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BSI Standards Publication

Power frequency overvoltage protective device for household and similar applications (POP)

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National foreword

This British Standard is the UK implementation of EN 50550:2011, incorporating corrigendum March 2012.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CENELEC corrigendum March 2012 is indicated in the text by AC1 AC1.

The UK participation in its preparation was entrusted by Technical Committee PEL/23, Electrical Accessories, to Subcommittee PEL/23/1, Circuit breakers and similar equipment for household use.

A list of organizations represented on this subcommittee 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.

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Compliance with a British Standard cannot confer immunity from legal obligations

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50550

February 2011

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English version

Power frequency overvoltage protective device for household and similar applications (POP)

Dispositif de protection contre les surtensions à fréquence industrielle pour les applications domestiques et analogues

Schutzeinrichtung gegen netzfrequente Überspannungen für Hausinstallationen und für ähnliche Anwendungen

This European Standard was approved by CENELEC on 2011-01-17. 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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization

Comité Européen de Normalisation Electrotechnique

Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This European Standard was prepared by the CENELEC BTTF 128-1, Power frequency overvoltage protective device for household and similar applications.

It was submitted to the formal vote and was approved by CENELEC as EN 50550 on 2011-01-15.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates are proposed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-01-15

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2014-01-15

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2004/108/EC. See Annex ZZ.

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1 Scope

This European Standard applies to power frequency overvoltage protection devices (hereafter referred to as “POP”) for household and similar uses, with a rated frequency of 50 Hz, a rated voltage 230 V a.c. (between phase and neutral), intended to be used in combination with a main protective device being either a CB in compliance with EN 60898-1 or EN 60898-2, a RCCB in compliance with EN 61008-1 or a RCBO in compliance with EN 61009-1.

NOTE 1 Requirements for POPs in combination with switching devices other than a main protective device, or a POP integrated in a MPD, are under consideration.

NOTE 2 Requirements for POP with functional earth connection regarding temporary overvoltage withstand are under consideration.

NOTE 3 A POP is not a protective device to be used for automatic disconnection of the supply in the meaning of HD 60364-4-41.

They are intended for use in an environment with pollution degree 2 and overvoltage category III.

They can be designed for factory assembly or for assembly on site.

These devices are intended to mitigate the effects of power frequency overvoltages between phase and neutral conductor (e.g. caused by loss of neutral conductor in the three phase supply upstream the POP) for downstream equipment by actuating the main protective device when an overvoltage between phase and neutral is detected.

NOTE 4 To mitigate means in this context that the POP will provide protection in most cases of power frequency overvoltages.

NOTE 5 Protection in case of overvoltage between phases is under consideration. In case of phase to phase electrical supply system with rated voltage between phases 230 V a.c. and no neutral conductor, one line monitored POP in compliance to this standard can be used according to manufacturer’s instruction.

The POP does not impair the protective function of the main protective device.

This European Standard does not apply for protection against common mode over voltages.

This European Standard does not apply to surge protective devices.

This European Standard states:

– the definitions of terms used for POP (Clause 3);

– the classification of POP (Clause 4);

– the characteristics of POP (Clause 5);

– the preferred values of the operating and influencing quantities (Clause 5);

– the marking and information to be provided for POP (Clause 6);

– the standard conditions for installation and operation in service (Clause 7);

– the requirements for construction and operation (Clause 8);

– the list of minimum requirements to be tested (Clause 9).

2 Normative references

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.

EN 50160:2010	Voltage characteristics of electricity supplied by public electricity networks
EN 55014-1:2006 + A1:2009	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission (CISPR 14-1:2005 + A1:2008)
EN 55022:2010	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 22:2008, mod.)
EN 60065:2002 + corr. Aug. 2007	Audio, video and similar electronic apparatus – Safety requirements (IEC 60065:2001, mod.)
EN 60384-14	Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains (IEC 60384-14)
EN 60664-1:2007	Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests (IEC 60664-1:2007)
EN 60664-3	Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution (IEC 60664-3)
EN 60898-1:2003 + corr. Feb. 2004 + A1:2004 + A11:2005 + A12:2008	Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation (IEC 60898-1:2002, mod. + A1:2002, mod.)
EN 60898-2:2006	Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 2: Circuit-breakers for a.c. and d.c. operation (IEC 60898-2:2000, mod. + A1:2003, mod.)
EN 60998-2-3	Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units (IEC 60998-2-3)
EN 61000 series	Electromagnetic compatibility (EMC) (IEC 61000 series)
EN 61008 series	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) (IEC 61008 series)
EN 61008-1:2004 + A11:2007 + A12:2009	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) – Part 1: General rules (IEC 61008-1:1996, mod. + A1:2002, mod.)
EN 61009 series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) (IEC 61009 series)
EN 61009-1:2004 + corr. Jul. 2006 + A11:2008 + A12:2009 + A13:2009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 1: General rules (IEC 61009-1:1996, mod. + A1:2002, mod. + corrigendum May 2003)

EN 61543:1995 + corr. Dec. 1997 + A11:2003 + corr. May. 2004 + A12:2005 + A2:2006	Residual current-operated protective devices (RCDs) for household and similar use – Electromagnetic compatibility (IEC 61543:1995 + A2:2005)
EN 61558-1	Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests (IEC 61558-1)
EN 61558-2 series	Safety of power transformers, power supplies, reactors and similar products – Part 2-X: Particular requirements and tests (IEC 61558-2 series)
EN ISO 306	Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST) (ISO 306:2004)
EN 61249-2 series	Base materials for printed circuits – Part 2: Specifications

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 60898-1:2003, EN 61008-1:2004, EN 61009-1:2004 and the following apply.

3.1
power frequency overvoltage
increase of the voltage at the rated frequency in the electrical supply system, above a specified threshold

3.2
Power frequency Overvoltage Protective device
POP
device intended to mitigate the effects of power frequency overvoltages between phase and neutral conductor (e.g. caused by loss of neutral conductor in the three phase supply upstream the POP) for downstream equipment

NOTE One line monitored POP can be used also to mitigate the effects of power frequency overvoltages between two phase's conductors in phase to phase electrical supply system.

3.3
main protective device
device to which the POP is intended to be associated, directly or through a release unit, with and that trips under specified conditions

NOTE The main protective device is a circuit breaker (EN 60898-1 or EN 60898-2) or a RCCB (EN 61008-1) or a RCBO (EN 61009-1).

3.4
actuating voltage
U_a
voltage values, measured between phase and neutral conductor, for which POP device shall actuate the main protective device

3.5
release unit
device mechanically connected to a main protective device, which releases the holding means and permits the automatic opening of the main protective device

3.6
POP assembly
combination of the POP device assembled as for normal use with the main protective device and release unit, if any

NOTE The main protective device is a circuit breaker (EN 60898-1 or EN 60898-2) or a RCCB (EN 61008-1) or a RCBO (EN 61009-1).

3.7
break time
t_B
time that elapses between the instant when the overvoltage is suddenly attained, and the instant when the MPD associated to the POP has switched off the circuit

NOTE For POP assembly.

3.8
non-actuating time
t_{0A}
maximum delay during which a given overvoltage can be applied to the POP without causing it to operate

4 Classification

4.1 According to the method of construction

4.1.1 POP assembled to the main protective device in factory by the manufacturer;

4.1.2 POP to be coupled by mechanical means on site with the main protective device;

4.1.3 POP to be assembled on site with the release unit associated or integrated to the main protective device.

4.2 According to the main protective device

4.2.1 POP for circuit breakers;

4.2.2 POP for RCBOs;

4.2.3 POP for RCCBs.

NOTE The same POP may be designed for more than one main protective device.

4.3 According to the range of ambient air temperature (only for POP according to 4.2.2 and 4.2.3)

4.3.1 POP for use at ambient air temperatures between - 5 °C and + 40 °C.

4.3.2 POP for use at ambient air temperatures between - 25 °C and + 40 °C.

NOTE Only applicable if at least one MPD to be assembled to the POP is suitable for this temperature range.

4.4 According to the number of monitored line to neutral conductor voltages

4.4.1 1 monitored line to neutral conductor voltages;

4.4.2 3 monitored lines to neutral conductor voltages.

NOTE POP according to classification 4.4.1 can be used to monitor voltage between two phases in phase to phase electrical supply system with rated voltage 230 V according to the instruction sheets accompanying the product. In this case, the voltage is not monitored between line and neutral but between two lines.

5 Characteristics

5.1 Summary of characteristics

The characteristics of the standard of the main protective device and the followings apply:

– protection against external influences;

– method of mounting;

– method of connection;

– value of rated operational voltage;

– value of rated frequency;

– limit values of break times and non actuating times;

– range of ambient air temperature.

5.2 Limit values of the break times and non-actuating times

The limit values of break time (see 3.7) and non-actuating time (see 3.8) for the POP are given in Table 1.

Table 1 – Limit values of break times and non-actuating times

	Standard values of break time and non-actuating time at a voltage (U_a) equal to				
	255 V	**275 V**	**300 V**	**350 V**	**400 V**
Maximum break time	No tripping	15 s	5 s	0,75 s	0,20 s
Minimum non-actuating time		3 s	1 s	0,25 s	0,07 s

6 Marking and other product information

6.1 Standard marking

In general, each POP shall be marked in a durable manner with all the following data:

a) manufacturer's name or trade mark;

b) type designation, catalogue number or serial number;

c) rated voltage with the symbol ~;

d) POP or EN 50550;

e) protection degree (only if different from IP20).

NOTE For POP classified according to 4.1.1, marking according to item d) is sufficient.

Moreover the following markings shall be placed on the products or in the instruction sheets accompanying the product:

f) the type designation and catalogue number of the main protective device for the POP intended to be associated with;

g) assembling method and wiring;

h) instructions for checking operation after assembly to verify the mechanical operation of the main protective device in case of devices according to classification 4.1.2;

i) range of the ambient air temperature;

j) for the devices classified according to 4.1.2 and 4.1.3, information about the needs to take into consideration the range of the ambient air temperature of the main protective device.

Information on how to reach the isolation of the installation shall be given; such information shall be given in the instruction sheet accompanying the product.

The information under a), b), c) and d) shall be visible when the POP is installed.

The information under i) shall not be visible when the POP is assembled with the MPD.

Marking shall be indelible, easily legible and not be placed on screws, washers or other removable parts.

Compliance is checked by inspection and by the test of 9.3.5.

With the POP assembled and enabled, the visible marking, required by the reference standard of the main protective device, shall be visible.

6.2 Additional marking

For POP classified according to 4.1.1, additional marking to other standards (EN or IEC or other) is allowed under the following conditions:

– the POP shall comply with all the requirements of the additional standard;

– the relevant standard to which the additional marking refers shall be indicated adjacent to this marking and shall be clearly differentiated or separated from the standard marking according to 6.1.

Compliance is checked by inspection and by carrying out all the test sequences required by the relevant standard. Equivalent or less severe test sequences need not be repeated.

7 Standard conditions for operation in service

7.1 General

The POP complying with this European Standard shall be capable of operating under the standard conditions given by the relevant MPD standard(s).

7.2 Conditions of installation

POP shall be installed in accordance with the manufacturer's instructions.

POP according to 4.1.2 and 4.1.3 shall only be installed together with the main protective device declared by the manufacturer.

7.3 Pollution degree

POP according to this European Standard are intended for environment with pollution degree 2, i.e.: normally, only non-conductive pollution occurs; occasionally, however, a temporary conductivity caused by condensation may be expected.

8 Requirements for construction and operation

NOTE For test purposes the association of the POP and the MPD will be referred hereafter as POP assembly.

8.1 Mechanical design

8.1.1 General

POP shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or surrounding.

The POP, the release unit, if any, and the main protective device shall be of the same manufacturer or trademark.

Compliance is checked by inspection and carrying out all the relevant tests specified.

The POP shall be constructed according to one of the methods of classification 4.1.

Compliance is checked by inspection.

When the main protective device is a CB it shall complied with EN 60898-1 or EN 60898-2.

When the main protective device is a RCD it shall comply either with EN 61008 series for RCCB or EN 61009 series for RCBO.

Compliance is checked according to the relevant standards.

POP shall be assembled only with main protective devices having the same rated frequency.

POP shall be assembled only with main protective devices having a higher or equal range of ambient air temperature (see 4.3).

The protective conductor of the installation shall not become live when the POP is operating.

The POP shall not create or simulate a fault current to operate the MPD.

It shall be connected either to the MPDs input terminals only or to its output terminals only, but not to both.

Compliance is checked by inspection and by the tests of 9.6.2.2.

8.1.2 Mechanism

8.1.2.1 POP shall be so designed and constructed not to change the functional characteristic of the main protective device.

Compliance is checked by inspection and by the tests of 9.3.1.

8.1.2.2 The association of the POP and the main protective device shall be made in a proper way according to the manufacturer instructions, in order to avoid uncorrected matching.

Compliance is checked by visual inspection and according the manufacturer instructions.

8.1.3 Clearances and creepage distances

The minimum required clearances and creepage distances are given in AC1⟩Table 2⟨AC1 which is based on the POP being designed for operating in an environment with pollution degree 2. However, the clearances of items 2 and 4 may be reduced provided that the tests at rated impulse voltage are withstood.

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to 4.8.1.1 and 4.8.1.3 of EN 60664-1:2007.

The values of Table 2 shall be verified for the complete POP assembly.

Table 2 – Minimum clearances and creepage distances

Description	Minimum clearances mm		Minimum creepage distances [a, b] mm											
			Group IIIa [c] (175 V ≤ CTI < 400 V) [d]				Group II (400 V ≤ CTI < 600 V) [d]				Group I (600 V ≤ CTI) [d]			
	Rated voltage		Working voltage [a]											
	230 V	400 V	> 25 V ≤ 50 V [e]	120 V	250 V	400 V	> 25 V ≤ 50 V [e]	120 V	250 V	400 V	> 25 V ≤ 50 V [e]	120 V	250 V	400 V
1. between live parts which are separated when the POP is in the isolation condition	4,0	4,0	1,2	2,0	4,0	4,0	0,9	2,0	4,0	4,0	0,6	2,0	4,0	4,0
2. between live parts of different polarity [f g]	3,0	3,0	1,2	1,5	3,0	4,0	0,9	1,5	3,0	3,0	0,6	1,5	3,0	3,0
3. between circuits supplied from different sources, one of which being PELV or SELV [h]	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0
			Rated voltage 230 V – 400 V											
4. between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the POP – surface on which the POP is mounted [i] – screws or other means for fixing the POP [i] – metal covers or boxes [i] – other accessible metal parts [j]	3,0		4,0				3,0				3,0			

Table 2 – Minimum clearances and creepage distances *(continued)*

NOTE 1 The values given for 400 V are also valid for 440 V.

NOTE 2 The parts of the neutral path, if any, are considered to be live parts.

[a] Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. For determination of creepage distances see Annex B.

[b] Creepage distances cannot be less than the associated clearances.

[c] For material group IIIb (100 V ≤ CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply.

[d] See EN 60112.

[e] For working voltages up to and including 25 V reference may be made to EN 60664-1.

[f] For auxiliary and control contacts the values are given in the relevant standard.

[g] This applies also to clearance and creepage distances between live parts of different polarity of the POP and equipments mounted close to it.

[h] To cover all different voltages including ELV in an auxiliary contact.

[i] The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the POP is mounted are not dependent on the design of the POP only, so that they can be reduced when the POP is mounted in the most unfavourable condition.

[j] Including a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use. The foil is pushed into corners, grooves, etc., by means of a straight unjointed test finger according to 9.14.

8.1.4 Clearances and creepage distances for electronic circuits connected between live parts or between live parts and the earth

For electronic circuits connected:

– between live parts, or

– between live parts and the earth circuit when the contacts are in the closed position,

the verification of the clearances and creepage distances is replaced by the tests of 9.8 and 9.9.

This is not applicable to terminals for external conductors.

8.1.5 Screws, current-currying parts and connections

The relevant subclause of the standard of the main protective device applies:

a) 8.1.4 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.1.4 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.1.4 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.12.

8.1.6 Terminals for external conductors

The relevant subclause of the standard of the main protective device applies:

a) 8.1.5 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.1.5 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.1.5 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.13.

If types or sizes of terminals are used, which are not considered in the standard of the main protective device a), b) or c), generic standards for terminals shall apply (for example piercing terminals according to EN 60998-2-3).

In case of POP classified according to 4.1.2, if supply cables to be associated to the main protective devices are provided, suitable indications for preventing wrong connections shall be given.

NOTE This requirement is considered to be met by the colours of the supply conductors of the POP and the installation instructions which accompany the device (see 6.2).

Compliance is checked by inspection.

8.2 Protection against electric shock

The relevant subclause of the standard of the main protective device applies:

a) 8.2 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.2 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.2 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.14 and 9.4.

8.3 Dielectric properties and isolating capability

When fitted on a main protective device, the POP shall not impair the suitability for isolation of the main protective device.

Compliance is checked by the tests of 9.4.

8.4 Temperature rise

The corresponding subclause of the standard of the main protective device applies:

a) 8.4 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.4 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.4 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by the tests of 9.5.

8.5 Operating characteristic

8.5.1 Operating characteristic

The operating characteristic of the POP shall be such that they ensure adequate protection, without premature operation.

Compliance is checked by the test of 9.6.

8.5.2 Effect of the ambient air temperature on the tripping characteristic

Ambient temperatures other than the reference temperature, within the limits of -5 °C and +40 °C, shall not unacceptably affect the tripping characteristic of POPs.

Compliance is checked by the test of 9.6.3.

8.6 Mechanical and electrical endurance

POP shall be capable of performing an adequate number of cycles of operations.

Compliance is checked by the test of 9.7.

8.7 Performance at short-circuit currents

POP shall be capable of withstanding a specified number of short-circuit operations of the main protective device during which they shall neither endanger the operator nor initiate a flashover between live parts or between live parts and earth.

Compliance is checked by the test of 9.3.2.

8.8 Resistance to mechanical shock and impact

The relevant subclause of the standard of the main protective device applies:

a) 8.9 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.8 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.8 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.15.

8.9 Resistance to heat

The relevant subclause of the standard of the main protective device applies:

a) 8.10 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.9 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.9 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.16.

8.10 Resistance to abnormal heat and to fire

The relevant subclause of the standard of the main protective device applies:

a) 8.11 of EN 60898-1:2003 for devices according to 4.2.1;

b) 8.10 of EN 61008-1:2004 for devices according to 4.2.3;

c) 8.10 of EN 61009-1:2004 for devices according to 4.2.2.

Compliance is checked by tests of 9.17.

8.11 Ageing of electronic components

POP shall operate reliably even after long service, taking into account the ageing of their components.

Compliance is checked by the tests of 9.3.3.

8.12 Behaviour at low ambient air temperature

POP for use in the range of -25 °C to +40 °C, according to classification 4.3.2, shall operate reliably at low temperatures.

Compliance is checked by the tests of 9.18.

8.13 Electromagnetic compatibility

POP shall operate reliably even in presence of electromagnetic disturbances and shall comply with relevant EMC requirements.

Compliance is checked by the tests of 9.10.

8.14 Safety performance of overstressed POPs

POP shall be able to withstand permanently 1,1 times the phase to phase voltage.

Compliance is checked by inspection and by the test of 9.11.

9 Tests

9.1 General

For the purpose of verification of conformity with the standard, type tests are carried out in test sequences.

NOTE Verification of the conformity to the standards may be made

– by the manufacturer for the purpose of suppliers declaration (13.5.1 of ISO/IEC Guide 2:2004);

– by an independent body for certification (13.5.2 of ISO/IEC Guide 2:2004).

According to the terminology of ISO/IEC Guide 2 the term "certification" can be used for the second case only.

The test sequences and the number of samples to be submitted are stated in Annex A.

Unless otherwise specified, each type test (or sequence of type tests) is made on a POP assembly in a clean and new condition, the influencing quantities having their normal reference values (see the relevant MPD standard(s)).

All the tests are carried out on the POPs assembled with the release unit, if any, and with the main protective device having the highest rated current and the corresponding minimum rated residual current if applicable, unless otherwise specified, and being representative of the series having the same fundamental design as defined in C.3.1 of EN 60898-1:2003, or A.3.1 of EN 61008-1:2004, or A.3.1 of EN 61009-1:2004.

For test purposes, this will be referred as to “POP assemblies“.

If the POP is designed to be assembled to different MPDs, according to classification 4.2, it shall be tested according to Table D.2.

9.2 Test condition

The POP assembly is mounted individually according to manufacturer's instructions and in free air, at an ambient temperature as required by the standard of the MPD, unless otherwise specified.

POP designed for installation in individual enclosures are tested in the smallest of such enclosures specified by the manufacturer.

NOTE An individual enclosure is an enclosure designed to accept one device only.

The POP is wired with the appropriate cable as defined by the manufacturer.

Where tolerances are not specified, type tests are carried out at values not less severe than those specified in this European Standard. Unless otherwise specified, tests are carried out at the rated voltage and rated frequency ± 5 %.

During the tests no maintenance or dismantling of the samples is allowed.

9.3 Verification of the influence of the POP on the correct operation of the main protective device

9.3.1 Verification of the operating characteristic of the main protective device

When fitted on a main protective device, the POP shall not disturb the correct operation of the main protective device. The following verifications of the operating characteristics of the combination shall be made on the devices having the largest number of poles, highest I_n and lowest $I_{\Delta n}$, as applicable:

a) *8.1.2 [1], 9.10.1.1 and 9.10.2 (only at the upper limit of instantaneous tripping current) of EN 60898-1:2003 and EN 60898-2:2006 for devices according to 4.2.1;*

b) *8.1.2 [1], 9.9.2.1, 9.9.2.2, 9.9.2.3 a), 9.15 of EN 61008-1:2004 for devices according to 4.2.3;*

c) *8.1.2 [1], 9.9.1.2 a), 9.9.1.2 b), 9.9.1.2 c) 1), 9.9.2.1, 9.9.2.2 (only at the upper limit of instantaneous tripping current), 9.11 of EN 61009-1:2004 for devices according to 4.2.2.*

9.3.2 Short-circuit test

9.3.2.1 General conditions for short-circuit test

The POP shall be in a new and clean condition, assembled to a main protective device in a new and clean condition.

9.3.2.2 Test circuit and test quantities

a) *9.12.2 and 9.12.4 of EN 60898-1:2003 for devices according to 4.2.1;*

b) *9.11.2.1 of EN 61008-1:2004 for devices according to 4.2.3;*

c) *9.12.2 and 9.12.3 of EN 61009-1:2004 for devices according to 4.2.2.*

9.3.2.3 Test procedure

a) *9.12.11.4.3 of EN 60898-1:2003 for devices according to 4.2.1;*

---

[1] Only inspections and manual tests.

b) 1) 9.11.2.3 b) of EN 61008-1:2004 for devices according to 4.2.3;

2) 9.11.2.4 a) of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.12.11.4 c) and 9.12.11.4 d) of EN 61009-1:2004 for devices according to 4.2.2.

After the tests shall be verified the prescriptions according to 9.3.2.4.

9.3.2.4 Condition of the POP after the test

After the test the POP assembly shall perform the following test:

a) 9.12.12.2 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.11.2.1 i) of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.12.12.2 and 9.12.12.3 of EN 61009-1:2004 for devices according to 4.2.2.

After the test, POP assembly shall be capable to perform the tests according to 9.6.2.2 and 9.6.2.3.

9.3.3 Verification of ageing of electronic components

The POP assembly is placed for a period of 168 h in an ambient temperature of 40 °C ± 2 °C and loaded with the rated current. The voltage on the electronic parts shall be 1,1 times the rated voltage.

After this test, the POP assembly in the cabinet is allowed to cool down to approximately room temperature without current passing. The electronic parts shall show no damage.

For POP classified according to 4.2.3, under the conditions of tests specified in 9.9.2.3 of EN 61008-1:2004, the RCCB shall trip with a test current of 1,25 $I_{\Delta n}$*. One test only is made on one pole taken at random without measurement of break time.*

For POP classified according to 4.2.2, under the conditions of tests specified in 9.9.1.2 c) of EN 61009-1:2004, the RCBO shall trip with a test current of 1,25 $I_{\Delta n}$*. One test only is made on one pole taken at random without measurement of break time.*

After the test, POP shall be capable to perform the tests according to 9.6.2.2 and 9.6.2.3.

9.3.4 Void

9.3.5 Test of indelibility of marking

The test is made by rubbing the marking by hand for 15 s with a piece of cotton soaked with water and again for 15 s with a piece of cotton soaked with aliphatic solvent hexane (with a content of aromatics of maximum 0,1 % volume, a kauributanol value of 29, initial boiling point approximately 65 °C, dry point approximately 69 °C and specific gravity of 0,68 g/cm³).

Marking made by impressing, moulding or engraving is not subjected to this test.

After this test, the marking shall be easily legible. The marking shall also remain easily legible after all the tests of this European Standard.

It shall not be easily possible to remove labels and they shall show no curling.

9.4 Test of dielectric properties

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly, the POP supplied as for normal use with its rated voltage:

a) 9.7 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.7 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.7 of EN 61009-1:2004 for devices according to 4.2.2.

with the following modifications.

If the POP assembly is provided with a terminal intended for the connection of functional earthing conductors, this terminal is treated like a pole.

During the verification of impulse withstand voltage across the open contacts (suitability for isolation), there shall be no disruptive discharges and no operation of surge protective components, if any.

9.5 Temperature rise

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly, the main protective device charged with In and the POP supplied as for normal use with its rated voltage:

a) 9.8 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.8 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.8 of EN 61009-1:2004 for devices according to 4.2.2.

The test current in the main protective devices may be generated at reduced voltage but the POP shall be supplied with their rated voltage. For this reason tests shall be made on samples specially prepared by the manufacturer or according to his instructions.

9.6 Verification of the operating characteristics

9.6.1 Test circuit

The POP is installed as in normal use.

The tests are carried out in a POP sample connected to a new sample of the associated main protective device compliant with its corresponding product standard.

The total harmonic distortions on the voltage supply shall not exceed a maximum of 8 % (for reference see EN 50160).

Stabilised voltage supplies and true RMS measurement techniques shall be applied.

9.6.2 Off-load characteristic tests with sinusoidal alternating voltages at the reference temperature of 20 °C ± 5 °C

9.6.2.1 General

The POP assembly shall perform the tests of 9.6.2.2 and 9.6.2.3. The tolerance of the voltages applied is ± 1 %.

Three measurements are carried out for each test. The values obtained shall not exceed the specified limit values.

The POP assembly shall be reclosed after each operation.

9.6.2.2 Verification of the correct operation in case of sudden appearance of overvoltage

The POP assembly is supplied at the rated voltage. Once thermal steady-state conditions are attained, the supplied voltage is suddenly increased (e.g. by means of a switch, a relay, etc.) up to 255 V and maintained for 1 h.

The POP assembly shall not trip.

Then the test circuit shall be successively calibrated at each of the values of the actuating voltage U_a *specified in Table 1.*

While the POP assembly is in the closed position and supplied at rated voltage, the supplied voltage is suddenly increased without interruption to U_a*.*

The POP assembly shall trip during each application of U_a*.*

After each operation, the voltage is reduced down to the rated voltage and the associated main protective device is switched on again.

Five measurements of the break time are made at each value of actuating voltage.

No value shall exceed the relevant limiting value specified in Table 1.

If the POP assembly is provided with a terminal intended to be connected to the protective conductor, this terminal shall only be wired to the neutral through a resistor of 1 Ω and the voltage drop across this resistor be measured.

In any case, the current calculated from the voltage drop measured at this 1 Ω resistor shall not exceed 0,5 mA r.m.s.

9.6.2.3 Verification of minimum non actuating times

The test circuit being successively calibrated at each of the actuating voltage U_a *specified in Table 1, the POP assembly being in the closed position, the supplied voltage is suddenly increased without interruption, from the rated voltage up to* U_a *for periods corresponding to the relevant minimum non-actuating times.*

Additionally, with the POP assembly being in the closed position and supplied at 255 V, the voltage is suddenly increased without interruption to 275 V for a 3 s period.

The POP assembly shall not trip during any of the tests.

9.6.3 Test of the effect of the ambient air temperature on the operating characteristic

The tests of 9.6.2.2 and 9.6.2.3 are repeated, under the following conditions:

a) ambient temperature: -5 °C;

b) ambient temperature: +40 °C with the POP assembly being supplied with the rated voltage, until it attains thermal steady-state conditions.

In practice these conditions are reached when the variation of temperature-rise does not exceed 1 K per hour;

c) ambient temperature: -25 °C, for POP classified according to 4.3.2 in conjunction to MPD rated for -25 °C.

9.7 Verification of the mechanical and electrical endurance

9.7.1 General test conditions

The POP assembly is fixed to a metal support.

The test is made at rated operational voltage.

9.7.2 Test procedure

POP assemblies are subjected to several actuating cycles, each actuating cycle consisting of applying a power frequency overvoltage that operates the switching device.

After each actuating cycle, the supply voltage is reduced down to the rated value and POP assembly is reclosed, in less than 1 min.

The POP assembly shall be operated as for normal use.

The actuating cycles shall be effected as follows:

– *48 actuating cycles distributed over 3 h, for a overvoltage of 315 V.*

Alternatively, the time for the test and the number of actuating cycles can be reduced to:

– *30 actuating cycles distributed over 1 h for a overvoltage of 400 V.*

9.7.3 Condition of the POP after test

Following the test of 9.7.2 the POP assembly shall not show

– *undue wear,*

– *damage of the enclosure permitting access to live parts by the standard test finger,*

– *loosening of electrical or mechanical connections,*

– *seepage of the sealing compound, if any.*

The POP assembly shall continue operating under the test conditions of 9.6.2.2.

9.8 Tests of creepage distances and clearances for electronic circuits (abnormal conditions)

9.8.1 *These tests replace the verifications of creepage distances and clearances of electronic circuits connected between live parts (phases and neutral) and/or between live parts and the earth circuit.*

POP shall not create fire and/or shock hazards under abnormal conditions likely to occur in service.

The conditions under which a component is used within a POP shall be in accordance with the operating characteristics marked on the component and/or given in the data provided by the manufacturer.

9.8.2 *When POP are exposed to abnormal conditions, no part shall reach temperatures likely to cause danger of fire to the surroundings of the POP, and no live parts shall become accessible.*

Compliance is checked by subjecting the POP assembly to a heating test under fault conditions as described in 9.8.3.

9.8.3 *Unless otherwise specified, the tests are made on POP assembly, connected and loaded as in normal use.*

Examination of the POP and its circuit diagram will show the fault conditions that shall be applied.

Generally one separate sample is submitted for each fault condition to be tested.

Each of the following fault conditions a) to e) shall be applied in turn, one test only being carried out for:

a) *short-circuit across clearances and creepage distances smaller than those given by curve A of Figure 1, with the following exception:*

   in the case of a printed board complying with the pull-off and peel strength requirements specified in EN 61249-2 series, the creepage distances and clearances between conductors, one of which may be connected to one pole of the supply mains, the values resulting from Figure 1 are replaced by the values calculated from the formula

   $$\log d = 0{,}78 \log (V/300) \text{ with a minimum of } 0{,}2 \text{ mm}$$

   where

   d *is the distance in millimetres;*

   V *is the peak value of the voltage in volts.*

   These distances can be determined by reference to Figure 2.

   The above-reduced values apply to the conductors themselves, but not to mounted components or associated soldered connections. Covering lacquer or the like on printed boards are ignored when calculating the distances.

   Clearances and creepage distances complying with the requirements of AC1 Table 2 AC1, and printed boards with type B coating complying with EN 60664-3 are excluded from this test;

b) *short-circuit across insulation consisting of lacquer or enamel coverings;*

c) *short-circuit or interruption of semiconductors;*

NOTE For integrated circuits and other semiconductor devices with more than two terminals, the number of tests theoretically required makes it impracticable to apply the open circuiting and/or shorting of all combinations of terminals. In this case, it is permissible first to analyze in detail, by a desk study, all the possible mechanical, thermal and electrical faults which may develop in the POP due to the malfunction of the electronic device or other circuit components. Only the combinations corresponding to faults that, on the basis of this analysis, are considered to be likely to cause the non-compliance of the POP with the requirements of the two last paragraphs of this subclause have to be investigated by this method.

d) *short circuit of electrolytic capacitors;*

e) *short circuit or disconnection of resistors, inductors or capacitors which do not comply with the requirements of the 9.9.2, 9.9.3 and 9.9.4.*

The temperatures resulting from the fault conditions are measured for the parts mentioned in Table 3 after steady-state has been reached, or after 4 h (whichever is the shorter time) under each of the fault conditions a) to e).

These temperatures shall not exceed the values given in Table 3.

Table 3 – Maximum permissible temperatures under abnormal conditions

Parts of the POP			Permissible temperature rise K
External parts	Metal parts	Knobs, handles, sensing surfaces, etc.	75
		Enclosure [a]	75
	Not metal parts	Knobs, handles, sensing surfaces, etc. [b]	75
		Enclosure [a b]	75
Inside of enclosures of insulating material			[c]
Windings [d]	Class A		115
	Class E		130
	Class B		140
	Class F		155
	Class H		175
	Class 200		195
	Class 220		215
	Class 250		245
Core laminations			As for the relevant windings
Supply cable and wiring:	Insulated with ordinary polyvinyl chloride [e]	not under mechanical stress	110
		under mechanical stress	110
	Insulated with natural rubber		110
Other insulations [d f] except thermoplastic	Non-impregnated paper		80
	Non-impregnated cardboard		90
	Impregnated cotton, silk, paper and textile, urea resins		100
	Laminates bonded with phenol-formaldehyde resins, phenol-formaldehyde mouldings with cellulose fillers		120
	Phenol-formaldehyde mouldings with mineral fillers		140
	Laminates bonded with epoxy resins		160
	Natural rubber		110
Thermoplastic materials [g]			[h]
Terminals and parts which may come into contact with cable insulation when installed			110
The values of the temperature rises are based on an ambient temperature of 25 °C, but the measurements are made under normal conditions.			

Table 3 – Maximum permissible temperatures under abnormal conditions *(continued)*

[a] For areas not exceeding 5 cm² and which are not likely to be touched in normal use, temperature rises up to 75 K are allowed under normal operating conditions.

[b] If these temperature rises are higher than those allowed by the class of the relevant insulating material, the nature of the material is the governing factor.

[c] The permissible temperature rises for the inside of enclosures of insulating material are those indicated for the relevant materials.

[d] For the purpose of this European Standard, the permissible temperature rises are based on the recommendations in EN 60085. The materials quoted above are shown only as examples. If materials other than those listed in EN 60085 are used, the maximum temperatures must not exceed those which have been proved to be satisfactory.

[e] The possibility of raising the values for wires and cables insulated with heat-resistant polyvinyl chloride is under consideration.

[f] The table does not apply to components which comply with relevant IEC standards.

[g] Natural and synthetic rubbers are not considered as being thermoplastic materials.

[h] Due to their wide variety, it is not possible to specify permissible temperature rises for thermoplastic materials. While the matter is under consideration, the following method shall be used.

a) The softening temperature of the material is determined on a separate specimen, under the conditions specified in EN ISO 306, modified as follows:
   – the depth of penetration is 0,1 mm;
   – the total thrust of 10 N is applied before the dial gauge is set to zero or its initial reading noted.

b) The temperature limits to be considered for determining the temperature rises are:
   – under normal operating conditions, a temperature 10 °C lower than the softening temperature as obtained under a);
   – under fault conditions, the softening temperature itself.

9.9 Requirements for capacitors and specific resistors and inductors used in electronic circuits

9.9.1 General

These requirements apply for capacitors (see 9.9.2) and specific resistors (see 9.9.3), inductors and windings (see 9.9.4) used in electronic circuits connected between live parts (phases and neutral) and/or between live parts and the earth circuit.

9.9.2 Capacitors

Capacitors,

– *the short-circuiting or disconnection of which would cause an infringement of the requirements under fault conditions with regard to shock or fire hazard,*

– *the short-circuiting of which would cause a current of 0,5 A or more through the terminals of the capacitor,*

– *for suppression of electromagnetic interference,*

shall comply with EN 60384-14.

NOTE Capacitors passing the damp heat steady-state test specified in 4.12 of that standard with a duration of not less than 21 days are considered acceptable.

These capacitors shall be marked with their rated voltage in volts (V), their rated capacitance in microfarads (µF) and their reference temperature in degrees Celsius (°C).

9.9.3 Resistors

Resistors, the short-circuiting or interruption of which would cause an infringement of the requirements with regard to the protection against fire and electric shock in case of a defect, shall have an adequately constant value under the overload conditions prevailing in the electronic switch.

These resistors shall comply with the requirements of 14.1 of EN 60065:2002 + corr. Aug. 2007

Tests already carried out on resistors and inductors complying with EN 60065 are not required to be repeated.

9.9.4 Inductors and windings

Inductors and windings shall comply with the requirements of EN 61558-1 and the relevant parts of EN 61558-2 series as applicable.

9.10 Electromagnetic compatibility

The following tests are based on EN 61543 and are performed on the POP assembly.

NOTE 1 EN 61000-3-2 is not required as the power dissipation of the POP is below the power limit.

NOTE 2 EN 61000-3-3 is not required as POP are unlikely to produce significant voltage fluctuations or flicker.

9.10.1 Immunity tests

9.10.1.1 Low frequency immunity

The test conditions for low frequency immunity are given in Table 4.

Table 4 – Low frequency immunity test conditions

Reference	Electromagnetic phenomena	Reference of basic standard for test description	Test level and test specification	Performance criteria
T 7.1	Harmonics, interharmonics	No requirements		
T 7.2	Signalling voltage	No requirements		
T 7.3	Voltage amplitude variations			
	Voltage dips	EN 61000-4-11	Acc. EN 61000-6-2	
			30 % reduction 10 ms (1)	No tripping during the test
			60 % reduction 100 ms [a]	No tripping during the test
			60 % reduction 1 s [a]	No tripping during the test
	Voltage interruptions	EN 61000-4-11	Acc. EN 61000-6-2	
			> 95 % reduction 5 s	No tripping during the test
T 7.4	Voltage unbalance	Refer to T 7.3		
T 7.5	Power frequency variations	[b]		

[a] Zero crossing.

[b] Immunity from power frequency variations is ensured by the fact that all performances of the device are tested at frequencies which may be subjected to variations in the range of ± 5 % of the rated frequency: see 9.2.

9.10.1.2 High frequency immunity

The test conditions for the high frequency immunity test are provided in Table 5.

Table 5 – High frequency immunity test conditions

Reference	Electromagnetic phenomena	Reference of basic standard for test description	Test level and test specification	Performance criteria
T 8.1	Conducted sine-wave form voltages or currents	EN 61000-4-6 [a]	0,15 MHz to 80 MHz Z = 150 Ω 3 V	No tripping during the test
T 8.2	Fast transients (bursts) Common mode	EN 61000-4-4 [b]	Level 4: 4 kV (peak) Tr/Th 5/50 ns Repetition frequency: 2,5 kHz	No tripping during the test [c]
T 8.3	Surges	EN 61000-4-5	Tr/Th 1,2/50 µs 5 kV (peak) common mode 4 kV (peak) differential mode	May trip during the test. No damage of the device
			Tr/Th 1,2/50 µs 4 kV (peak) common mode 2 kV (peak) differential mode	No tripping during the test. No damage of the device.
T 8.4	Current oscillatory transients	8/20 µs surge current test	Peak value: 3 kA (- 0 % / + 10 %) [d]	May trip during the test. No damage of the device.
T 8.5	Radiated magnetic field	EN 61000-4-3	Acc. EN 61000-6-2 80 MHz – 1 000 MHz 10 V/m 80 % MA (1 KHz)	No tripping during the test
T 8.6	Conducted common mode disturbances in the frequency range lower than 150 kHz	Values derived from EN 61000-4-16	Level 3 [e]	No tripping during the test

[a] With the agreement of the manufacturer, the conducted test T 7.1 can be extended from 80 MHz to 230 MHz. In this case, the test T 7.5 is to start from 230 MHz instead of 80 MHz.

[b] In addition, the sample shall be mounted as in normal use on a flat insulating support at a distance of 10 cm from the earth plane.

[c] The test is carried out in single phase on one pole of each sample taken at random. Three new samples are submitted to the test. If one sample does not comply with the criterion by tripping during the test, three further samples are tested, which shall not trip.

[d] One pole chosen at random shall be submitted to 10 applications of the surge current. The polarity of the surge wave shall be inverted after every two applications. The interval between two consecutive applications shall be about 30 s.

[e] Current levels are given in Table 5a of EN 61543:1995. They are derived from EN 61000-4-16, taking into account a common mode impedance of 150 Ω. Conventional test currents are applied according to Figure 1 of EN 61543:1995. The test circuit is given in Figure 1 of EN 61543:1995. A simplification of this test is given in EN 61543.

9.10.1.3 Electromagnetic discharges

The test conditions for the electromagnetic discharge test are provided in Table 6.

Table 6 – Test conditions for electrostatic discharges

Reference	Electromagnetic phenomena	Reference of basic standard for test description	Test level and test specification	Performance criteria
T 9.1	Electrostatic discharges	EN 61000-4-2	Level 3 8 kV air 6 kV contact	No tripping during the test [a]

[a] Three new samples are submitted to the test. All three samples shall pass the test.

The point to which discharges shall be applied is selected by an exploration of the accessible surfaces of the [AC1⟩POP⟨AC1], when installed as for normal use. During exploration the selection is made with 20 discharges per second.

The selected point is tested with 10 positive and 10 negative polarity discharges with a time interval of minimum 1 s between subsequent discharges..

9.10.2 Emission tests

Emission tests are required only for POPs containing a continuously operating oscillator.

NOTE POPs other than those containing a continuously operating oscillator do not usually generate continuous or transient disturbances except during their switching process. The frequency, the level and the consequence of such emissions are considered as part of the normal electromagnetic environment of low-voltage installations.

The emission requirements are set in Table 7.

Table 7 – Emissions test conditions

Reference	Electromagnetic phenomena	Reference of basic standard for test description	Frequency range	Limits
T 10.1	Conducted disturbance at mains terminals	EN 55022, Class B or EN 55014-1 [a]	0,15 MHz – 0,5 MHz Limits decrease linearly with the logarithm of the frequency	66 dB (µV) – 56 dB (µV) quasi-peak 56 dB (µV) – 46 dB (µV) average
			0,5 MHz – 5 MHz	56 dB (µV) quasi-peak 46 dB (µV) average
			5 MHz – 30 MHz	60 dB (µV) quasi-peak 50 dB (µV) average
T 10.2	Radiated disturbance	EN 55022, Class B [b]	30 MHz – 230 MHz 230 MHz – 1 000 MHz	30 dB (µV/m) at 10 m 37 dB (µV/m) at 10 m

[a] EN 55014-1 and EN 55022 specify the same test requirements for conducted disturbances.

[b] Although EN 61543 gives EN 55014-1 as a reference, the scope of EN 55022 is considered to be more appropriate to cover POP and is referenced in the generic standard EN 61000-6-3 as the basic standard applicable.

9.11 Test of safety performance of overstressed POPs

The POP assembly is supplied at the rated voltage until thermal stability is attained.

The supplied voltage is then increased to 440 V and maintained for 1 h. Afterwards the voltage is decreased to the rated voltage again. The POP assembly may trip and after the test the POP assembly shall operate correctly according to the test of 9.6.2.

If the POP, according to the manufacturer instructions, may be assembled and wired with the MPD in more than one way (e.g. to the MPDs line terminals, to the MPDs load terminals), the test shall be repeated for each configuration.

9.12 Test of reliability of screws, current-carrying parts and connections

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.4 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.4 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.4 of EN 61009-1:2004 for devices according to 4.2.2.

9.13 Test of reliability of terminals for external conductors

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.5 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.5 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.5 of EN 61009-1:2004 for devices according to 4.2.2.

9.14 Verification of protection against electric shock

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.6 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.6 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.6 of EN 61009-1:2004 for devices according to 4.2.2.

9.15 Verification of resistance to mechanical shock and impact

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.13 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.12 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.13 of EN 61009-1:2004 for devices according to 4.2.2.

9.16 Test of resistance to heat

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.14 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.13 of EN 61008-1:2004 for devices according to 4.2.3;

c) 9.14 of EN 61009-1:2004 for devices according to 4.2.2.

9.17 Resistance to abnormal heat and to fire

The following subclauses of the standard for the main protective device apply, as far as possible, on the POP assembly:

a) 9.15 of EN 60898-1:2003 for devices according to 4.2.1;

b) 9.14 of EN 61008-1:2004 for devices according to 4.2.3;

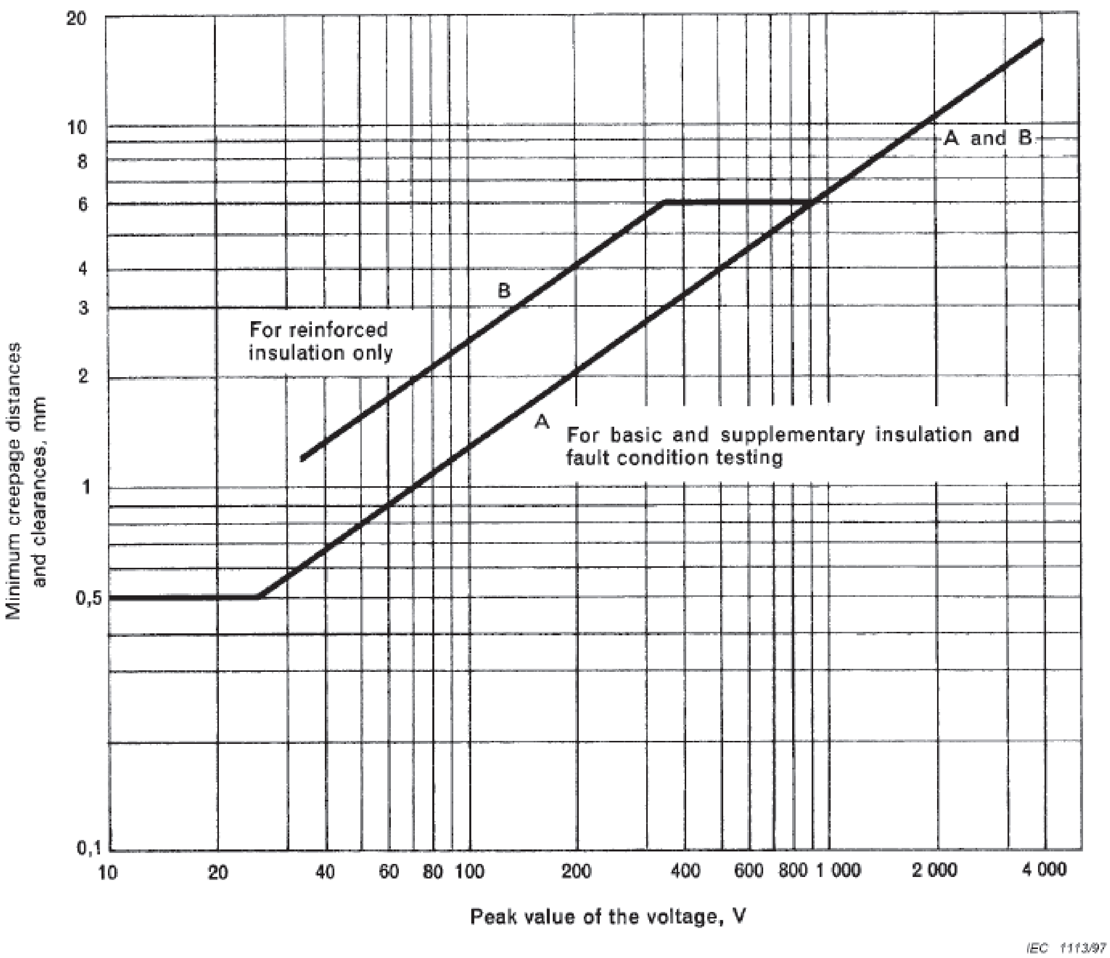
c) 9.15 of EN 61009-1:2004 for devices according to 4.2.2.

9.18 Verification of the correct operation at low ambient air temperatures for RCDs for use at temperatures between -25 °C and +40 °C

For POP classified according to 4.3.2, the relevant subclause of the standard of the MPD applies for the POP assembly:

a) 9.Z1 of EN 61008-1:2004 for devices according to 4.2.3;

b) 9.Z1 of EN 61009-1:2004 for devices according to 4.2.2.



For parts conductively connected to the supply mains with voltages in the range of 220 V – 250 V (r.m.s.), the dimensions are equal to those related to 354 V peak.

A voltage across the basic insulation is determined by short-circuiting the supplementary insulation and vice versa.

The graphs of Figure 9 of EN 60065:2002 + corr. Aug. 2007 are defined by the following:

– Curve A: 34 V corresponds to 0,6 mm, 354 V corresponds to 3,0 mm;

– Curve B: 34 V corresponds to 1,2 mm, 354 V corresponds to 6,0 mm.

Under certain conditions, these distances may be reduced as given in 9.8.3 a).

Figure 1 – Minimum creepage distances and clearances measured in millimetres

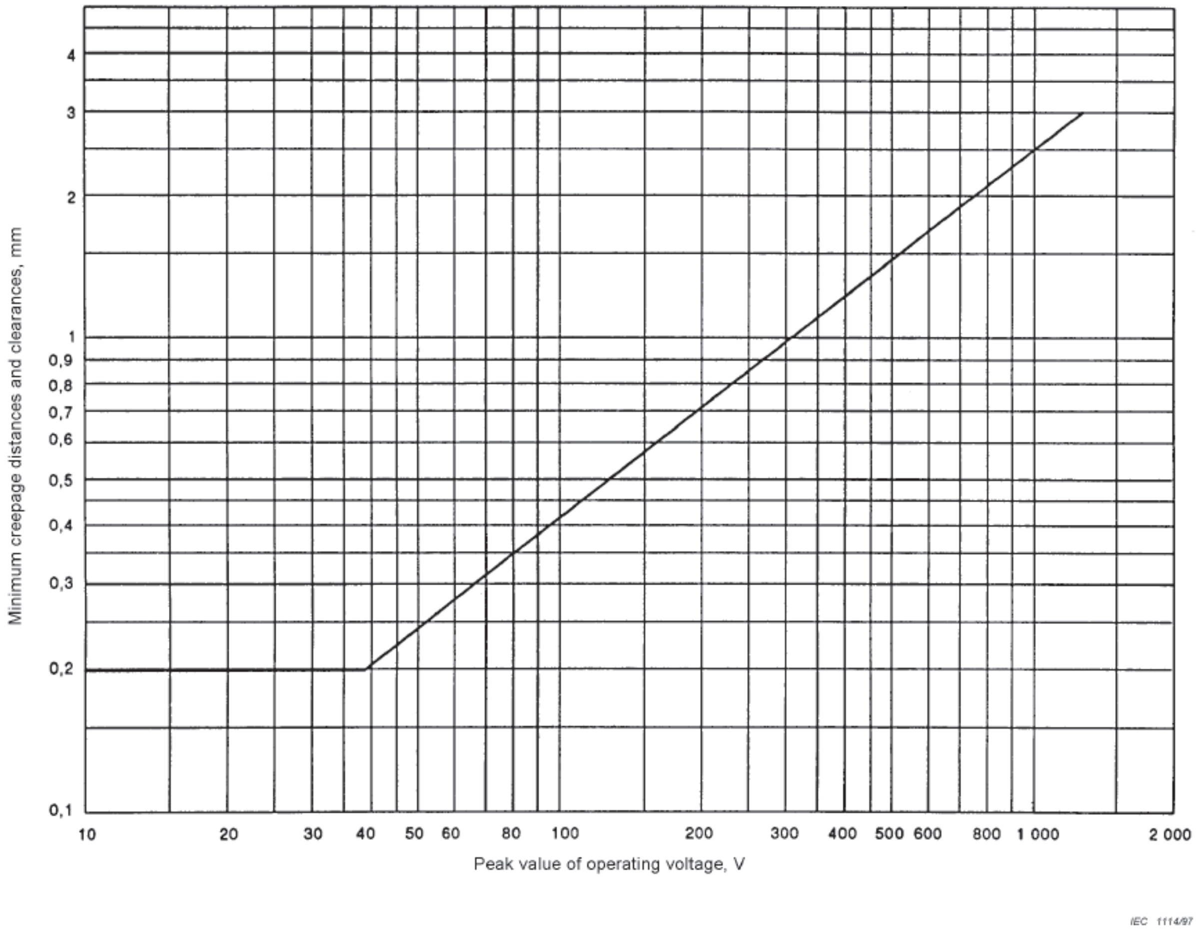


Figure 2 – Minimum creepage distances and clearances as a function of peak value of operating voltage

Annex A
(normative)

Test sequences

The tests are made according Table A.1, where the tests in each sequence are carried out in the order indicated.

Table A.1 – Test sequences

Test sequence	Clause or subclause	Test or inspection
A	6	Marking
	8.1.1	General
	8.1.2	Mechanism
	9.3.5	Indelibility of marking
	8.1.3 and 8.1.4	Clearance and creepage distances
	9.12	Reliability of screws, current currying parts and connections
	9.13	Reliability of terminals for external conductors
	9.14	Protection against electric shock
	9.15	Resistance to mechanical shock and impact
	9.16	Resistance to heat
	9.17	Resistance to abnormal heat and to fire
B	9.4	Dielectrics properties
	9.5	Temperature rise
	9.11	Verification of safety performance of overstressed POPs
	9.6	Operating characteristics
C	9.7	Verification of the mechanical and electrical endurance
D	9.3.1	Operating characteristics of the main protective device
	9.3.2.3 a)	Short circuit test (only for devices according to 4.2.1)
	9.3.2.3 b) 1)	Short circuit test (only for devices according to 4.2.3)
	9.3.2.3 b) 2)	Short circuit test (only for devices according to 4.2.3)
	9.3.2.3 c)	Short circuit test (only for devices according to 4.2.2)
E	9.3.2.3 b) 1)	Short circuit test (only for devices according to 4.2.3)
	9.3.2.3 c)	Short circuit test (only for devices according to 4.2.2)
F	9.3.3	Ageing of electronic components
G	9.10	Electromagnetic compatibility
H	9.8 and 9.9	Tests of creepage distances and clearances for electronic circuits
I	9.18	Verification of the correct operation at low ambient air temperatures for RCCBs for use at temperatures between -25 °C and +40 °C

The number of samples to be submitted to the full test procedure is given in Annex D.

Annex B
(normative)

Determination of clearances and creepage distances

In determining clearances and creepage distances, it is recommended that the following points should be considered.

If a clearance or creepage distance is influenced by one or more metal parts, the sum of the sections should have at least the prescribed minimum value.

Individual sections less than 1 mm in length should not be taken into consideration in the calculation of the total length of clearances and creepage distances.

In determining creepage distance:

– grooves at least 1 mm wide and 1 mm deep should be measured along their contour;

– grooves having any dimension less than these dimensions should be neglected;

– ridges at least 1 mm high:

  - are measured along their contour, if they are integral parts of a component of insulating material (for instance by moulding, welding or cementing);

  - are measured along the shorter of the two following paths: along the profile of the ridge, if the ridges are not integral parts of a component of insulating material.

The application of the foregoing recommendations is illustrated as follows:

– Figures B.1 a), B.1 b) and B.1 c) indicate the inclusion or exclusion of a groove in a creepage distance;

– Figures B.1 d) and B.1 e) indicate the inclusion or exclusion of a ridge in a creepage distance;

– Figure B.1 f) indicates how to take into account a joint when the ridge is formed by an inserted insulating barrier, the outside profile of which is longer than the length of the joint;

– Figures B.1 g), B.1 h), B.1 i) and B.1 j) illustrate how to determine the creepage distance in the case of fixing means situated in recesses in insulating parts of insulating material.

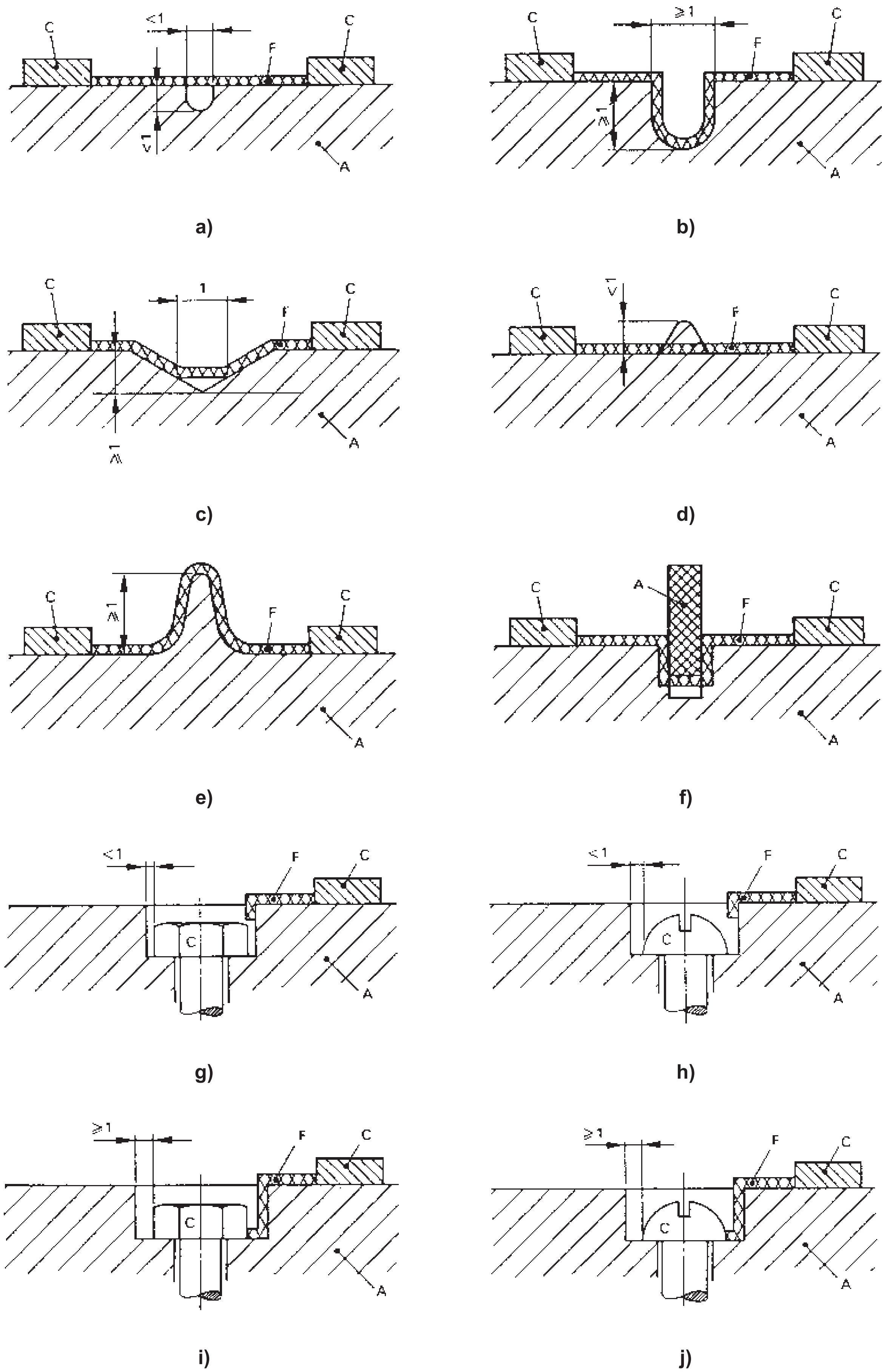


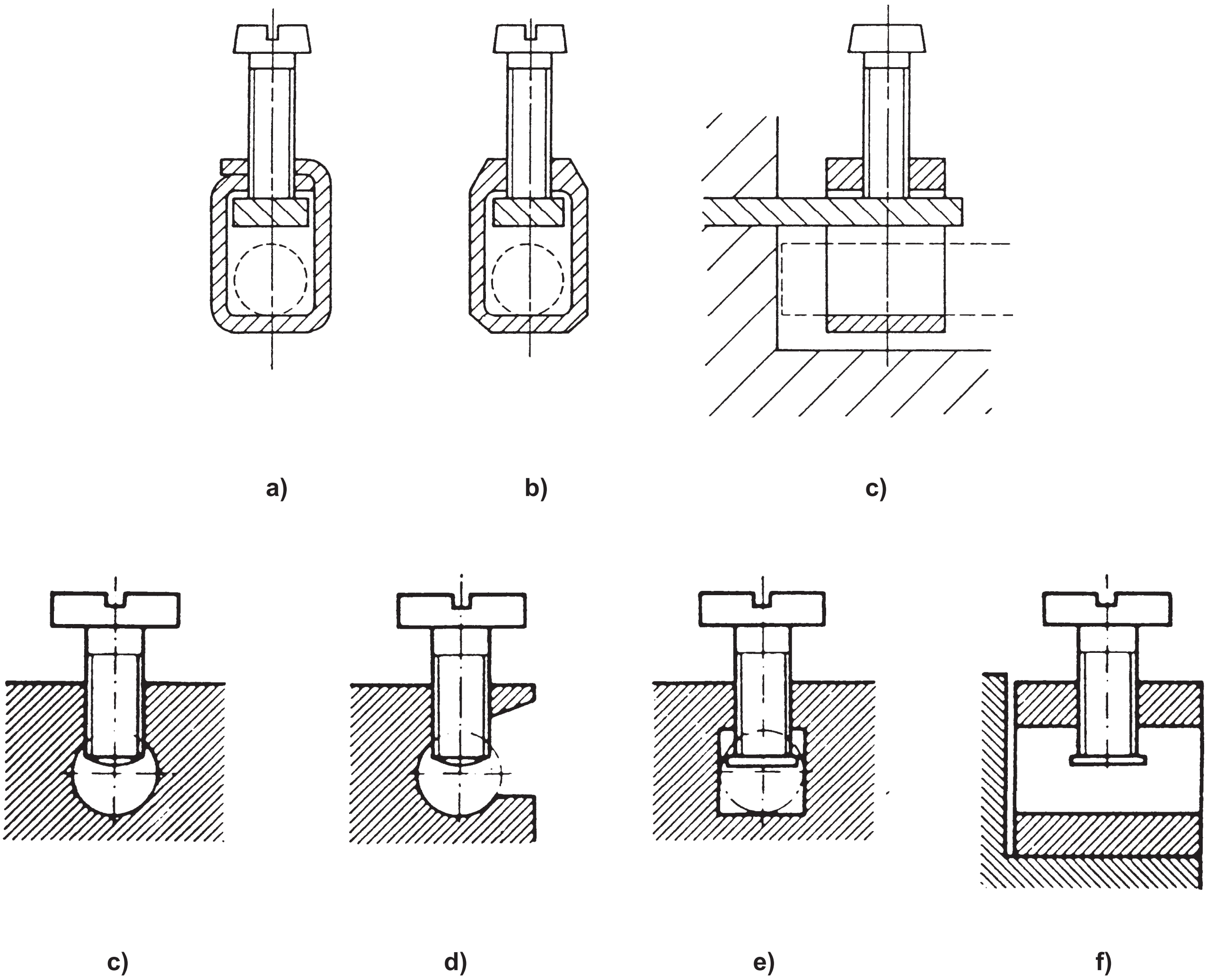
Figure B.1 – Illustrations of the application of creepage distances

Annex C
(informative)

Examples of terminal designs

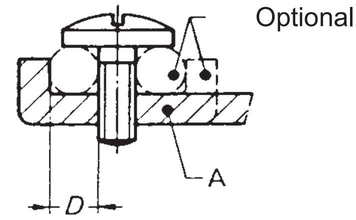
In this annex some examples of design of terminals are given.

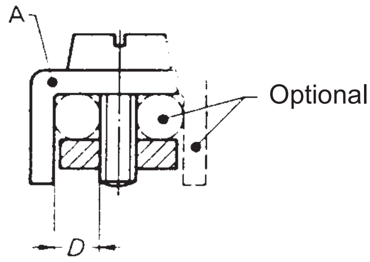
The conductor locations shall have a diameter suitable for solid rigid conductors and a cross sectional area for accepting rigid stranded conductors.



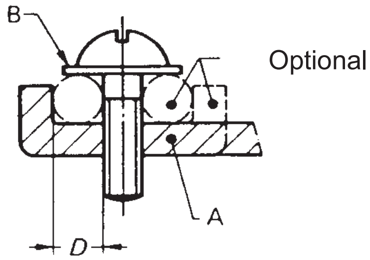
The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of a terminal provided with a stirrup.

Figure C.1 – Examples of pillar terminals

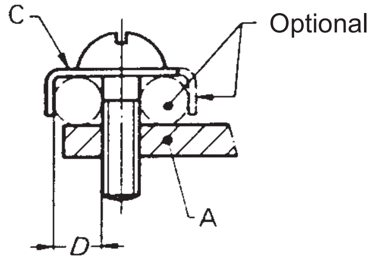




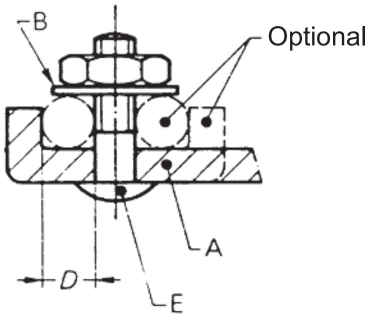
a) and b) Screw terminals not requiring washer or clamping plate



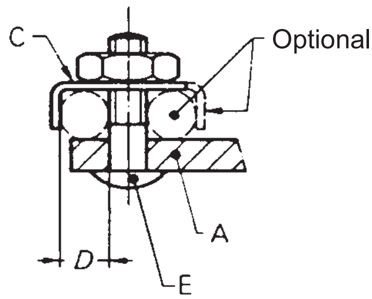
c) Screw terminals requiring washer or clamping plate



d) Screw terminals requiring anti-spread device



c) Stud terminals requiring washer or clamping plate



d) Stud terminals requiring anti-spread device

Key

A fixed part

B washer or clamping plate

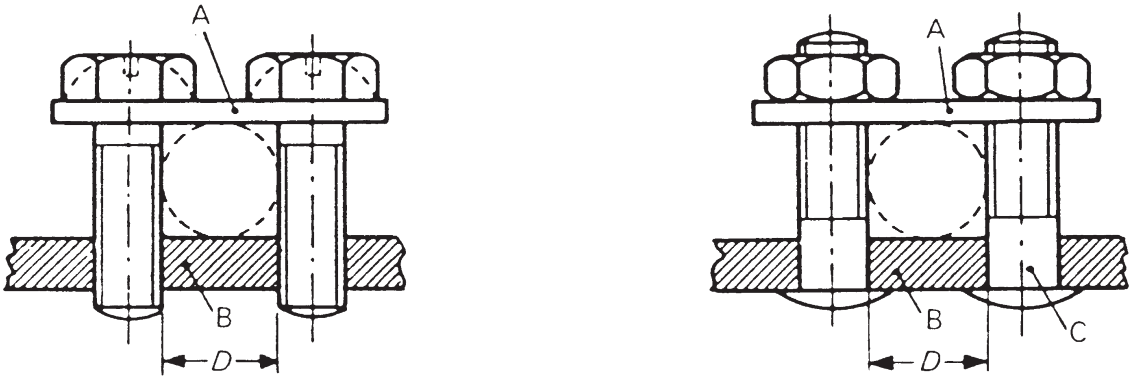
C anti-spread device

D conductor space

E stud

The part which retains the conductor in position may be of insulating material, provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

Figure C.2 – Examples of screw terminals and stud terminals



a) b)

Key

A saddle

B fixed part

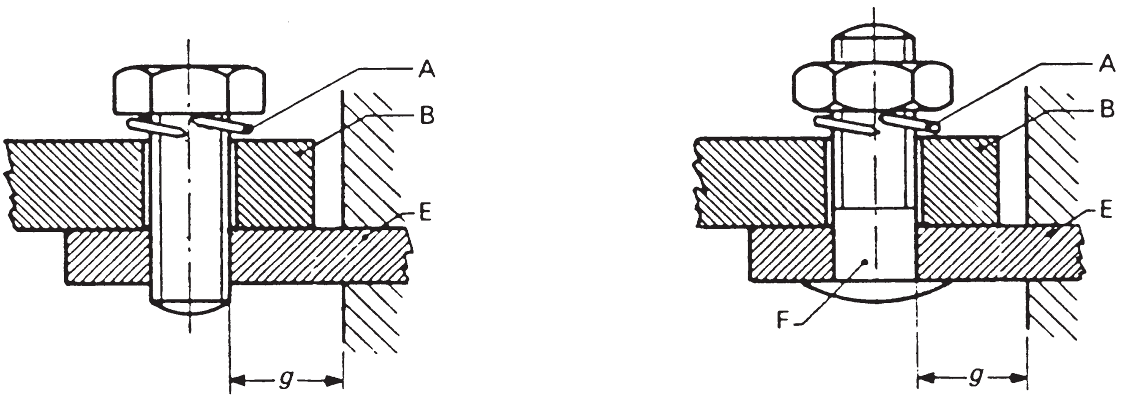
C stud

D conductor space

The two faces of the saddle may be of different shapes to accommodate conductors of either small or large cross-sectional area, by inverting the saddle.

The terminals may have more than two clamping screws or studs.

Figure C.3 – Examples of saddle terminals



a) b)

Key

A locking means

B cable lug or bar

E fixed part

F stud

For this type of terminal, a spring washer or equally effective locking means shall be provided and the surface within the clamping area shall be smooth.

For certain types of equipment, the use of lug terminals of sizes smaller than that required is allowed.

Figure C.4 – Examples of lug terminals

Annex D
(normative)

Number of samples for full test procedure

Table D.1 – Number of samples for full test procedure

Test sequence	Number of samples
A	1
B	3
C	3
D	3
E	3
F	3
G	3
H	3
I	3

Table D.2 – Additional tests for POP already fully tested together with one kind of main protective device

POP already tested with	Additional test sequences with other main protective devices, according to subclause(s)		
	Circuit breakers	**RCBO**	**RCCB**
Circuit breakers		6 9.3 9.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.10 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]	6 9.3 9.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.10 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]
RCBO	6 9.3 9.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]		6 9.3 9.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]
RCCB	6 9.3.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]	6 9.3.4 9.6 [a] 9.7 [a] 9.8 [a] 9.9 [a] 9.12 [a] 9.13 [a] 9.14 [a] 9.15 [a] 9.16 [a] 9.17 [a]	

[a] For tests 9.6, 9.7, 9.8, 9.9, 9.12, 9.13, 9.14, 9.15, 9.16 and 9.17, it is enough with performing the test on three samples in total, at least one per each MPD.

Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Annex I of the EC Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

Bibliography

EN 60085	Electrical insulation – Thermal evaluation and designation (IEC 60085)
HD 60364-4-41	Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock (IEC 60364-4-41)
EN 60112	Method for the determination of the proof and the comparative tracking indices of solid insulating materials (IEC 60112)
ISO/IEC Guide 2:2004	Standardization and related activities -- General vocabulary

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