatus, the cross-sections indicated in the relevant specification are valid.

NOTE 3 In cases where it is necessary to provide for conductors other than those specified in the table, agreement should be reached between the manufacturer and the user.

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**Annex ZA**  
(normative)

**Normative references to international publications  
with their corresponding European publications**

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-11	1981	Environmental testing Part 2: Tests - Test Ka: Salt mist	EN 60068-2-11	1999
IEC 60068-2-30	2005	Environmental testing Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60238	2004	Edison screw lampholders	EN 60238 + corr. January	2004 2005
IEC 60269-1	1998	Low-voltage fuses Part 1: General requirements	EN 60269-1	1998
IEC 60439-1 A1	1999 2004	Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies	EN 60439-1 A1	1999 2004
IEC 60446	1999	Basic and safety principles for man-machine interface, marking and identification - Identification of conductors by colours or numerals	EN 60446	1999
IEC 60529 A1	1989 1999	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May A1	1991 1993 2000
IEC 60695-11-10	1999	Fire hazard testing Part 11-10: Test flames - 50 W horizontal and vertical flame test methods	EN 60695-11-10	1999
ISO 3231	1993	Paints and varnishes - Determination of resistance to humid atmospheres containing sulphur dioxide	EN ISO 3231	1997
ISO 4628-3	2003	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance Part 3: Assessment of degree of rusting	EN ISO 4628-3	2003
ISO 4892-2	1994	Plastics - Methods of exposure to laboratory light sources Part 2: Xenon arc sources	EN ISO 4892-2	1999
ISO 6506-1	2005	Metallic materials - Brinell hardness test Part 1: Test method	EN ISO 6506-1	2005
ISO 9223	1992	Corrosion of metals and alloys - Corrosivity of - atmosphere - Classification	-	-

## Annex ZB (informative)

### A-deviations

**A-deviation:** National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC member.

This European Standard falls under Directive 73/23/EEC

NOTE (from CEN/CENELEC IR Part 2:2002, 2.17) Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

<u>Clause</u>	<u>Deviation</u>
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2.1.102	<b>Spain</b> (Royal Decree 842/2002 (Reglamento Electrotécnico de Baja Tensión), Article 14)
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The configuration of some parts of the electrical installations, including the assemblies for public distribution cables, are under the responsibility of the utilities.

Furthermore, the requirements may be different for each region in Spain and be regulated by regional legislation.

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