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Titre

Title:

LOW VOLTAGE POWER SUPPLIES, D.C. OUTPUT – Part 7: Safety Requirements

Note d'introduction

Introductory note

This document has the status of a draft product standard for Safety.
It has been prepared by 22E/WG2. It takes into account the comments by National committees received with document 22E/86/RVN

These comments were treated by 22E/WG2, in accordance with the decisions taken at the meeting of SC22E in February 2001 in London (BSI) UK (22E/85/RM, clause X b)

It is circulated at the same time as 22E/87/NP

ATTENTION	ATTENTION
CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)	**Parallel IEC CDV/CENELEC Enquiry**

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW VOLTAGE POWER SUPPLIES, DC OUTPUT –

Part 7: Safety Requirements

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61204-7 has been prepared by subcommittee 22E: Stabilized power supplies , of IEC technical committee 22: Power electronic systems & equipment.

IEC 61204-7 has the status of a product standard.

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

FDIS	Report on voting
22E/XX/FDIS	22E/XX/RVD

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

The committee has decided that this publication remains valid until 3 years from the publication date. At this date, in accordance with the committee's decision, the publication will be :

- Reaffirmed,
- Withdrawn,
- Replaced by a revised edition, or
- Amended.

Annexes A, B, C, D, E, F, G, J, K, M, N, P, U, V, Y, PS-A, PS-B (under consideration), PS-C (reserved for future use), PS-D and PS-E form an integral part of this standard.

Annexes Q, R, S, T, W, X and PS-F are for information only.

IEC 61204 consists of the following parts, under the general title: Low voltage power supplies, DC output

Part 1: Terms and definitions

Part 2: Performance characteristics

Part 3: Electromagnetic compatibility (EMC)

Part 4: Tests other than EMC

Part 5: Measurement of the magnetic component of the reactive near field.

Part 6: Requirements for low-voltage power supplies of assessed performance

Part 7: Safety Requirements

NOTE Some parts may not yet be available.

This standard IEC 61204-7 makes reference to the standard IEC60950 Edition 3 or IEC 60950-1 Edition 1 in the form of “clause number/RD”. In this context, “RD” means “Reference Document” i.e. IEC60950 Edition 3 or IEC 60950-1 Edition 1. Wherever the word equipment occurs in this reference document, this means POWER SUPPLY.

In this standard, the following print types are used:

– Requirements proper and normative annexes: in roman type.
– *Compliance statements and test specifications: in italic type.*
– Notes and other informative matter: in smaller roman type.
– Normative conditions within tables: in smaller roman type.
– Terms that are defined in 1.2: SMALL CAPITALS.

LOW VOLTAGE POWER SUPPLIES, DC OUTPUT –

Part 7: Safety Requirements

0 Principles of Safety

The principles of clause 0/RD apply.

1 General

1.1 Scope

1.1.1 Equipment covered by this standard.

This part of IEC 61204 specifies the safety requirements for POWER SUPPLY units ~~(PSUs)~~ providing DC output(s) with or without auxiliary AC output(s) operating from AC or DC source voltages up to 600 V a.c. or 1 000 V d.c. (See exceptions in 1.1.3).

NOTE Ringing Generators used in Telecoms applications are covered by this standard.

This product standard covers both STAND-ALONE and COMPONENT POWER SUPPLY units as defined in this document. POWER SUPPLY units, which comply with the main body of this standard, satisfy the requirements of POWER SUPPLY units for use in IT equipment normally covered by IEC60950 Edition 3 or IEC 60950-1 Edition 1. power supply units will also comply with the appropriate standard or application requirements given below if they also meet the additional requirements of the appropriate annex.

PS-A Measurement, control and laboratory equipment - normally covered by IEC 61010-1.
PS-B Medical equipment - normally covered by IEC 60601-1 (under development).
PS-C Reserved for future use.
PS-D Audio, Video and similar electronic apparatus - normally covered by IEC 60065.
PS-E dc power and distribution equipment.
This standard also covers DC-DC converters.
Where no standards exist, use of this standard for other applications is not precluded.

1.1.2 Additional requirements

Requirements additional to those specified in this standard may be necessary for:

– power supplies intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres);

– equipment intended to be used in vehicles, on board ships or aircraft, or in tropical countries;

– equipment intended for use where ingress of water is possible; for guidance on such requirements and on relevant testing, see annex T/RD.

NOTE 1 Attention is drawn to the fact that authorities in some countries impose additional requirements for health, environmental and similar reasons.

NOTE 2 Power supplies for use in power installations may have to meet additional requirements of IEC 62103.

1.1.3 Exclusions

This standard does not apply to:

– motor-generator sets;

– uninterruptible power supplies (UPS) to IEC 62040;

– POWER SUPPLIES covered by IEC 61558 (i.e. power supply units incorporating safety isolating transformers providing **SELV** or **PELV** output(s) in accordance with IEC 60364-4-41 and POWER SUPPLIES for use with household and other consumer products, except those covered by IEC 60065 and IEC 60950.

– Transformers covered by IEC 61558;

– Step-down converters covered by IEC 61046;

– POWER SUPPLIES and converters for use with or in products covered by IEC 61347-2-2.

1.2 Definitions

The provisions of clause 1.2/RD apply with the addition of:

Definition in alphabetical order of nouns

Current, output short circuit	1.2.1.108
Current limit, output	1.2.1.107
Current, rated output	1.2.1.102
Current range, rated output	1.2.1.103
Equipment, DC power and distribution	1.2.100.3
Frequency, rated output	1.2.1.104
Frequency range, rated output	1.2.1.105
Mains output, auxiliary	1.2.8.100
Power, rated output	1.2.1.106
Power supply	1.2.100.1
Power supply, component	1.2.100.2
Power supply, stand-alone	1.2.100.4
Voltage, rated output	1.2.1.100
Voltage range, rated output	1.2.1.101

The definition of SELV CIRCUIT in this standard is that defined in IEC 60950 and not that in IEC 60364-4-41.

1.2.100 Equipment

1.2.100.1
power supply
an electrical or electronic device which transforms electrical power into single or multiple power outputs. It may also isolate, regulate and/or convert the power. This may consist of one or more individual power supplies with associated circuitry and hardware

1.2.100.2
component power supply
a power supply which may not comply with some of the requirements of the standard such as enclosure requirements. This type of power supply is intended for incorporation within an end product, which in turn complies with all the requirements of the end product standard.

1.2.100.3
DC power and distribution equipment
an equipment to supply DC power to communication equipment; and normally consisting of batteries, power supplies, control and monitoring circuits, and distribution panels all interconnected to provide isolated secondary circuit power to IT equipment loads. Components within this system are normally installed in racks, cabinets, or other structures

1.2.100.4
stand-alone power supply
a power supply that in itself is an end use product

1.2.1.100
rated output voltage
the output voltage as declared by the manufacturer

1.2.1.101
rated output voltage range
the output voltage range as declared by the manufacturer, expressed by its lower and upper rated output voltages

1.2.1.102
rated output current
the output current as declared by the manufacturer

1.2.1.103
rated output current range
the output current range as declared by the manufacturer, expressed by its lower and upper rated output currents

1.2.1.104
rated output frequency
the output frequency as declared by the manufacturer

1.2.1.105
rated output frequency range
the output frequency range as declared by the manufacturer, expressed by its lower and upper rated output frequencies

1.2.1.106
rated output power
the continuous or average total output power as specified by the manufacturer

1.2.1.107
output current limit
the maximum current obtainable from an output with the other outputs, if any, loaded to minimum or no load conditions

1.2.1.108
output short circuit current
the current resulting from a direct short circuit across the output with the other outputs, if any, loaded to minimum or no load conditions.

1.2.8.100
auxiliary mains output
an AC output which is either directly connected or via EMC filtering components, AC switches or fuses to the ac mains supply.

1.3 General requirements

The provisions of 1.3/RD apply.

1.4 General conditions for tests

The provisions of 1.4/RD apply with the addition of:

1.4.100 Output loading

For tests involving the determination of working voltages, selv circuits and tnv circuits, it is important to conduct investigative testing between zero load and 10% of full rated load, or in some cases between zero and full rated load depending on the power supply topology, to determine the worst case. If the manufacturer specifies a minimum load in the user guide, then this consideration may not be necessary.

NOTE Typical output averaging filter chokes go off-load or lose control between zero and 10 % of the full rated load and can cause outputs to no longer meet the requirements of selv circuits or tnv circuits under certain conditions. This phenomenon can also cause problems with control loops.

1.4.101 If the output voltage is controlled by any means accessible to the operator, the tests shall be conducted at the worst case voltage level(s) permitted by the control means.

1.4.4.100 A component power supply is normally tested on the bench unless instructed by the manufacturer to test in the end product or in an enclosure simulating end usage.

1.4.5.100 For power supplies using DC input, if the voltage range is not specified, the tolerance shall be taken as + 20% and -15%.

1.4.5.101 In determining the most unfavourable input voltage, consideration shall be given to the test being conducted. power supplies that are rated for operation on both AC and DC inputs, shall be tested using both AC and DC supplies.

NOTE For some products and tests the worst case input voltage may be the minimum value e.g., for heating test.

1.4.6.100 For touch currents and protective conductor currents, the test shall be conducted at the upper limit of the rated frequency range. Where facilities are unavailable to provide the required higher frequency ac mains supply, it is permitted to measure the values at any available frequency within the specified rated frequency range, and scale these valuse using the formula:

$$I_{HF} = I_M \times FH / FM$$

where

I_{HF} = current at the highest frequency within the specified range

I_M = current measured at the available frequency within the specified range

FH = highest frequency within the specified range

FM = available frequency within the specified range

1.4.10.100 For determining the input current, all outputs including auxiliary mains outputs and AC outputs (ringing generators) shall be loaded to their rated values.

1.4.12.100 When conducting the heating test, consideration shall be given to the clearance around ventilation openings as specified by the manufacturer and to the various permitted orientations of the power supply in application, irrespective of whether integral fans are fitted.

If the rated ambient is above 50 °C, the heating test (see 4.5.1/RD) shall be conducted at the rated ambient.

1.4.14.100 Consideration shall be given to the permitted orientations of the power supply and the effects of any forced airflow during abnormal testing. In all cases, the electric strength tests of 5.3.8.2/RD shall be carried out.

1.4.14.101 When a manufacturer specifies a minimum load for an output, disconnection of the minimum load is considered a single fault.

1.5 Components

The provisions of 1.5/RD apply with the addition of:

1.5.100 Electrolytic capacitors

Electrolytic capacitors shall have adequate clearances for venting in accordance with the capacitor manufacturer’s specifications.

1.5.101 AC Mains supply connected transformers

Transformers intended to be connected directly, or via EMC filtering components, AC switches or fuses, to the ac mains supply, and which meet the requirements of IEC61558, are considered acceptable. Acceptability of the combination is to be determined in the application.

1.5.7.1.100 Where a Y1 capacitor is used to bridge double or reinforced insulation and its insulating coating is used to provide reinforced insulation, the capacitor shall comply with the requirements for reinforced insulation between the terminals and the body.

1.6 Power interface

The provisions of 1.6/RD apply.

1.6.2.100 The outputs shall be loaded within the manufacturers specified ratings to provide the maximum input current.

1.7 Marking and instructions

The provisions of 1.7/RD apply with the addition of:

1.7.1.100 DC outputs and AC auxiliary outputs of stand-alone power supplies must be marked with polarity, voltage and current ratings. In addition AC auxiliary outputs shall be marked with the frequency if different from the input frequency. This information may be provided in the instructions if the output appears on a polarized connector.

1.7.1.101 Component power supplies shall be provided with at least the following information for input and output as applicable, either on the power supply or in the installation instructions or data sheets or specifications.

– rated voltage(s) or rated voltage range(s)/ rated current(s) or rated current range(s)
– for DC only, symbol or notation “d.c.” for the nature of the voltage
– rated frequency or rated frequency range(s)
– rated maximum ambient temperature if greater than 25OC, or operating conditions, e.g. maximum base plate temperature.
– output current limit(s)
– output short circuit current(s)
– rated maximum output power where it is less than the sum of the individual maximum rated output powers
– symbol or notation “double insulated” for Class II power supply
– requirement for overcurrent protection if not provided as an integral part of the power supply
– terminal or pin-out identification
– information about the airflow, if applicable

NOTE Optional output level information may be provided as per Annex PS-F.

The following shall be marked on the power supply:

– manufacturer’s identification
– manufacturer’s model or type reference

NOTE The following table describes if a particular requirement can be in the form of markings and/or installation instructions.

Information	Power Supply Type

	Stand-alone	Component
Rated voltage	M 1	M or D 2
For DC only	M	M or D
Rated frequency	M	M or D
Rated maximum ambient	M or D	M or D
Output current limit(s)	M or D	M or D
Rated maximum output	M	M or D
Symbol for double insulation	M	M
Requirement for over-current	M or D	M or D
Terminal or pin-out	M or D3	M or D
DC polarity	M	M or D
AC auxiliary out frequency	M	M or D
Manufacturer's identification	M	M
Model or type reference	M	M

1 M marked on product

2 D installation instructions or data sheets

3 If output connector is polarized, information may be in the instruction or data sheets.

1.7.7.1.100 The symbol ⏚ (IEC 60417, No. 5019) shall be used only for the main protective earthing terminal.

1.7.7.2.100 The input terminals of component power supplies shall be identified. For DC inputs, the polarity shall be identified.

2 Protection from hazards

The provisions of 2/RD apply with the following additions:

2.1 Protection from electric shock and energy hazards

The provisions of 2.1/RD apply, except in the case of component power supplies, and with the following addition:

2.1.1.7.100 The input discharge test shall be carried out at maximum input voltage including the tolerance and at the most unfavourable loading condition, which is usually no load. If a resistor is provided to comply with the requirements of 2.1.1.7./RD, an overcurrent protective device, if provided, shall not be wired between the capacitor and resistor.

2.2 SELV circuits

The provisions of 2.2/RD apply with the following additions:

2.2.2.100 An SELV CIRCUIT shall remain an SELV CIRCUIT over its rated output current range and shall take into account the interactive effects of any other outputs operating within their rated output current ranges.

2.3 TNV circuits

The provisions of 2.3/RD apply to outputs designated as tnv circuits with the following note.

NOTE For 2.3.1. - The ringing signal may be generated within the power supply and the uncadenced (uninterrupted) signal may be on internal and/or external circuits. The separation of these circuits from other circuits is as follows:

Separation of Ringing Circuits from other Circuits

Type of circuit	Required separation
Primary	2.3.3./RD
TNV-2, TNV-3	Not required - test as Annex M/RD
SELV, TNV-1, Accessible Conductive Parts	2.3.2./RD
Other circuits	2.3.4./RD

2.3.1.100 A TNV CIRCUIT shall remain a TNV CIRCUIT over its rated output current range and shall take into account the interactive effects of any other outputs operating within their rated output current ranges.

2.4 Limited current circuits

The provisions of 2.4/RD apply with the following provision (this provision has been incorporated into IEC 60950-1 Edition 1).

2.4.100 Alternatively, it is permitted to use the measuring instruments of annex D/RD instead of the non-inductive resistor of 2 000 Ω ± 10% mentioned in 2.4/RD. When using the measuring instrument of figure D.1/RD, the voltage U2 is measured and the current available from the limited current circuit is calculated by dividing the measured voltage U2 by 500. The calculated value shall not exceed 0,7 mA peak. When using the measuring instrument of figure D.2/RD, the measured value of the current shall not exceed 0,7 mA peak.

NOTE If one side of the limited current circuit has a conductive connection to earth then point B of the measuring circuit of figure D.1/RD should be connected to that point.

2.5 Limited power sources

The provisions of 2.5/RD apply.

2.6 Provisions for earthing and bonding

The provisions of 2.6/RD apply.

NOTE For component power supplies, when measuring the resistance of the protective bonding conductor, or measuring the voltage drop across the protective bonding conductor, the resistance should be less than 0,1Ω and the measured voltage drop should be less than 2,5 V.

2.7 Overcurrent and earth fault protection in primary circuits

The provisions of 2.7/RD apply.

2.8 Safety interlocks

The provisions of 2.8/RD apply.

2.9 Electrical insulation

The provisions of 2.9/RD apply.

2.10 Clearances, creepage distances and distances through insulation

The provisions of 2.10/RD apply.

3 Wiring, connections and supply

The provisions of 3/RD apply.

4 Physical requirements

The provisions of 4/RD apply with the following notes.

NOTE 1 For component power supplies 4.2.2/RD always applies and 4.2.3/RD is to be conducted if applicable.

NOTE 2 For component power supplies with thermoplastic enclosures which are operator accessible in the end product, 4.2.7/RD applies.

NOTE 3 Normally 4.2.8/RD, 4.2.9/RD, 4.3.7/RD, 4.3.10/RD, 4.3.11/RD, 4.3.12/RD and 4.3.13/RD do not apply to power supplies. However, component power supplies may be used in the end-use equipment for which one or more of these sections may apply. These clauses may also apply to stand alone power supplies.

NOTE 4 An example of the test equipment for conducting the test of 4.3.6/RD may be found in IEC 60065 figure 11.

5 Electrical requirements and simulated abnormal conditions

5.1 Touch current and protective conductor current

The provisions of 5.1/RD apply with the following additions and notes.

NOTE 1 Touch currents caused by Y capacitors are higher in IT power distribution systems than in TN or TT systems by a factor of $1+\sqrt{3}=2{,}73$.

NOTE 2 With reference to 5.1.6/RD, the touch current of a component power supply should be less than the values given in Table 5A.

5.2 Electric strength

The provisions of 5.2/RD apply.

5.3 Abnormal operating and fault conditions

The provisions of 5.3/RD apply with the following additions:

5.3.2.100 For the blocked airflow and locked rotor tests, the permitted orientations of the power supply in the application in question shall be taken into account.

5.3.1 Transformers

The provisions of 5.3.3/RD apply with following additions and notes:

5.3.3.100 The compliance criteria of 5.3.8.1/RD and 5.3.8.2/RD apply to 5.3.3/RD.

NOTE For integrated transformers in printed wiring boards the maximum temperature class of the printed wiring board material must be considered.

5.3.5.100 Sub-clause 5.3.5/RD applies to primary circuits also (this provision has been incorporated into IEC 60950-1 Edition 1).

5.3.2 Simulation of faults

The provisions of 5.3.6/RD apply with the addition of the following note:

NOTE When conducting tests on a component power supply, the protective device which protects it, whether this be the building installation protective device, one within the end equipment or one within the power supply itself, must be in the circuit.

5.3.8.1.100 During the tests

Fuses are not permitted to shatter or rupture their casing. Neither must their end caps become loose during the abnormal tests. Where fuses rated for AC are used in DC circuits, then the test shall be repeated 10 times using the DC supply, and shall pass the electric strength test between their end caps, using a test voltage as specified in table 5B/RD.

An electrolytic capacitor is permitted to vent if venting does not cause a safety hazard within the meaning of this standard.

Where thermal controls, thermistors and the like are relied upon for safety, they shall comply with the applicable IEC component standard or shall be tested in application in accordance with Annex K/RD. If they do not comply with the applicable IEC component standard or annex K/RD, then they shall be short circuited for all abnormal operating conditions.

Traces of printed circuit boards are not permitted to act as fuses. If the trace opens then it is to be linked out across the break and the test repeated. This process must be repeated until the test reaches an ultimate conclusion (without a trace opening).

NOTE - One method to determine whether fire or molten metal propagate beyond the EUT, is to conduct abnormal tests with the EUT covered with cheesecloth or tissue paper.

6 Connection to telecommunication networks

The provisions of 6.2/RD do not normally apply. The provisions of 6.1/RD and 6.3/RD apply only if the output of a power supply is intended to be connected directly to a telecommunication network. power supplies with outputs classed as tnv circuits must comply with 2.3/RD.

7 Connection to a cable distribution system

This clause is applicable to IEC60950-1 Edition 1 only, and applies solely to power supplies which may have a connection to cable distribution systems.

ANNEXES/RD

All the Annexes of the reference document apply with the exception of annexes H and L. Annex Y may be applicable but only when IEC 60950-1, Edition 1, is used.

Annex PS-A
(normative)

Requirements for power supply units for use in Electrical Equipment for Measurement, Control and Laboratory use

PS-A.1 General

Power supply units used in test and measurement, control and laboratory equipment shall comply with the additional requirements of this annex.

NOTE The following are the additional requirements to comply with IEC 61010-1 Edition 2. For the complete and actual text of the requirements, see IEC 61010-1 Edition 2. Some of the following requirements may not be applicable to component power supplies. However, consideration should be given to surfaces that may serve as enclosure in the end application. Alternatively, if a power supply unit is required to comply with IEC 61010-1 Edition 2 only, then the requirements of IEC 61010-1 Edition 2 alone may be used. However the power supply unit in that case may not comply with IEC 61204-7.

NOTE Stand alone power supplies having either hazardous voltage or hazardous energy level output terminals must comply with the requirements of Annex PS-A.

Comparison of IEC 61010-1 Edition 2 and IEC 61204-7 (based on the IEC60950 Edition 3 and IEC 60950-1 Edition 1)

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
1.1	Scope	1.1		
1.1.1	Equipment included in scope		PS-A.1.1.1	Replace “This part of IEC 61010-1” with “annex”. Add text “power supplies used with ” after “ safety requirements for”.
1.1.2	Equipment excluded from scope			Not applicable for power supplies.
1.1.3	Computing equipment		PS-A.1.1.3	Replace “standard” (2 places) with “annex” and add “power supplies for” before the word “computers”
1.2	Object	0		
1.3	Verification		PS-A.1.3	Replace “standard” with “annex” (2 places).
1.4	Environmental Conditions		PS-A.1.4	Similar to IEC 61204-7.
1.4.1	Normal environmental condition		PS-A.1.4.1	Replace “standard” with “annex”
1.4.2	Extended environmental conditions		PS-A.1.4.2	Replace “standard” with “annex”. Not in IEC 61204-7 – important factors: over-voltage categories III and IV; higher relative humidity and mains supply fluctuations in excess of +/- 10%.

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
2	Normative references	Annexes P, Q	Plus standards under comments	IEC 60027 IEC 60060 IEC 60335 IEC 60664-3 IEC 60707 IEC 60799 IEC 60947-1 IEC 60947-3 ISO 306:1994
3	Terms and definitions	1.2		
3.1.1	Fixed equipment		PS-A.3.1.1	
3.1.2	Permanently connected equipment	1.2.5.3		
3.1.3	Portable equipment	1.2.3.3		
3,1,4	Hand-held equipment	1.2.3.2		
3.1.5	Tool	1.2.7.4		
3.2.1	Terminal		PS-A.3.2.1	
3.2.2	Functional earth term.		PS-A.3.2.2*	*Without the note.
3.2.3	Protective conductor terminal		PS-A.3.2.3	
3.2.4	Enclosure	1.2.6.1		
3.2.5	Barrier		PS-A.3.2.5	
3.3.1	Rated (value)		PS-A.3.3.1	
3.3.2	Rating		PS-A.3.3.2	
3.4.1	Type test	1.2.13.1		
3.4.2	Routine test	1.2.13.3		
3.5.1	Accessible	1.2.7.1		
3.5.2	Hazard	0		Covered in “Principles of Safety”
3.5.3	Hazardous live		PS-A.3.5.3	

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
3.5.4	High integrity			Not applicable for power supplies
3.5.5	Mains	1.2.8.1 1.2.8.2*		*This applies to IEC 60950-1 only.
3.5.6	Mains circuit	1.2.8.2* 1.2.8.3**		*IEC 60950 **IEC 60950-1
3.5.7	Protective impedance			Not applicable for power supplies
3.5.8	Protective bonding	1.2.13.11		
3.5.9	Normal use	1.2.2.1		
3.5.10	Normal condition		PS-A.3.5.10	
3.5.11	Single fault condition		PSA-.3.5.11	
3.5.12	Operator		PS-A.3.5.12	
3.5.13	Responsible body		PS-A.3.5.13	
3.5.14	Wet location		PS-A.3.5.14	
3.6.1	Basic insulation	1.2.9.2		
3.6.2	Supplementary insulation	1.2.9.3		
3.6.3	Double insulation	1.2.9.4		
3.6.4	Reinforced insulation	1.2.9.5		
3.6.5	Pollution		PS-A.3.6.5	
3.6.6	Pollution degree		PS-A.3.6.6	
3.6.6.1	Pollution degree 1		PS-A.3.6.6.1	
3.6.6.2	Pollution degree 2		PS-A.3.6.6.2	
3.6.6.3	Pollution degree 3		PS-A.3.6.6.3	
3.6.7	Clearance	1.2.10.1		
3.6.8	Creepage distance	1.2.10.2		
4	Tests	1.4		

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
4.1	General	1.4.1 1.4.2		
4.2	Sequence of tests	1.4.3		
4.3.1	Environmental conditions		PS-A.4.3.1	
4.3.2	State of equipment	1.4.4		
4.3.2.1	Position of equipment	1.4.4		
4.3.2.2	Accessories			Not applicable for power supplies
4.3.2.3	Covers and removable parts	1.4.4		
4.3.2.4	Mains supply	1.4.5.101 1.4.5		
4.3.2.5	Input and output voltages	1.4.10.100		
4.3.2.6	Earth terminals	1.4.9		
4.3.2.7	Controls	1.4.4		
4.3.2.8	Connections		PS-A.4.3.2.8	Applicable to stand alone power supplies only.
4.3.2.9	Load on motors	1.4.4		
4.3.2.10	Output	1.4.100 1.4.101		
4.3.2.11	Duty cycle	1.4.4 1.7.3 4.5.1		
4.3.2.12	Loading and filling			Not applicable for power supplies
4.3.2.13	Heating equipment			Not applicable for power supplies
4.4	Testing in single fault condition	1.4.14		
4.4.1	General	1.4.14		
4.4.2	Application of fault conditions	1.4.14		
4.4.2.1	Protective impedance			Not applicable for power supplies
4.4.2.2.	Protective conductor		PS-A.4.4.2.2	

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
4.4.2.3	Equipment or parts for short term or intermittent operation	5.3.5 5.3.7 5.3.8		
4.4.2.4	Motors	5.3.2 Annex B		
4.4.2.5	Capacitors (motors)	Annex B8		
4.4.2.6	Mains transformers	5.3.3 Annex C		
4.4.2.6.1	Short circuit	5.3.3		
4.4.2.6.2	Overload	Annex C1		
4.4.2.7	Outputs	5.3		
4.4.2.8	Equipment for more than one supply		PS-A.4.4.2.8	
4.4.2.9	Cooling	5.3.1		
4.4.2.10	Heating devices			Not applicable for power supplies.
4.4.2.11	Insulation between circuits and parts	5.3.4		
4.4.2.12	Interlocks	2.8		IEC 61204-7 does not specify “high integrity” components. This may make IEC 61204-7 more onerous.
4.4.3	Duration of tests		PS-A.4.4.3	
4.4.3.1		5.3.7	PS-A.4.4.3.1	Wording in IEC 61010-1 is more specific. Thermal equilibrium.
4.4.3.2			PS-A.4.4.3.2	Thermal cutouts and similar
4.4.3.3			PS-A.4.4.3.3	Fuse characteristics
4.4.4	Conformity after application of fault conditions		PS-A.4.4.4	
4.4.4.1			PS-A.4.4.4.1	Conformity-shock
4.4.4.2			PS-A.4.4.4.2	Conformity-temp
4.4.4.3			PS-A.4.4.4.3	Conformity-fire

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
4.4.4.4			PS-A.4.4.4.4	Conformity-other hazards
5	Marking and documentation	1.7		
5.1	Marking	1.7		
5.1.1	Marking-general	1.7.1	Plus third paragraph of PS-A.5.1.1	
5.1.2	Identification	1.7.1		
5.1.3	Mains supply	1.7.1	Plus PS-A.5.1.3 Table PS-A1	Table 1 provides more symbols than IEC 61204-7
5.1.4	Fuses	1.7.6		
5.1.5	Terminals, connections and operating devices		PS-A.5.1.5	Applicable for stand alone power supplies only
5.1.5.1	Terminals		PS-A.5.1.5.1	
5.1.6	Switches and circuit breakers	1.5.1 3.4.2 3.4.5 3.4.8		
5.1.7	Equipment protected by double insulation or reinforced insulation	1.7.1		
5.1.8	Field wiring terminal boxes		PS-A.5.1.8	
5.2	Warning markings		PS-A.5.2	
5.3	Durability of markings		PS-A.5.3	Different solvent than IEC 61204-7, 1.7.13
5.4	Documentation		PS-A.5.4	
5.4.1	General		PS-A.5.4.1	More detailed than 1.7.2
5.4.2	Equipment ratings		PS-A.5.4.2	More detailed than 1.7.2
5.4.3	Equipment installation		PS-A.5.4.3	More detailed than 1.7.2
5.4.4	Equipment operation		PS-A.5.4.4	More detailed than 1.7.2
5.4.5	Equipment maintenance		PS-A.5.4.5	More detailed than 1.7.2

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
6	Protection against electric shock			
6.1	General			
6.1.1	Requirements	2		
6.1.2	Exceptions a) lamp sockets b) batteries c) terminals**	2.1.1.1	PS-A.6.1.2 PS-A.6.1.2 b) PS-A.6.1.2 c)	6.1.2 complete without section a). ** Terminals of this type are applicable to stand alone power supplies only
6.2	Determination of accessible parts	2.1.1.1		
6.2.1	Examinations	2.1.1.1		
6.2.2	Openings above parts that are hazardous live		PS-A.6.2.2	Has additional tests than IEC 61204-7
6.2.3	Openings for preset controls		PS-A.6.2.3	
6.3	Permissible limits for accessible parts	2.1.1.1 2.1.1.5	Port ion of PS-A.6.3	No energy hazard shall exist between an accessible part and earth or two accessible parts on the power supply within a distance of 1.8 m.
6.3.1	Values in normal condition			
6.3.1 a)	Voltage		PS-A.6.3.1 a)	IEC 61010-1 covers wet locations that are not covered by IEC 61204-7. For wet locations use IEC 61010-1, 6.3.1 a)
6.3.1 b)	Current		PS-A.6.3.1 (b)	
6.3.1 c)	Capacitance	2.4.2		
6.3.2	Values in single fault condition			
6.3.2 a)	Single fault – voltage	2.2.3 2.3.2	PS-A.6.3.2 a) *	* wet condition only.

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
6.3.2 b)	Single fault – current	2.4.2 5.1	PS-A.6.3.2 b) 1)*	5.1.7 is not applicable. The 5% earthing (leakage) conductor current is not permitted for permanently connected power supplies in IEC 61010-1. *Add the 3.5mA limit for permanently connected equipment and the measuring circuit for wet locations from 6.3.2 b) 1).
6.3.2 (c)	Capacitance (single fault)	2.4.2		IEC 61010-1 is less restrictive.
6.4	Protection in normal condition	1.3.2 2.2.2	PS-A.6.4*	*The paragraph in the text of 6.4 starting with “Conformity is checked. . .”
6.5	Protection in single fault condition	0.2.1 2.2.3		
6.5.1	Protective bonding	2.6.1		
6.5.1.1	Integrity of protective bonding	2.6.1 2.6.5.4 2.6.5.5 3.1.9	PS-A.6.5.1.1*	*Parts (a), (d), (e), (f), and (h) in the text of 6.5.1.1
6.5.1.2	Protective conductor terminal	2.6.4 3.3	PS-A.6.5.1.2*	*Table 2 of 6.5.1.2 specifying tightening torques.
6.5.1.3	Impedance of protective bonding of plug connected equipment	2.6.3.3* 2.6.3.4**	PS-A.6.5.1.3***	*IEC 60950 **IEC 60950-1 ***Test current is the larger of 25 A d.c. or a.c. r.m.s. or 2 times the current rating of the power supply.
6.5.1.4	Bonding impedance permanently connected equipment	2.6.3.3* 2.6.3.4**		*IEC 60950 **IEC 60950-1 IEC 61204-7 is more restrictive.
6.5.1.5	Indirect bonding for test and measurement equipment			Not applicable for power supplies.
6.5.2	Double insulation and reinforced insulation	2.9.5	PS-A.6.5.2*	*Refer to 6.7 and 6.8
6.5.3	Protective impedance	1.5.7		IEC 61204-7 more onerous.

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
6.5.4	Automatic disconnection of the supply		PS-A.6.5.4	
6.6	Connections to external circuits			
6.6.1	General	3.5		Rated conditions at terminals must align with power supply rating.
6.6.2	Terminals for external circuits		PS-A.6.6.2	For stand alone power supplies 6.6.2 is required but conflicts with IEC 60950 and IEC 60950-1. So in this case 6.6.2 takes precedence.
6.6.3	Circuits with terminals which are hazardous live	3.1.9 3.3.6	PS-A.6.6.3	For stand alone power supplies 6.6.3 is required but conflicts with IEC 60950. So in this case 6.6.3 takes precedence.
6.6.4	Accessible terminals for stranded conductors	3.3.8		
6.7	Clearances and creepage distances		PS-A.6.7	Different procedure than used in IEC 61204-7
6.7.1	General requirements			
6.7.1.1	Clearances	2.10.3		
6.7.1.2	Creepage distances	2.10.4		
6.7.2	Mains circuits	2.10.3 2.10.4		
6.7.3	Circuits other than Mains circuits			
6.7.3.1	Clearance values - General		PS-A.6.7.3.1	
6.7.3.2	Clearance values where Table 5 does not apply and for circuits in measurement category I		PS-A.6.7.3.2	
6.7.3.3	Creepage distance values		PS-A.6.7.3.3	
6.7.4 6.7.4.1 6.7.4.2	Measuring circuits			Not applicable for power supplies

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
6.8	Procedure for dielectric strength tests	5.2	PS-A.6.8	Different procedure than used in IEC61204-7 The test in IEC 61010--1 is not needed except for reduced clearance based upon homogenous construction that is not addressed in the main body of IEC 61204-7. If reduced clearances are usedrefer to IEC 61010-1, section 6.8.
6.8.1	Reference test earth		PS-A.6.8.1	
6.8.2	Humidity preconditioning		PS-A.6.8.2	
6.8.3	Conduct of tests		PS-A.6.8.3	
6.8.4	Voltage tests		PS-A.6.8.4	
6.8.4.1	Altitude correction of test voltages for checking clearances in homogeneous construction			Not acceptable for power supplies.
6.9	Constructional requirements for protection against electric shock			
6.9.1	General	1.3.2 2.9.1 2.10.5.2 3.1.3 3.1.9	PS-A.6.9.1 b)	
6.9.2	Enclosures of equipment with double insulation or reinforced insulation	1.2.4.2 2.2.3 2.9.5		Essentially covered by IEC 61204-7
6.9.3	Over-range indication		PS-A.6.9.3	May be applicable to stand alone power supplies.
6.10	Connection to mains supply source and conncections between parts of equipment			

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
6.10.1	Mains supply cords	3.2.5	PS-A.6.10.1 Parts b) and c)	
6.10.2	Fitting of non-detachable mains supply cords	3.2.6	PS-A.6.10.2* and Table PS-A11	*After the 25 times pull test, the cord anchorage is subjected for 1 minute to a torque of the value shown in Table 11.
6.10.3	Plugs and connectors	1.5.1 1.7.5 3.2.4 4.3.5		
6.11	Disconnection from supply source			
6.11.1	General	3.4.1		
6.11.1.1	Exceptions	3.4.1		IEC 61204-7 more onerous
6.11.2.	Requirements according to type of equipment			
6.11.2.1	Permanently connected equipment and multi-phase equipment	3.4.3		
6.11.2.2	Single phase cord-connected equipment	3.4.2 3.4.6		
6.11.2.3	Hazards arising from function			Not applicable for power supplies
6.11.3	Disconnecting devices	3.4.2		
6.11.3.1	Switches and circuit breakers	1.5.1 3.4.2 3.4.5 3.4.8		
6.11.3.2	Appliance couplers and plugs	1.5.1 3.2.4	PS-A.6.11.3.2 *	*Maximum cord length for portable equipment is 3 m.
7	Protection against mechanical hazards	4.4		
7.1	General	4.4.1	PS-A.7.1*	* Single fault condition shall be taken into account.
7.2	Moving parts	4.4.2		
7.3	Stability	4.1		

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
7.4	Provisions for lifting and carrying		PS-A.7.4	
7.5	Wall mounting	4.2.10	PS-A.7.5*	* Third and fourth paragraphs apply.
7.6	Expelled parts			Not applicable for power supplies.
8	Mechanical resistance to shock and impact		PS-A.8	
8.1	Enclosure rigidity test			
8.1.1	Static test		PS-A.8.1.1	
8.1.2	Dynamic test	4.2.5		
8.2	Drop test			
8.2.1	Equipment other than hand-held equipment and direct plug-in equipment		PS-A.8.2.1	8.2.1 covers power supplies up to 20 kg. and also up to 100 kg.
8.2.1.1	Corner drop test		PS-A.8.2.1.1	
8.2.1.2	Face drop test		PS-A.8.2.1.2	
8.2.2	Hand-held equipment and direct plug-in equipment	4.2.6	PS-A.8.2.2*	* If the minimum rated ambient is below 2°C, the test is conducted at the specified ambient.
9	Protection against the spread of fire	4.7		
9.1	Eliminating or reducing the sources of ignition within the equipment	4.7.1 4.7.2.1		IEC 61204-7 is more onerous.
9.2	Containment of fire within the equipment, should it occur	4.7.1 4.7.2	PS-A.9.2 b)*	* Clause 9.4 is not applicable
9.2.1	Constructional requirements	4.6.2 4.7.3	PS-A.9.2.1a) PS-A.9.2.1 b) Figure PS-A6	
9.3	Limited energy circuit	2.5		Essentially the same as IEC 61204-7.

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
9.4	Requirements for equipment containing or using flammable liquids			Not applicable for power supplies
9.5	Overcurrent protection	2.7		
9.5.1	Permanently connected equipment	2.7.1		
9.5.2	Other equipment		PS-A.9.5.2	
10	Equipment temperature limits and resistance to heat			
10.1	Surface temperature limits for protection against burns		PS-A.10.1 Table PS-A15	
10.2	Temperatures of windings	4.5.1 5.3.8.1 Annex C.1	PS-A.10.2*	*Minimum ambient is 40° (C) A max temperature of 300 degree C is permitted in IEC 61204-7 under single fault conditions but not in IEC 61010-1.
10.3	Other temperature measurements	4.5 and 5.3	PS-A.10.3*	*Part a), c), d) and e) of text of 10.3 . Part b) is not applicable to power supplies.
10.4	Conduct of temperature tests	1.4.12 1.4.13		Ambient is 40°C minimum.
10.4.1	Temperature measurement of heating equipment			Not applicable for power supplies
10.4.2	Equipment intended for installation in a cabinet or a wall		PS-A.10.4.2	
10.5	Resistance to heat		PS-A.10.5	
10.5.1	Integrity of clearances and creepage distances		PS-A.10.5.1	Distances measured when the power supply is hot.
10.5.2	Non-metallic enclosures	4.2.7	PS-A.10.5.2*	*Tests of PS-A.8.1.1 and PS-A.8.2.1 are repeated after the test of 4.2.7/RD.
10.5.3	Insulating material	4.5.2		

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
11 11.1 11.2 11.3 11.4	Protection against hazards from fluids			Not applicable for power supplies
11.5	Battery electrolyte		PS-A.11.5	
11.6	Specially protected equipment	Annex T	PS-A.6.8*	* Electric stregth test only
11.7 11.7.1 11.7.2 11.7.3 11.7.4	Fluid pressure and leakage			Not applicable for power supplies
12 12.1 12.2 12.2.1 12.2.2	Protection against radiation, including laser sources, and against sonic and ultrasonic pressure			Not applicable for power supplies
12.3	Ultraviolet (UV) radiation			Not applicable for power supplies
12.4	Microwave radiation			Not applicable for power supplies
12.5 12.5.1 12.5.2	Sonic and ultrasonic pressure			Not applicable for power supplies
12.6	Laser sources	4.3.13* 4.3.13.5**		*IEC 60950 **IEC 60950-1
13 13.1 13.2 13.2.1	Protection against liberated gases, explosion and implosion			Not applicable for power supplies
13.2.2	Batteries and battery charging		PS-A.13.2.2	
13.2.3	Implosion of cathode ray tubes			Not applicable for power supplies
13.2.4	Equipment rated for high pressure			Not applicable for power supplies
14	Components			

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
14.1	General	1.5.1 1.5.2		
14.2	Motors			
14.2.1	Motor temperatures	Annex B3		Mininum ambient is 40° C
14.2.2	Series excitation motors			Not applicable for power supplies
14.3	Overtemperature protection devices	Annex K		
14.4	Fuse holders	2.1.1.1 b)		
14.5	Mains voltage selecting devices		PS-A.14.5	
14.6	High integrity components			Not used in IEC 61204-7. Not applicable to power supplies.
14.7	Mains transformers tested outside equipment	5.3.3 Annex C		
14.8	Printed circuit boards		PS-A.14.8	All pwbs must be rated FV-1(V-1.)
14.9	Circuits or components used as transient overvoltage limiting devices			Not permitted by IEC 61204-7 in the primary circuit.
15	Protection by interlocks	2.8		
15.1	General	2.8.1 2.8.2		
15.2	Prevention of reactivating	2.8.3		
15.3	Reliability	2.8.4 2.8.7.2 2.8.7.3		
16 16.1 16.2	Test and measurement equipment			Not applicable for power supplies
Annex A	Measuring circuits for accessible current	Annex D	AnnexPS-A.4	
Annex B	Standard test finger	Fig.2A		Rigid finger is referenced in 2.1.1.1d)

Clause in IEC 61010-1	Topic	Clause in IEC 61204-7		Comments
		Main body	Annex PS-A	
Annex C	Measurement of clearances and creepage distances	Annex F		
Annex D	Parts between which insulation requirements are specified	2.2.3		IEC 61204-7 is more stringent
Annex E	Reduction of pollution degrees	2.10.7	Annex PS-A.E*	* Covered by IEC 61204-7 clause 2.10.7 except that for IEC 61010-1, coated PWBs are not acceptable for reducing pollution degree 3 to 1. Also coated PWBs tested to IEC 61204-7 clause 2.10.6 are not permitted to use the separation distances of table 2N for use in IEC 61010-1.
Annex F	Routine tests		Annex PS-A.F Annex PS-A.F1 Annex PS-A.F2* Annex PS-A.F3**	* Time is 2 seconds compared to 1 second for IEC 61204-7. **Not applicable to power supplies
Annex G	Leakage and rupture from fluids under pressure			Not applicable to power supplies
NOTE 1- Those clauses in the column for Annex PS-A will generally be added in their entirety with appropriate editing to Annex PS-A. If a portion of the clause is indicated, see Note 2. NOTE 2 - In the “comments” column, material marked with asterisk(s) is a brief summary of parts of clauses that are to be added to Annex PS-A.				

PS-A.1 Scope and Object

PS-A.1.1 Scope

PS-A.1.1.1 Power supplies included in scope

This annex specifies general safety requirements for power supplies intended for professional, industrial process, and educational use, any of which may incorporate computing devices, as defined in a) to d) below, when used under the environmental conditions of PS-A.1.4.

a) Electrical test and measurement equipment

   This is equipment which by electrical means tests, measures, indicates or records one or more electrical or non-electrical quantities, also non-measuring equipment such as signal generators, measurement standards, power supplies, transducers, transmitters, etc.

NOTE All indicating and recording electrical measuring instruments fall within the scope of IEC 61010-1 unless they are panel meters designed only for building-in to other equipment. Build-in panel meters are considered to be components, and only need to meet the relevant requirements of IEC 61010-1, or other standards, as part of the equipment into which they are built.

b) Electrical control equipment

This is equipment which controls one or more output quantities to specific values, with each value determined by manual setting, by local or remote programming, or by one or more input variables.

c) Electrical laboratory equipment

This is equipment which measures, indicates, monitors or analyses substances, or is used to prepare materials, and includes in vitro diagnostic (IVD) equipment

This equipment may also be used in areas other than laboratories, for example self-test IVD equipment may be used in the home.

d) Accessories intended for use with the above (e.g. sample handling equipment).

PS-A.1.1.3 Computing equipment

This annex applies to power supplies where these are used with computers, processors, etc. which form part of equipment within the scope of this standard or are designed for use exclusively with the equipment.

NOTE Computing devices and similar equipment within the scope of IEC 60950 or IEC 60950-1 and conforming to its requirements are considered to be suitable for use with equipment within the scope of this standard. However, some of the requirements of IEC 60950 or IEC 60950-1 for resistance to moisture and liquids are less stringent than those in this standard. If hazards from moisture or liquids could affect equipment that conforms to IEC 60950 or IEC 60950-1 and is used with equipment which conforms to this annex, the instructions for use should specify any additional precautions required.

PS-A.1.3 Verification

This annex also specifies methods of verifying, through inspection and type testing, that the power supply meets the requirements of IEC 61010-1.

NOTE Requirements for routine tests are given in annex PS-A.F.

PS-A.1.4 Environmental conditions

PS-A.1.4.1 Normal environmental conditions

This annex applies to power supplies designed to be safe at least under the following conditions:

a) indoor use;

b) altitude up to 2 000 m;

c) temperature 5 °C to 40 °C;

d) maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;

e) mains supply voltage fluctuations up to ±10 % of the nominal voltage;

f) Transient overvoltages typically present on the mains supply.

NOTE The normal level of transient overvoltages is impulse withstand (overvoltage) category II of IEC 60364-4-443.

g) applicable rated pollution degree.

PS-A.1.4.2 Extended environmental conditions

This annex applies to power supplies designed to be safe not only in the environmental conditions specified in PS-A.1.4.1, but also in any of the following conditions for which the power supply is rated by the manufacturer:

a) outdoor use;

b) altitude above 2000 m;

c) ambient temperatures below 5 °C or above 40 °C;

d) relative humidity above the levels specified in PS-A.1.4.1;

e) mains supply voltage fluctuations exceeding ±10 % of the nominal voltage.

PS-A.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this annex. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this annex are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60027, Letter symbols to be used in electrical technology

IEC 60050(151), International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices

IEC 60060, High-voltage test techniques

IEC 60335, Safety of household and similar electrical appliances

IEC 60664-3, Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings to achieve insulation coordination of printed board assemblies

IEC 60707, Methods of tests for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source

IEC 60799, Electrical accessories – Cord sets and interconnection cord sets

IEC 60947-1, Low-voltage switchgear and controlgear – Part 1: General rules

IEC 60947-3, Low-voltage switchgear and controlgear – Part 3: Switches, disconnecters, switch-disconnectors and fuse-combination units

ISO 306:1994, Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)

PS-A.3 Terms and definitions

Unless otherwise specified, values of "voltage" and "current" are the r.m.s. values of an alternating, direct or composite voltage or current.

Definition in alphabetical order of nouns

Barrier	PS-A.3.2.5
Body, responsible	PS-A.3.5.11
Category, overvoltage	PS-A.3.7.2
Category I, overvoltage	PS-A.3.7.2.1
Category II, overvoltage	PS-A.3.7.2.2
Category III, overvoltage	PS-A.3.7.2.3
Category IV, overvoltage	PS-A.3.7.2.4
Condition, Normal	PS-A.3.5.8
Condition, single fault	PS-A.3.5.9
Co-ordination, insulation	PS-A.3.7.1
Hazard	PS-A.3.5.2
Hazardous live	PS-A.3.5.3
Pollution	PS-A.3.7.3

Pollution degree	PS-A.3.7.4
Pollution degree 1	PS-A.3.7.4.1
Pollution degree 2	PS-A.3.7.4.2
Pollution degree 3	PS-A.3.7.4.3
Pollution degree 4	PS-A.3.7.4.4
Rated (value)	PS-A.3.3.1
Rating	PS-A.3.3.2
Terminal	PS-A.3.2.1
Terminal, functional earth	PS-A.3.2.2
Terminal, protective conductor	PS-A.3.2.3

PS-A.3.1.1 fixed power supplies
power supplies fastened to a support, or otherwise secured in a specific location (826-07-07).

PS-A.3.2.1 terminal
A component provided for the connection of a power supply to external conductors [IEV 151-01-03].

NOTE Terminals can contain one or several contacts and the term therefore includes sockets, connectors, etc.

PS-A.3.2.2 functional earth terminal
A terminal by which electrical connection is made directly to a point of measuring or control circuit or to a screening part and which is intended to be earthed for any functional purpose other than safety.

PS-A.3.2.3 protective conductor terminal
A terminal which is bonded to conductive parts of a power supply for safety purposes and is intended to be connected to an external protective earthing system.

PS-A.3.2.5 barrier
A part providing protection against direct contact from any usual direction of access.

NOTE Enclosures and barriers may provide protection against the spread of fire (see PS-A.9.2.1 b)).

PS-A.3.3.1 rated (value)
A quantity value assigned, generally by a manufacturer, for a specified operating condition of a component power supply or stand alone power supply [IEV 151-04-03].

PS-A.3.3.2 rating
Set of rated values and operating conditions [IEV 151-04--04].

PS-A.3.5.3 hazardous live
Capable of rendering an electric shock or electric burn in normal condition or single fault condition.

NOTE See PS-A.6.3.1 a) and b) for values applicable to normal condition and PS-A.6.3.2 a) and b) for the higher values deemed to be appropriate in single fault condition.

PS-A.3.5.10 normal condition
Condition in which all means for protection against hazards are intact.

PS-A.3.5.11 single fault condition
Condition in which one means for protection against hazard is defective or one fault is present which could cause a hazard.

NOTE If a single fault condition results unavoidably in another single fault condition, the two failures are considered as one single fault condition

PS-A.3.5.12 operator

Person operating the power supply for its intended purpose.

NOTE The operator should have received training appropriate for this purpose.

PS-A.3.5.13 responsible body
Individual or group responsible for the use and maintenance of the power supply and for ensuring that operators are adequately trained.

PS-A.3.5.14 wet location
Location where water or another conductive liquid may be present and is likely to cause reduced human body impedance due to wetting of the contact between the human body and the equipment, or wetting of the contact between the human body and the environment.

PS-A.3.6.5 pollution
Addition of foreign matter, solid, liquid or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity.

PS-A.3.6.6 pollution degree

For the purpose of evaluating spacings, the following degrees of pollution in the micro-environment are defined.

PS-A.3.6.6.1 pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

PS-A.3.6.6.2 pollution degree 2

Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

PS-A.3.6.6.3 pollution degree 3

Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected.

NOTE In such conditions, power supplies are normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

PS-A.4.3.1 Environmental conditions

Unless otherwise specified in this standard, the following environmental conditions shall exist in the test location:

a) a temperature of 15 °C to 35 °C;

b) a relative humidity of not more than 75 %, but not exceeding the limits of PS-A.1.4.1 d);

c) an air pressure of 75 kPa to 106 kPa;

d) no hoar-frost, dew, percolating water, rain, solar radiation, etc.

PS-A.4.3.2.8 Connections

The power supply shall be connected for its intended purpose, or not connected.

PS-A.4.4.2.2 Protective conductor

The protective conductor shall be interrupted, except for permanently connected power supplies or power supplies utilizing a connector in accordance with IEC 60309.

PS-A.4.4.2.8 power supplies for more than one supply

power supplies which are designed to be operated from more than one type of supply shall be simultaneously connected to these supplies, unless this is prevented by the construction.

PS-A.4.4.3 Duration of tests

PS-A.4.4.3.1 The power supply shall be operated until further change as a result of the applied fault is unlikely. Each test is normally limited to 1 h since a secondary fault arising from a single fault condition will usually manifest itself within that time. If there is an indication that a risk of electric shock, spread of fire or injury to persons may eventually occur, the test shall be continued until one of these hazards does occur or for a maximum period of 4 h, unless a hazard occurs before then.

PS-A.4.4.3.2 Where a device which interrupts or limits the current during operation is included to

limit the temperature of parts which can easily be touched, the maximum temperature attained by the
power supply shall be measured, whether the device operates or not.

PS-A.4.4.3.3 If a fault is terminated by the opening of a fuse and if the fuse does not operate within approximately 1 s, the current through the fuse under the relevant fault condition shall be measured. Evaluation with the pre-arcing time/current characteristics shall be made to find out whether the minimum operating current of the fuse is reached or exceeded and what is the maximum time before the fuse operates. The current through the fuse may vary as a function of time.

If the minimum operating current of the fuse is not reached in the test, the power supply shall be operated for a period corresponding to the maximum fusing time or continuously for the duration specified in PS-A.4.4.3.1.

If a fault is terminated by the opening of a fuse and if the fuse does not operate within approximately 1 s, the current through the fuse under the relevant fault condition shall be measured. Evaluation with the pre-arcing time/current characteristics shall be made to find out whether the minimum operating current of the fuse is reached or exceeded and what is the maximum time before the fuse operates. The current through the fuse may vary as a function of time.

If the minimum operating current of the fuse is not reached in the test, the power supply shall be operated for a period corresponding to the maximum fusing time or continuously till the conditions stabilize.

PS-A.4.4.4 Conformity after application of fault conditions

PS-A.4.4.4.1 Conformity with requirements for protection against electric shock is checked after the application of single faults as follows:

a) by making the measurements of PS-A.6.3.2 a) and b) to check that no accessible conductive parts have become hazardous live;
b) by performing a voltage test on double insulation or reinforced insulation to check that there is still one level of protection by insulation. The voltage test is made as specified in PS-A.6.8 (without conformity preconditioning) with the test voltage for basic insulation.
c) by measuring the temperature of transformer windings if the protection against electrical hazards is achieved by double insulation or reinforced insulation within the transformer. The temperatures of 5.3.8.1/RD shall not be exceeded.

PS-A.4.4.4.2 Conformity with requirements for temperature protection is checked by determining the temperature of the outer surface of the enclosure and of parts which can easily be touched.

Except for heated surfaces of heating equipment, the temperature of these parts shall not exceed 105 °C at an ambient temperature of 40 °C or the maximum rated ambient temperature if higher.

This temperature is determined by measuring the temperature rise of the surface or part and adding it to 40 °C or the maximum rated ambient temperature if higher.

PS-A.4.4.4.3 Conformity with requirements for protection against the spread of fire is checked by placing the power supply on white tissue-paper covering a softwood surface and covering the power supply with cheesecloth. No molten metal, burning insulation, flaming particles, etc. shall fall on the surface on which the power supply stands and there shall be no charring, glowing, or flaming of the tissue paper or cheesecloth. Melting of insulation material shall be ignored if no hazard could arise.

PS-A.4.4.4.4 Conformity with requirements for protection against other hazards is checked as specified in PS-A.7.1, PS-A.8, PS-A.11.5, PS-A.14.5 and PS-A.14.8.

PS-A.5.1.1 General

Letter symbols for quantities and units shall be in accordance with IEC 60027. Graphic symbols shall be in accordance with Table PS-A1 if applicable. There are no colour requirements for symbols. Graphic symbols shall be explained in the documentation.

NOTE Markings should not be on the bottom of the power supply, except where space is limited.

Conformity is checked by inspection.

PS-A.5.1.3 Mains supply

The power supply shall be marked with the following information:

a) nature of supply:
   1) a.c.: rated mains frequency or range of frequencies;
   2) d.c.: symbol 1 of Table PS-A1;

      NOTE 1 For information purposes it may be useful to mark:

   – power supplies intended for a.c. with symbol 2 of Table PS-A1;
   – power supplies suitable for both a.c. and d.c. with symbol 3 of Table PS-A1;
   – power supplies for three-phase supply with symbol 4 of Table PS-A1.

b) the rated value(s) of the supply voltage(s) or the rated range of the supply voltages;

   NOTE 2 rated voltage fluctuations may also be marked.

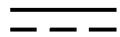
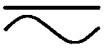
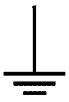
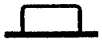
c) the maximum rated power in watts (active power) or volt-amperes (apparent power), or the maximum rated input current, with all accessories or plug-in modules connected. If the power supply can be used on more than one voltage range, separate values shall be marked for each voltage range unless the maximum and minimum values do not differ by more than 20 % of the mean value;

d) power supplies which the operator can set for different rated supply voltages shall be provided with means for the indication of the voltage for which the power supply is set. For portable power supplies the indication shall be visible from the exterior. If the power supply is so constructed that the supply voltage setting can be altered without the use of a tool, the action of changing the setting shall also change the indication;

e) accessory mains socket-outlets accepting standard mains plugs shall be marked with the voltage if it is different from the mains supply voltage. If the outlet is for use only with specific equipment, it shall be marked to identify the equipment for which it is intended. If not, the maximum rated current or power shall be marked, or symbol 14 of Table PS-A1 placed beside the outlet with the full details included in the documentation.

   Conformity is checked by inspection and by measurement of power or input current to check the marking of PS-A.5.1.3 c)). The measurement is made after the current has reached a stationary stage (usually after 1 min) so as to exclude any initial inrush current. The power supply shall be in the condition of maximum power consumption. Transients are ignored. The measured value shall not exceed the marked value by more than 10 %.

Table PS-A1 – Symbols

Number	Symbol	Publication	Description
1		IEC 60417, No. 5031	Direct current
2		IEC 60417, No. 5032	Alternating current
3		IEC 60417, No. 5033	Both direct and alternating current
4		IEC 60617-2, No.02-02-06	Three-phase alternating current
5		IEC 60417, No. 5017	Earth (ground) terminal
6		IEC 60417, No. 5019	Protective conductor terminal
7		IEC 60417, No. 5020	Frame or chassis terminal
8		IEC 60417, No. 5021	Equipotentiality
9		IEC 60417, No. 5007	On (Supply)
10		IEC 60417, No. 5008	Off (Supply)
11		IEC 60417, No. 5172	Power supplies protected throughout by double insulation or reinforced insulation
12			Caution, risk of electric shock
13		IEC 60417, No. 5041	Caution, hot surface
14			Caution , risk of danger (See note)
15		IEC 60417, No. 5268	In position of a bistable push control

16		IEC 60417, No. 5269	Out position of a bistable push control
NOTE See PS-A.5.4.1 which requires manufacturers to state that documentation must be consulted in all cases where this symbol is marked.			

PS-A.5.1.5 Terminals, connections and operating devices

If necessary for safety, an indication shall be given of the purpose of terminals, connectors, controls, and indicators, including any connections for fluids such as gas, water and drainage. Where there is insufficient space, symbol 14 of Table PS-A1 may be used.

NOTE 1 For additional information, see IEC 60445 and IEC 60447.

NOTE 2 Individual pins of multi-pin connectors need not be marked.

PS-A.5.1.5.1 Terminals

Terminals for connection to the mains supply shall be identifiable.

The following terminals shall be marked as follows:

a) functional earth terminals with symbol 5 of Table PS-A1;

b) protective conductor terminals with symbol 6 of Table PS-A1, except when the protective conductor terminal is part of an approved mains appliance inlet. The symbol shall be placed close to or on the terminal;

c) terminals of measuring and control circuits which are permitted by PS-A.6.6.3 to be connected to accessible conductive parts with symbol 7 of Table PS-A1 if this connection is not self-evident;

NOTE This symbol may also be considered as a warning symbol in that it indicates that a hazardous live voltage must not be connected to the terminal. The symbol should also be used if it is likely that the operator could make such a connection inadvertently.

d) terminals supplied from the interior of the equipment and which are hazardous live, with the voltage, current, charge or energy value or range, or with symbol 14 of Table PS-A1. This requirement does not apply to mains supply outlets where a standard mains socket outlet is used;

e) accessible functional earth terminals connected to accessible conductive parts, with an indication that this is the case, unless it is self-evident. Symbol 8 of Table PS-A1 is acceptable for this marking.

Conformity is checked by inspection.

PS-A.5.1.8 Field-wiring terminal boxes

If the temperature of the terminals or the enclosure of a field-wiring terminal box or compartment exceeds 60 °C in normal condition at an ambient temperature of 40 °C, or the maximum rated ambient temperature if higher, there shall be a marking of the minimum temperature rating of the cable to be connected to the terminals. The marking shall be visible before and during connection, or be beside the terminals.

Conformity, in case of doubt, is checked by measurement as specified in PS-A.10.3 a) and, if applicable, by inspection of markings.

PS-A.5.2 Warning markings

Warning markings shall be visible when the stand alone power supply (does not apply to component power supplies) is ready for normal use. If a warning applies to a particular part of the stand alone power supply, the marking shall be placed on or near to this part.

The size of warning markings shall be as follows.

a) Symbols shall be at least 2,75 mm high. Text shall be at least 1,5 mm high and contrasting in colour with the background.

b) Symbols or text moulded, stamped or engraved in a material shall be at least 2,0 mm high. If not contrasting in colour, they shall have a depth or raised height of at least 0,5 mm.

If it is necessary for the responsible body or operator to refer to the instruction manual to preserve the protection afforded by the power supply, the power supply shall be marked with symbol 14 of Table PS-A11. Symbol 14 is not required to be used with symbols which are explained in the manual.

If the instructions for use state that an operator is permitted to gain access, using a tool, to a part which in normal use may be hazardous live, there shall be a warning marking which states that the power supply must be isolated or disconnected from the hazardous live voltage before access.

Warning markings are specified in PS-A.5.1.5.1 c), PS-A.6.1.2 b), PS-A.6.6.2, 4.4.2/RD, 4.1/RD, PS-A.10.1, PS-A.13.2.2.

Conformity is checked by inspection.

PS-A.5.3 Durability of markings

Markings in accordance with 1.7.1/RD, PS-A.5.1.3, table PS-A1, PS-A.5.1.5, PS-A.5.1.5.1, PS-A.5.1.8 and PS-A.5.2 shall remain clear and legible under conditions of normal use and resist the effects of cleaning agents specified by the manufacturer.

Conformity is checked by inspection and by performing the following test for durability of markings on the outside of the powersupply. The markings are rubbed by hand, without undue pressure, for 30 s with a cloth soaked with the specified cleaning agent (or, if not specified, with isopropyl alcohol).

The markings shall be clearly legible after the above treatment, and adhesive labels shall not have worked loose or become curled at the edges

PS-A.5.4 Documentation

PS-A.5.4.1 General

Power supplies shall be accompanied by documentation for safety purposes as follows:

a) intended use of the power supply;

b) technical specification;

c) instructions for use;

d) name and address of manufacturer or supplier from whom technical assistance may be obtained;

e) the information specified in PS-A.5.4.2 to PS-A.5.4.5;

   not applicable to power supplies

f) not applicable to power supplies

   If applicable, warning statements and a clear explanation of warning symbols marked on the power supply shall be provided in the documentation or shall be durably and legibly marked on the power supply. In particular, there shall be a statement that documentation needs to be consulted in all cases where symbol 14 of Table PS-A1 is used, in order to find out the nature of the potential hazard and any actions which have to be taken.

Conformity is checked by inspection.

PS-A.5.4.2 Power supply ratings

Documentation shall include the following:

a) the supply voltage or voltage range, frequency or frequency range, and power or current rating;

b) a description of all input and output connections;

c) the rating of the insulation of external circuits, appropriate for single fault conditions, if such circuits are nowhere accessible (see PS-A.6.6.2);

d) a statement of the range of environmental conditions for which the equipment is designed (see PS-A.1.4);

e) a statement of the degree of protection, if the equipment is rated according to IEC 60529.

Conformity is checked by inspection.

PS-A.5.4.3 Power supply installation

The documentation shall include installation and specific commissioning instructions (examples are listed below) and if necessary for safety, warnings against hazards which could arise during installation or commissioning of the power supply:

a) assembly, location and mounting requirements;

b) instructions for protective earthing;

c) connections to the supply;

d) for permanently connected power supplies:

   1) supply wiring requirements;

   2) requirements for any external switch or circuit-breaker (see 3.4.3/RD) and external overcurrent protection devices (see 2.7.1/RD) and a recommendation that the switch or circuit-breaker be near the power supply;

e) ventilation requirements;

f) requirements for special services, for example air, cooling liquid;

g) not applicable

h) not applicable

i) not applicable

Conformity is checked by inspection.

PS-A.5.4.4 Power supply operation

Instructions for use shall include, if applicable:

a) identification of operating controls and their use in all operating modes;

b) an instruction not to position the power supply so that it is difficult to operate the disconnecting device;

c) instructions for interconnection to other equipment, including indication of detachable parts and any special materials;

d) specification of limits for intermittent operation;

e) an explanation of symbols related to safety which are used on the power supply;

f) not applicable;

g) not applicable;

h) not applicable

i) not applicable

There shall be a statement in the instructions that, if the power supply is used in a manner not specified by the manufacturer, the protection provided by the power supply may be impaired.

Conformity is checked by inspection.

PS-A.5.4.5 Power supply maintenance

Instructions for the responsible body concerning preventive maintenance and inspection necessary for safety shall be given in sufficient detail.

NOTE Instructions should advise the responsible body of any tests necessary to check that power supply is still in a safe condition. They should also warn against the repetition of any tests of this standard which could damage the power supply and reduce protection against hazards.

For power supplies using replaceable batteries, the specific battery type shall be stated.

The manufacturer shall specify any parts which are required to be examined or supplied only by the manufacturer or his agent.

The rating and characteristics of replaceable fuses shall be stated.

Conformity is checked by inspection.

PS-A.6.1.2 Exceptions (from protection against electric shock)

If it is not feasible for operating reasons to prevent the following parts being both accessible and hazardous live, they are permitted to be accessible to the operator during normal use while they are hazardous live:

a) parts of lamps and lamp sockets after lamp removal;
b) parts intended to be replaced by the operator (e.g. batteries) and which may be hazardous live during the replacement or other operator action, but only if they are accessible only by means of a tool and have a warning marking (see PS-A.5.2);
c) locking and screw-held type measuring terminals, including terminals which do not require the use of a tool.

If any of the parts in a) and b) receive a charge from an internal capacitor, they shall not be hazardous live 10 s after interruption of the supply.

If a charge is received from an internal capacitor, conformity is checked by the measurements of PS-A.6.3 to establish that the levels of 2.4.2/RD are not exceeded.

PS-A.6.2.2 Openings above parts that are hazardous live

A metal test pin 100 mm long and 4 mm in diameter is inserted in any openings above parts which are hazardous live. The test pin is suspended freely and allowed to penetrate up to 100 mm. The additional safety measures of PS-A.6.5. for protection in single fault condition are not required solely because a part is accessible by this test only. This test is not applied to terminals.

PS-A.6.2.3 Openings for pre-set controls

A metal test pin 3 mm in diameter is inserted through holes intended to give access to pre-set controls which require the use of a screwdriver or other tool. The test pin is applied in every possible direction through the hole. Penetration shall not exceed three times the distance from the enclosure surface to the control shaft or 100 mm, whichever is smaller.

PS-A.6.3 Permissible limits for accessible parts

The voltage, current, charge or energy between an accessible part and reference test earth, or between any two accessible parts on the same piece of equipment within a distance of 1,8 m (over a surface or through air), shall not exceed the values of PS-A.6.3.1 in normal condition nor of PS-A.6.3.2 in single fault condition.

PS-A.6.3.1 Values in normal condition

The following values apply to accessible circuits in wet locations only. The values for dry locations are covered by 2.2.2/RD.

Values above the following levels in normal condition are deemed to be hazardous live. The limits of PS-A.6.3.1 b) and c) apply only if the voltage exceeds the values of PS-A.6.3.1 a).

a) For power supplies rated for use in wet locations, the voltage levels are 16 V r.m.s. and 22,6 V peak or 35 V d.c.

b) The current levels are:

   1) 0,5 mA r.m.s. for sinusoidal waveforms, 0,7 mA peak for non-sinusoidal waveform or mixed frequencies, or 2 mA d.c., when measured with the measuring circuit of Figure D.1/RD. Alternatively the measuring circuit of Figure D.1/RD can be used if the frequency does not exceed 100 Hz.The measuring circuit of Figure PS-A.A.4 is used for power supplies rated for use in wet locations.

   2) 70 mA r.m.s. when measured with the measuring circuit of Figure D.1/RD. This relates to possible burns at higher frequencies.

c) Limits of 2.4.2/RD apply.

PS-A.6.3.2 Values in single fault condition

The following values apply to accessible circuits in wet locations only. The values for dry locations are covered by 2.2.3/RD.

Values above the following levels in single fault condition are deemed to be hazardous live. The limits of PS-A.6.3.2 b) and c) apply only if the voltage exceeds the values of PS-A.6.3.2 a).

a) For power supplies rated for use in wet locations, the voltage levels are 33 V r.m.s. and 46,7 V peak or 70 V dc. For temporary voltages, the levels are those of Figure PS-A1, measured across a 50 kΩ resistor (use curves A and C only in Figure PS-A1).

b) The current levels are:

   1) 3,5 mA r.m.s. for sinusoidal waveforms, 5 mA peak for non-sinusoidal waveforms or mixed frequencies, or 15 mA d.c., when measured with the measuring circuit of Figure D.1/RD. Alternatively, the measuring circuit of Figure D.1/RD can be used if the frequency does not exceed 100 Hz. The measuring circuit of Figure PS-A.A.4 is used for power supplies rated for use in wet locations;

c) Limits of 2.4.2/RD apply.

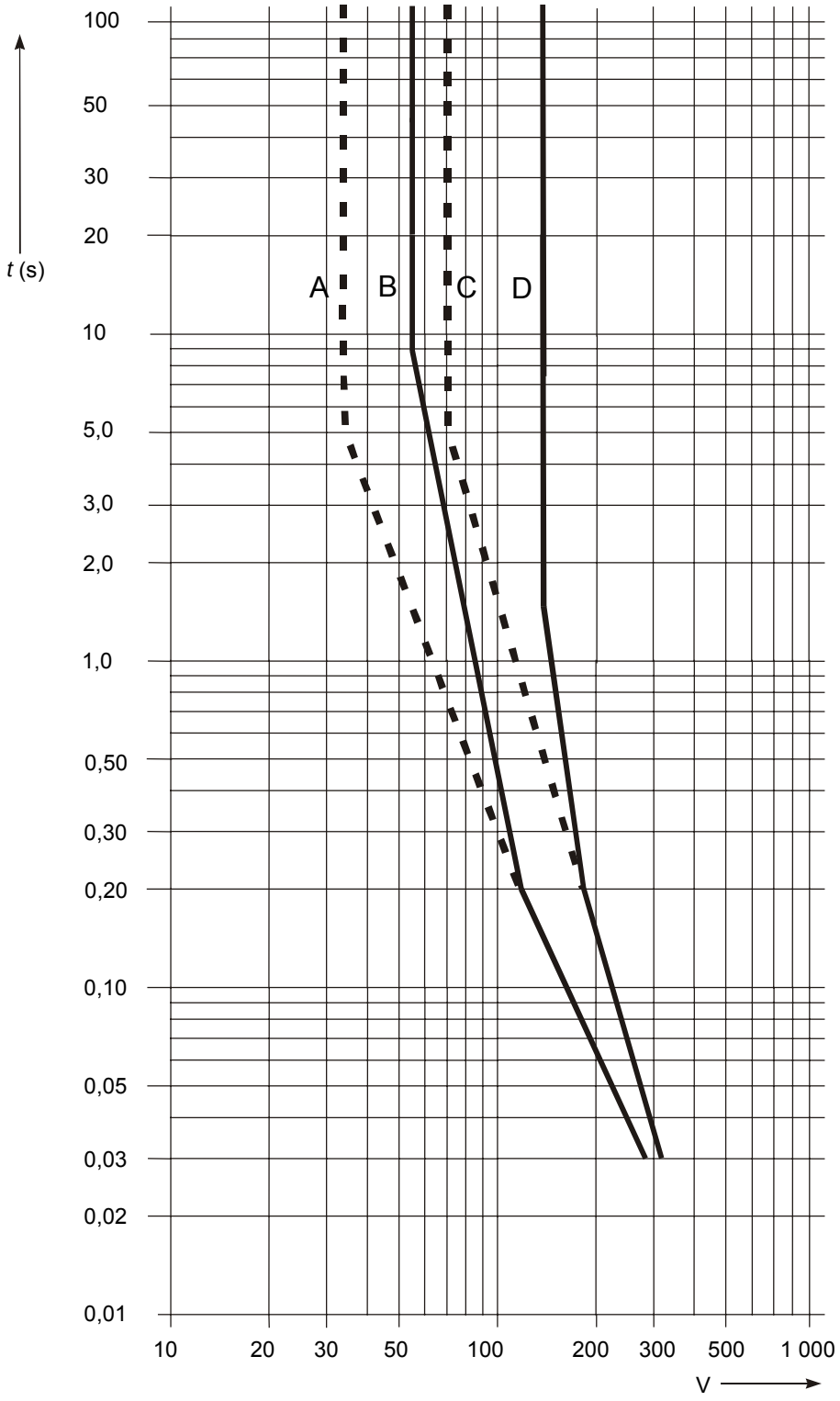


Figure PS-A1 – Maximum duration of short-term temporary accessible voltages in single fault condition (see PS-A.6.3.2 a))

PS-A.6.4 Protection in normal condition

Requirements of 2.1.1/RD apply.

Conformity is checked by:

1) the determination of 2.1.1/RD, PS-A.6.2.2 and PS-A.6.2.3, and the measurements of PS-A.6.3.1 a) and b), to establish that accessible conductive parts are not hazardous live;
2) inspection or measurement of clearances and creepage distances as specified in PS-A.6.7;
3) the tests of PS-A.6.8 for dielectric strength of basic insulation;
4) the tests of 4.2.5/RD and PS-A.8 for rigidity of enclosures and barriers.

PS-A.6.5.1.1 Integrity of protective bonding

The integrity of protective bonding shall be assured by the following means.

a) Protective bonding shall consist of directly connected structural parts or discrete conductors, or both. It shall withstand all thermal and dynamic stresses to which it could be subjected before one of the over-current protective means specified in 2.7/RD disconnects the equipment from the supply.
d) Movable conductive connections, for example, hinges, slides, etc., shall not be the sole protective bonding path unless they are specifically designed for electrical inter-connection and meet the requirements of PS-A.6.5.1.3.
e) The exterior metal braid of cables, even if connected to the protective conductor terminal, shall not be regarded as protective bonding.
f) If power from the mains supply is passed through power supply for use by other equipment, means shall also be provided for passing the protective conductor through the power supply to protect the other equipment. The impedance to the protective conductor path through the equipment shall not exceed that specified in PS-A.6.5.1.3.
h) Power supplies using protective bonding shall be provided with a terminal meeting the requirements of PS-A.6.5.1.2 and suitable for connection to a protective conductor.

Conformity is checked by inspection.

PS-A.6.5.1.2 Protective conductor terminal

j) If the protective conductor terminal is a binding screw it shall be of a suitable size for the bond wire, but no smaller than M 4 (No. 6), with at least three turns of the screw engaged. The contact pressure required for a bonding connection shall not be capable of being reduced by deformation of materials forming part of the connection.

Conformity is checked by inspection and by the following test. The assembly of a screw in a metal part or nut, together with the least favourable grounding conductor to be secured, and any associated conductor securing means shall withstand, without mechanical failure, three operations of assembly and disassembly when using the tightening torques specified in Table PS-A2.

Table PS-A2 – Tightening torque for screw assemblies

Size of screw (mm)	4,0	5,0	6,0	8,0	10,0
Tightening torque (N·m)	1,2	2,0	3,0	6,0	10,0

PS-A.6.5.1.3 Impedance of protective bonding

For power supplies rated 16 A or less, conformity is checked by applying a test current for 1 min and then calculating impedance. The test current is the greater of:

a) 25 A d.c. or a.c. r.m.s. at rated mains frequency;
b) a current equal to twice the rated current of the equipment.

If the power supply contains overcurrent protection devices for all poles of the mains supply, and if the wiring on the supply side of the overcurrent protection devices cannot become

connected to accessible conductive parts in the case of a single fault, the test current need not be more than twice the rated current of the internal overcurrent protection devices.

For power supplies rated above 16 A, 2.6.3.3 of IEC 60950 or 2.6.3.4 of IEC 60950-1applies.

PS-A.6.5.2 Double insulation and reinforced insulation

Clearances and creepage distances forming part of double insulation or reinforced insulation shall meet the applicable requirements of PS-A.6.7 (see 2.2.3/RD and 2.9.5/RD). Enclosures shall meet the requirements of 1.2.4.2/RD, 2.2.3/RD and 2.9.5/RD..

Solid insulation forming part of reinforced insulation shall pass the voltage test of PS-A.6.8 with the values for reinforced insulation.

Conformity is checked as specified in PS-A.6.7 (see 2.2.3/RD and 2.9.5/RD), PS-A.6.8 and 1.2.4.2/RD, 2.2.3/RD and 2.9.5/RD. The parts of double insulation are tested separately if this is possible; the tests for reinforced insulation are otherwise used. Clearances and creepage distances necessary for safety can be checked by measurement.

PS-A.6.5.4 Automatic disconnection of the supply

If automatic disconnection of the supply is used for protection in single fault condition, the automatic disconnection device shall meet all the following requirements.

a) It shall be supplied with the power supply or the installation instructions shall specify the device to be fitted as part of the installation.
b) It shall be rated to disconnect the load within the time specified in 2.4.2/RD for dry locations and Figure PS-A1 for wet locations.
c) It shall be rated for the maximum rated load conditions of the power supply.

Conformity is checked by inspection of the device specification and, if applicable, installation instructions. In case of doubt the device is tested to check that it disconnects the supply within the required time.

PS-A.6.6.2 Terminals for external circuits

This applies to stand alone power supplies only.

Terminals which receive a charge from an internal capacitor shall not be hazardous live 10 s after interruption of the supply.

Terminals which are energized from the interior, with hazardous live voltage exceeding 1 kV r.m.s. or 1,5 kV d.c., or with floating voltage exceeding 1 kV r.m.s. or 1,5 kV d.c., shall not be accessible. Power supplies with such terminals shall be designed so that an accessible hazardous live voltage is not present when connectors are not mated, or shall be marked with symbol 12 of Table PS-A1 (see PS-A.5.2) to warn the operator of the possible presence of an accessible hazardous live voltage.

Unmated measuring terminals which are hazardous live when the maximum rated voltage is applied to the terminal shall not be accessible.

NOTE For locking and screw-held terminals, see PS-A.6.1.2 c).

Conformity is checked by inspection, and by the determination of accessible parts as specified in PS-A.6.2.2 and PS-A.6.2.3.

PS-A.6.6.3 Circuits with terminals which are hazardous live

This applies to stand alone power supplies only.

These circuits shall not be connected to accessible conductive parts, except for circuits which are not mains circuits, and which are designed to be operated with one terminal contact at earth potential. In such cases, the accessible conductive parts shall not be hazardous live.

If such a circuit is also designed to be operated with one accessible terminal contact (signal low) floating at a voltage which is not hazardous live, this terminal contact is permitted to be connected to a common functional earth terminal or system (for example a coaxial screening system). This common functional earth terminal or system is also permitted to be connected to other accessible conductive parts.

Conformity is checked by inspection.

PS-A.6.7 Clearances and creepage distances

Clearances and creepage distances are specified in 2.10.3/RD, 2.10.4/RD, PS-A.6.7.3.1, PS-A.6.7.3.2 and PS-A.6.7.3.3 so as to withstand the voltages that appear on the system for which the power supply is intended. They also take account of rated environmental conditions and of any protective devices fitted within the power supply or required by the manufacturer's instructions.

There are no clearance or creepage distance requirements for the interior of void-free moulded parts, including the inner layers of multi-layer printed circuit boards.

Conformity is checked by inspection and measurement. When determining a clearance or creepage distance to accessible parts, the accessible surface of an insulating enclosure is considered to be conductive as if it was covered by metal foil wherever it can be touched with a standard test finger (see 2.1.1/RD). Conformity for homogeneous construction is checked as specified in PS-A.6.7.3.1 c).

PS-A.6.7.3 Circuits other than mains circuits

PS-A.6.7.3.1 Clearance values – general

This is permitted only if the secondary circuits are connected to protective earth or isolated from the primary circuit by a metal screen connected to protective earth. Otherwise, the requirements of 2.10.3/RD apply.

a) For circuits derived from mains circuits, clearances shall have the values as specified in Table PS-A5 except for the conditions specified in b) below.
b) Clearances for the following cases are specified in PS-A.6.7.3.2. Such cases include clearances where:
    1) means have been taken within the equipment which limit overvoltages to levels below the applicable impulse withstand voltage of Table PS-A5;
    2) the maximum possible transient overvoltage is above the applicable impulse withstand voltage of Table PS-A5;
    3) the working voltage is the sum of voltages from more than one circuit, or is a mixed voltage;
    4) it is controlled by the source (external to the equipment, but as specified by the manufacturer) to levels below the impulse withstand voltage.of Table PS-A5, provided that the power supply is not intended for connection to other sources which would permit higher impulse voltages.
c) Not acceptable for power supplies

Table PS-A5 – Clearances for circuits derived from mains circuits

Working voltage	Clearance			
a.c. r.m.s. or d.c.	Mains voltage ≤100 V Rated impulse voltage 500 V	Mains voltage >100 V ≤150 V Rated impulse voltage 800 V	Mains voltage >150 V ≤300 V Rated impulse voltage 1 500 V	Mains voltage >300 V ≤600 V Rated impulse voltage 2 500 V
V	mm	mm	mm	mm
50	0,05	0,12	0,53	1,51
100	0,07	0,13	0,61	1,57
150	0,10	0,16	0,69	1,64
300	0,24	0,39	0,94	1,83
600	0,79	1,01	1,61	2,41
1 000	1,66	1,92	2,52	3,45
1 250	2,23	2,50	3,16	4,16
1 600	3,08	3,39	4,11	5,21
2 000	4,17	4,49	5,30	6,48
2 500	5,64	6,02	6,91	8,05
3 200	7,98	8,37	9,16	10,2
4 000	10,6	10,9	11,6	12,8
5 000	13,7	14,0	14,9	16,1
6 300	17,8	18,2	19,1	20,3
8 000	23,5	23,9	24,7	26,0
10 000	30,3	30,7	31,6	32,9
12 500	39,1	39,6	40,5	41,9
16 000	52,0	52,5	53,5	54,9
20 000	67,4	67,9	68,9	70,5
25 000	87,4	87,9	89,0	90,6
32 000	117	117	118	120
40 000	151	151	153	154
50 000	196	196	198	199
63 000	258	258	260	261

PS-A.6.7.3.2 Clearance values where Table PS-A5 does not apply

Clearances for basic insulation and supplementary insulation are determined from the following formula:

$$\text{Clearance} = D1 + F(D2 - D1)$$

where:

D1 and D2 are clearances taken from Table PS-A6;

D1 is the clearance that would be applicable to the maximum voltage U_M if it consisted only of a 1.2 x 50 μs impulse;

D2 is the clearance that would be applicable to the maximum voltage U_m if it consisted only of the peak working voltage U_W, without any transient overvoltage;

The maximum voltage (U_m) is the maximum peak working voltage Uw plus the maximum transient overvoltage U_t;

F is a factor, determined from one of the equations:

$F=(1{,}25\ U_W / U_m) - 0{,}25$ if $0{,}2 < U_W / U_m \leq 1$

F = 0 if $U_W / U_m \leq 0.2$

Clearances for reinforced insulation are calculated using the same formula, but using the values of D1 and D2 specified in Table PS-A6 for a voltage 1,6 times the actual working voltage.

NOTE The following are two examples:

a) Clearance for reinforced insulation for a peak working voltage of 3500 V and a maximum transient overvoltage of 4 500 V.

$U_M = U_W + Ut = (3\ 500 + 4\ 500)$ V = 8 000 V

$F=(1{,}25\ U_W/U_m) - 0{,}25 = (1{,}25 \times 3500 / 8\ 000) - 0{,}25 = 0{,}347$

D1 = 16,7 mm; D2 = 29,5 mm (Values for 8 000 x 1,6 =12 800 V)

Clearance = D1 + F(D2 - D1) = 16,7 + 0,347(29,5 - 16,7) = 17,7 + 4,4 = 21,1 mm

b) Clearance for basic insulation for a secondary peak working voltage of 400 V derived from a primary voltage of 230 V a.c, but with overvoltage controlled within the equipment to a maximum of 2100 V.

$U_M = U_W + U_t = (400 + 2\ 100)$ V = 2500 V

$U_w/U_m) < 0{,}2$, so F = 0

Clearance = D1 = 1,45 mm.

Table PS-A6 – Clearance values for the calculation of PS-A.6.7.3.2

$\hat{U}_m$	CLEARANCE		$\hat{U}_m$	CLEARANCE	
	D1	D2		D1	D2
V	mm	mm	V	mm	mm
14,1 to 266	0,010	0,010	4 000	2,93	6,05
283	0,010	0,013	4 530	3,53	7,29
330	0,010	0,020	5 660	4,92	10,1
354	0,013	0,025	6 000	5,37	10,8
453	0,027	0,052	7 070	6,86	13,1
500	0,036	0,071	8 000	8,25	15,2
566	0,052	0,10	8 910	9,69	17,2
707	0,081	0,20	11 300	12,9	22,8
800	0,099	0,29	14 100	16,7	29,5
891	0,12	0,41	17 700	21,8	38,5
1 130	0,19	0,83	22 600	29,0	51,2
1 410	0,38	1,27	28 300	37,8	66,7
1 500	0,45	1,40	35 400	49,1	86,7
1 770	0,75	1,79	45 300	65,5	116
2 260	1,25	2,58	56 600	85,0	150
2 500	1,45	3,00	70 700	110	195
2 830	1,74	3,61	89 100	145	255
3 540	2,44	5,04	100 000	165	290

NOTE 1 - Interpolation of clearances is allowed.

NOTE 2 - Minimum clearance for pollution degree 2 is 0,2 mm, for pollution degree 3 is 0,8 mm.

PS-A.6.7.3.3 Creepage distance values

Table PS-A7 gives the CREEPAGE DISTANCES related to the WORKING VOLTAGE.

Table PS-A7 – Creepage distances

Working voltage r.m.s. or d.c.	BASIC INSULATION or SUPPLEMENTARY INSULATION								
	On printed wiring board		Other circuits						
	Pollution degree		Pollution degree						
	1	2	1	2			3		
	Material group	Material group		Material group			Material group		
	IIIb	IIIa		I	II	IIIa-b	I	II	IIIa-b (see note)
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,40	0,40	0,40	1,00	1,00	1,00
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,05	1,05	1,05
16	0,025	0,04	0,10	0,45	0,45	0,45	1,10	1,10	1,10
20	0,025	0,04	0,11	0,48	0,48	0,48	1,20	1,20	1,20
25	0,025	0,04	0,125	0,50	0,50	0,50	1,25	1,25	1,25
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3
40	0,025	0,04	0,16	0,56	0,80	1,10	1,4	1,6	1,8
50	0,025	0,04	0,18	0,60	0,85	1,20	1,5	1,7	1,9
63	0,040	0,063	0,20	0,63	0,90	1,25	1,6	1,8	2,0
80	0,063	0,10	0,22	0,67	0,95	1,3	1,7	1,9	2,1
100	0,10	0,16	0,25	0,71	1,00	1,4	1,8	2,0	2,2
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4
160	0,25	0,40	0,32	0,80	1,1	1,6	2,0	2,2	2,5
200	0,40	0,63	0,42	1,00	1,4	2,0	2,5	2,8	3,2
250	0,56	1,0	0,56	1,25	1,8	2,5	3,2	3,6	4,0
320	0,75	1,6	0,75	1,60	2,2	3,2	4,0	4,5	5,0
400	1,0	2,0	1,0	2,0	2,8	4,0	5,0	5,6	6,3
500	1,3	2,5	1,3	2,5	3,6	5,0	6,3	7,1	8,0
630	1,8	3,2	1,8	3,2	4,5	6,3	8,0	9,0	10,0
800	2,4	4,0	2,4	4,0	5,6	8,0	10,0	11	12,5
1 000	3,2	5,0	3,2	5,0	7,1	10,0	12,5	14	16
1 250	4,2	6,3	4,2	6,3	9,0	12,5	16	18	20
1 600	5,6	8,0	5,6	8,0	11	16	20	22	25
2 000	7,5	10,0	7,5	10,0	14	20	25	28	32
2 500	10,0	12,5	10,0	12,5	18	25	32	36	40
3 200	12,5	16	12,5	16	22	32	40	45	50
4 000	16	20	16	20	28	40	50	56	63
5 000	20	25	20	25	36	50	63	71	80
6 300	25	32	25	32	45	63	80	90	100
8 000	32	40	32	40	56	80	100	110	125
10 000	40	50	40	50	71	100	125	140	160
12 500	50	63	50	63	90	125			
16 000	63	80	63	80	110	160			
20 000	80	100	80	100	140	200			
25 000	100	125	100	125	180	250			
32 000	125	160	125	160	220	320			
40 000	160	200	160	200	280	400			
50 000	200	250	200	250	360	500			
63 000	250	320	250	320	450	600			

NOTE 1 Material Group IIIb is not recommended for application in pollution degree 3 above 630 V.

NOTE 2 Interpolation of creepage distances is allowed.

PS-A.6.8 Procedure for dielectric strength tests

PS-A.6.8.1 Reference test earth

The reference test earth is the reference point for voltage tests. It is one or more of the following, bonded together if more than one:

a) any protective conductor terminal or functional earth terminal;

b) any accessible conductive part, except for any live parts permitted to be accessible because they do not exceed the values of PS-A.6.3.1 a) and b). Such live parts are bonded together but do not form part of the reference test earth. Also excluded are accessible conductive parts which are allowed to be hazardous live by the exceptions of PS-A.6.1.2 b) and c);

c) any accessible insulating part of the enclosure, covered with metal foil everywhere except around terminals. For test voltages up to 10 kV a.c. peak or d.c. the distance from foil to terminal is not more than 20 mm. For higher voltages the distance is the minimum to prevent flashover;

d) accessible parts of controls with parts made of insulating material being wrapped in metal foil or having soft conductive material pressed against them.

PS-A.6.8.2 Humidity preconditioning

To ensure that power supply will not become hazardous in the humidity conditions of PS-A.1.4, it is subjected to humidity preconditioning before the voltage tests of PS-A.6.8.4. The power supply is not operated during preconditioning.

If wrapping in foil is required by PS-A.6.8.1, the foil is not applied until after humidity preconditioning and recovery.

Electrical components, covers, and other parts which can be removed by hand are removed and subjected to the humidity preconditioning together with the main part.

Preconditioning is carried out in a humidity chamber containing air with a humidity of 92,5 % RH ± 2,5 % RH. The temperature of the air in the chamber is maintained at 40 °C ± 2 °C.

Before applying humidity, the power supply is brought to a temperature of 42 °C ± 2 °C, normally by keeping it at this temperature for at least 4 h before the humidity preconditioning.

The air in the chamber is stirred and the chamber is designed so that condensation will not precipitate on the equipment.

The power supply remains in the chamber for 48 h, after which it is removed and allowed a recovery period of 2 h under the environmental conditions of PS-A.4.3.1, with the covers of non-ventilated power supplies removed.

PS-A.6.8.3 Conduct of tests

The tests specified in PS-A.6.8.4 are performed and completed within 1 h of the end of the recovery period after humidity preconditioning. The power supply is not operated during the tests.

Voltage tests are not made between two circuits, or between a circuit and an accessible conductive part, if they are connected to each other or not separated from each other.

Protective impedance and voltage limiting devices in parallel with the insulation to be tested may be disconnected.

Where two or more protective means are used in combination (see 2.2.3/RD, PS-A.6.6.2 and PS-A.6.6.3), the voltages specified for double insulation and reinforced insulation could be applied to parts of circuits which are not required to withstand these voltages. To avoid this, such parts may be disconnected during the tests, or the parts of circuits where double insulation or reinforced insulation is required may be tested separately.

PS-A.6.8.4 Voltage tests

Voltage tests are applied, using the values specified in Table PS-A9. No breakdown or repeated flashover shall occur. Corona effects and similar phenomena are disregarded.

For solid insulation, the a.c. and d.c. tests are alternative test methods. It is sufficient that the insulation passes either of the two. The tests are conducted with the voltage raised gradually over a period of 5 s or less to the specified value so that no appreciable transients occur, then maintained for 5 s.

NOTE 1 When testing circuits, it may not be possible to separate tests of clearance from tests of solid insulation.

NOTE 2 The maximum test current of test equipment is usually limited to avoid hazards arising from the test and damage to the power supply which fails the test.

NOTE 3 It may be useful to make partial discharges within the insulation material perceptible (see IEC 60270).

NOTE 4 Care should be taken to discharge stored energy after test.

Table PS-A9 – Test voltages for basic insulation

CLEARANCE	Voltage a.c. r.m.s. 50/60 Hz	Voltage a.c. peak 50/60 Hz or d.c.	CLEARANCE	Voltage a.c. r.m.s. 50/60 Hz	Voltage a.c. peak 50/60 Hz or d.c.
mm	V	V	mm	V	V
0,010	230	330	16,5	7 600	10 700
0,025	310	440	17,0	7 800	11 000
0,040	370	520	17,5	8 000	11 300
0,063	420	600	18,0	8 200	11 600
0,1	500	700	19	8 600	12 100
0,2	620	880	20	9 000	12 700
0,3	710	1 010	25	10 800	15 300
0,5	840	1 200	30	12 600	17 900
1,0	1 060	1 500	35	14 400	20 400
1,4	1 330	1 880	40	16 200	22 900
2,0	1 690	2 400	45	17 900	25 300
2,5	1 960	2 770	50	19 600	27 700
3,0	2 210	3 130	55	21 200	30 000
3,5	2 450	3 470	60	22 900	32 300
4,0	2 680	3 790	65	24 500	34 600
4,5	2 900	4 100	70	26 100	36 900
5,0	3 110	4 400	75	27 700	39 100
5,5	3 320	4 690	80	29 200	41 300
6,0	3 520	4 970	85	30 800	43 500
6,5	3 710	5 250	90	32 300	45 700
7,0	3 900	5 510	95	33 800	47 900
7,5	4 080	5 780	100	35 400	50 000
8,0	4 300	6 030	110	38 400	54 200
8,5	4 400	6 300	120	41 300	58 400
9,0	4 600	6 500	130	44 200	62 600
9,5	4 800	6 800	140	47 100	66 700
10,0	4 950	7 000	150	50 000	70 700
10,5	5 200	7 300	160	52 800	74 700
11,0	5 400	7 600	170	55 600	78 700
11,5	5 600	7 900	180	58 400	82 600
12,0	5 800	8 200	190	61 200	86 500
12,5	6 000	8 500	200	63 900	90 400
13,0	6 200	8 800	210	66 600	94 200
13,5	6 400	9 000	220	69 300	98 000
14,0	6 600	9 300	230	72 000	102 000
14,5	6 800	9 600	240	74 700	106 000
15,0	7 000	9 900	250	77 300	109 400
15,5	7 200	10 200	264	81 100	115 000
16,0	7 400	10 500			

PS-A.6.9 Constructional requirements for protection against electric shock

PS-A.6.9.1 General

If a failure could cause a hazard:

b) screws securing removable covers shall be captive if their length determines a CLEARANCE or CREEPAGE DISTANCE between accessible conductive parts and hazardous live parts.

PS-A.6.9.3 Over-range indication

If a hazard could arise from an operator's reliance on the value (for example, voltage) displayed by the stand alone power supply, the display shall give an unambiguous indication whenever the value is above the maximum positive value or below the minimum negative value of the range to which the instrument is set.

NOTE - Examples of hazardous indications include the following, unless there is a separate unambiguous indication of an over-range value:

a) analogue meters with stops at the exact ends of the range;

b) digital meters which show a low value when the true value is above the range maximum (for example 1 001,5 V displayed as 001,5 V);

Conformity is checked by inspection and, in case of doubt, by provoking an over-range value.

PS-A.6.10.1 Mains supply cords

The following requirements apply to non-detachable mains supply cords and to detachable mains supply cords supplied with the power supply.

b) If a cord is likely to contact hot external parts of the power supply, it shall be made of suitably heat-resistant material.

c) If the cord is detachable, both the cord and the appliance inlet shall have at least the highest temperature rating for either part.

NOTE The requirement for an equal temperature rating for both cord and the appliance inlet ensures that cord sets of low temperature rating cannot be used inadvertently.

PS-A.6.10.2 Fitting of non-detachable mains supply cords

Conformity is checked by inspection and the following push-pull test: the cord is pushed into the power supply manually, as far as possible. It is then subjected 25 times to a steady pull of the value shown in Table PS-A11, applied for 1 s each time in the least favourable direction. Immediately afterwards it is subjected for 1 min to a torque of the value shown in Table PS-A11.

Table PS-A11 – Physical tests on power supply cords

Mass of equipment kg	Pull N	Torque N·m
≤1	30	0,10
>1 ≤4	60	0,25
>4	100	0,35

After the tests:

1) the cord shall not have been damaged;
2) the cord shall not have been displaced longitudinally by more than 2 mm;
3) there shall be no signs of strain at the point where the anchorage clamps the cord;
4) clearances and creepage distances shall not have been reduced below the applicable values;
5) the cord shall pass the voltage test of PS-A.6.8.

PS-A.6.11.3.2 Appliance couplers and plugs

If an appliance coupler or separable plug is used as the disconnecting device, it shall be readily identifiable and easily reached by the operator. For single-phase portable equipment, a plug on a cord of length not greater than 3 m is considered to be easily reached. The protective earth conductor of an appliance coupler shall be connected before the supply conductors and disconnected after them.

Conformity is checked by inspection.

PS-A.7 Protection against mechanical hazards

PS-A.7.1 General

Operation shall not lead to a mechanical hazard in normal condition or single fault condition.

PS-A.7.4 Provisions for lifting and carrying

If carrying handles or grips are fitted to or supplied with the equipment they shall be capable of withstanding a force of four times the weight of the power supply.

Power supplies or parts having a mass of 18 kg or more shall be provided with a means for lifting and carrying or directions shall be given in the manufacturer's documentation.

Conformity is checked by inspection and by the following test.

A single handle or grip is subjected to a force corresponding to four times the weight of the equipment. The force is applied uniformly over a 7 cm width at the centre of the handle or grip, without clamping. The force is steadily increased so that the test value is attained after 10 s and maintained for a period of 1 min.

If more than one handle or grip is fitted, the force is distributed between the handles or grips in the same proportion as in normal use. If the power supply is fitted with more than one handle or grip but is so designed that it may readily be carried by only one handle or grip, each handle or grip shall be capable of sustaining the total force.

The handles or grips shall not break loose from the power supply and there shall not be any permanent distortion, cracking or other evidence of failure.

PS-A.7.5 Wall mounting

Mounting brackets on power supplies intended to be mounted on a wall or ceiling shall withstand a force of four times the weight of the power supply.

Conformity is checked after mounting the power supply in accordance with the manufacturer's instructions, using the fasteners and wall construction specified. Adjustable brackets are adjusted to the position that will give the maximum projection from the wall.

If no wall construction is specified, a 10 mm ± 2 mm thick plaster board (drywall) on nominal 50 mm x 100 mm ± 10 mm studs at 400 mm ± 10 mm centres is to be used as the support surface. Fasteners are applied as specified in the instructions, but if not specified are positioned in the plasterboard between the studs.

The mounting brackets are then subjected to the weight of the power supply plus a test weight of three times the weight of the power supply, acting vertically through the centre of gravity. The test weight is applied gradually and is increased from zero to full load in 5 s to 10 s, then maintained for 1 min.

After the test, there shall be no damage to the bracket or the mounting surface.

PS-A.8 Mechanical resistance to shock and impact

Power supplies shall not cause a hazard when subjected to shock and impact likely to occur in normal use. Power supplies shall have adequate mechanical strength, components shall be reliably secured, and electrical connections shall be secure.

Conformity is checked by performing the tests of PS-A.8.1 and, except for fixed power supplies, the appropriate test of PS-A.8.2. The power supply is not operated during the tests. Parts which do not form part of an enclosure are not subjected to the tests of PS-A.8.1.

After completion of the tests, the power supply shall pass the voltage tests of PS-A.6.8 (without humidity preconditioning) and is inspected to check that:

a) parts which are hazardous live have not become accessible;

b) enclosures show no cracks which could cause a hazard;

c) clearances are not less than their permitted values and the insulation of internal wiring remains undamaged;

d) barriers have not been damaged or loosened;

e) no moving parts are exposed, except as permitted by 4.4.2/RD;

f) there has been no damage which could cause spread of fire.

Damage to the finish, small dents which do not reduce creepage distances or clearances below the values specified in this standard, and small chips which do not adversely affect the protection against electric shock or moisture, are ignored. Breakage of any part which is not part of an enclosure is ignored.

PS-A.8.1 Enclosure rigidity test

PS-A.8.1.1 Static test

The power supply is held firmly against a rigid support and subjected to a force of 30 N applied by the hemispherical end of a hard rod of 12 mm diameter. The rod is applied to each part of the enclosure which is accessible when the power supply is ready for use, and which could cause a hazard if distorted, including any part of the bottom of portable power supplies.

In case of doubt whether a non-metallic enclosure will pass this test at an elevated temperature, this test is performed after the power supply is operated at an ambient termperature of 40 °C, or the maximum rated ambient temperature if higher, until a steady-state condition is reached. The power supply is disconnected from the supply source before the test is performed.

PS-A.8.2 Drop test

PS-A.8.2.1 power supplies other than direct plug-in power supplies

The test is carried out as follows:

a) for power supplies with a mass up to 20 kg, a corner drop test, as specified in PS-A.8.2.1.1;
b) for power supplies with a mass over 20 kg but up to 100 kg, a face drop test, as specified in PS-A.8.2.1.2;
c) for fixed power supplies and for power supplies with a mass over 100 kg, no test is required.

NOTE If the power supply consists of two or more units, the value for the mass refers to the mass of each individual unit. However, if one or more units are intended to be attached to or supported by another unit, these units are treated as a single unit.

The method of test shall not allow the power supply to topple onto the next face instead of falling back onto the test face as intended, nor roll around the next edge.

If the number of bottom edges exceeds four, the number of drops shall be limited to four edges.

PS-A.8.2.1.1 Corner drop test

The power supply is placed in its position of normal use on a smooth, hard rigid surface of concrete or steel. One bottom edge is raised above the test surface by placing a wooden stud 10 mm high under one corner, and a 20 mm wooden stud under an adjacent corner. The power supply is then lifted above the test surface by rotating it about the edge on the two studs, until the other corner adjacent to the 10 mm stud is raised 100 mm ± 10 mm, or so that the angle made by the power supply and the test surface is 30°, whichever condition is less severe. It is then allowed to fall freely onto the test surface. The power supply is subjected to one drop on each of four bottom corners by applying the test along four bottom edges in turn.

PS-A.8.2.1.2 Face drop test

The equipment is placed in its position of normal use on a smooth, hard, rigid surface of concrete or steel. It is then tilted about one bottom edge so that the distance between the opposite edge and the test surface is 25 mm ± 2,5 mm, or so that the angle made by the bottom and the test surface is 30°, whichever is less severe. It is then allowed to fall freely onto the test surface.

PS-A.8.2.1 Equipment other than hand-held power supply and direct plug-in power supply

The test is carried out as follows:

a) for equipment with a mass up to 20 kg, a corner drop test, as specified in PS-A.8.2.1.1;

b) for equipment with a mass over 20 kg but up to 100 kg, a face drop test, as specified in PS-A.8.2.1.2;

c) for equipment with a mass over 100 kg, no test is required.

NOTE If the equipment consists of two or more units, the value for the mass refers to the mass of each individual unit. However, if one or more units are intended to be attached to or supported by another unit, these units are treated as a single unit.

The method of test shall not allow the equipment to topple onto the next face instead of falling back onto the test face as intended, nor roll around the next edge.

Where the number of bottom edges exceeds four, the number of drops shall be limited to four edges.

PS-A.8.2.1.1 Corner drop test

The equipment is placed in its position of normal use on a smooth, hard rigid surface of concrete or steel. One bottom edge is raised above the test surface by placing a wooden stud 10 mm high under one corner, and a 20 mm wooden stud under an adjacent corner. The equipment is then lifted above the test surface by rotating it about the edge on the two studs, until the other corner adjacent to the 10 mm stud is raised 100 mm ± 10 mm, or so that the angle made by the equipment and the test surface is 30°, whichever condition is the less severe. It is then allowed to fall freely onto the test surface. The equipment is subjected to one drop on each of four bottom corners by applying the test along four bottom edges in turn.

PS-A.8.2.1.2 Face drop test

The power supply is placed in its position of normal use on a smooth, hard, rigid surface of concrete or steel. It is then tilted about one bottom edge so that the distance between the opposite edge and the test surface is 25 mm ± 2,5 mm, or so that the angle made by the bottom and the test surface is 30°, whichever is less severe. It is then allowed to fall freely onto the test surface.

PS-A.8.2.2 Direct plug-in power supplies

A direct plug-in power supply is dropped once through a distance of 1 m on to a 50 mm thick hardwood board having a density of more than 700 kg/m3 lying flat on a rigid base such as concrete block. The power supply is dropped so that it lands in the position expected to present the most severe condition.

Non-metallic enclosures with a minimum rated ambient temperature below 2 ºC are cooled to the minimum rated ambient temperature, then tested within 10 min.

PS-A.9 Protection against the spread of fire

PS-A.9.2 Containment of the fire within the equipment, should it occur

The risk of the spread of fire outside the power supply is considered to be reduced to a tolerable level if the power supply meets one of the following constructional requirements:

a) energizing of the power supply is controlled by a switch that is held closed by the operator;

b) the power supply and its enclosure conform to the constructional requirements of PS-A.9.2.1.

Conformity is checked by inspection, and as specified in PS-A.9.2.1.

PS-A.9.2.1 Constructional requirements

The following constructional requirements shall be met.

a) Insulated wire shall have a flammability classification FV-1 or better, of IEC 60707, connectors and insulating material on which components are mounted shall have a flammability classification FV-2 or better, of IEC 60707. (Also see PS-A.14.8 for requirements for printed circuit boards.)

   Conformity is checked by inspection of data on materials, or by performing the FV tests specified in IEC 60707 on three samples of the relevant parts. The samples may be any of the following:

   1) complete parts;
   2) sections of a part, including the area with the least wall thickness and any ventilation openings;
   3) specimens in accordance with IEC 60707.

b) The enclosure shall meet the following requirements:

   1) the bottom shall have no openings or, to the extent specified in Figure 4E/RD, shall be constructed with baffles as specified in Figure PS-A6, or be made of metal, perforated as specified in Table PS-A12, or be a metal screen with a mesh not exceeding 2 mm x 2 mm centre to centre and a wire diameter of at least 0,45 mm;
   2) the sides shall have no openings within the area that is included within the inclined line C in Figure 4E/RD;
   3) the enclosure, and any baffle or flame barrier, shall be made of metal (except magnesium) or of non-metallic materials having a flammability classification of FV-1 or better, of IEC 60707;
   4) the enclosures, and any baffle or flame barrier, shall have adequate rigidity.

Conformity is checked by inspection. In case of doubt, the flammability classification of requirement b)3) is checked as in a).

Table PS-A12 – Acceptable perforation of the bottom of an enclosure

Dimensions in millimetres

Minimum thickness	Maximum diameter of holes	Minimum spacing of holes centre to centre
0,66	1,14	1,70 (233 holes / 645 mm2)
0,66	1,19	2,36
0,76	1.15	1,70
0,76	1,19	2,36
0,81	1,91	3,18 (72 holes / 645 mm2)
0,89	1,90	3,18
0,91	1,60	2,77
0,91	1,98	3,18
1,00	1,60	2,77
1,00	2,00	3,00

Y = twice X but never less than 25 mm;
1 = Baffle plates (may be below the bottom of the enclosure);
2 = Bottom of enclosure.

Figure PS-A6 – Baffle

PS-A.9.5.2 Power supplies other than permanently connected power supplies

If overcurrent protection is provided, it shall be within the power supply.

Conformity is checked by inspection.

PS-A.10 Equipment temperature limits and resistance to heat

PS-A.10.1 Surface temperature limits for protection against burns

Easily touched surfaces shall not exceed the values of Table PS-A15 in normal condition, or 105 °C in single fault condition, at an ambient temperature of 40 °C, or the maximum rated ambient temperature if higher.

If easily touched heated surfaces are necessary for functional reasons, they are permitted to exceed the values of Table PS-A15 in normal condition and to exceed 105 °C in single fault condition, provided that they are recognizable as such by appearance or function or are marked with symbol 13 of Table PS-A1 (see PS-A.5.2).

Surfaces protected by guards that prevent them being touched accidentally are not considered to be easily-touched surfaces, provided that the guards cannot be removed without the use of a tool.

Table PS-A15 – Surface temperature limits in normal condition

Part	Limit °C
1. Outer surface of enclosure	
a) metal	70
b) non-metallic	80
c) small areas that are not likely to be touched in normal use	100
2. Knobs and handles	
a) metal	55
b) non-metallic	70
c) non-metallic parts that in normal use are held only for short periods	85

Conformity is checked by measurement as specified in PS-A.10.4, and by inspection of guards to check that they protect against accidentally touching surfaces that are at temperatures above the values of Table PS-A15, and that they cannot be removed without the aid of a tool.

PS-A.10.2 Temperatures of windings

If a hazard could be caused by excessive temperature, the temperature of the insulating material of windings shall not exceed the values of Table PS-A16 in normal condition or single fault condition. Ambient in IEC 61010-1 is 40°C minimum.

A maximum temperature of 300 degree C for insulation is permitted under single fault conditions in clause 5.3.8.1/RD of IEC 61204-7 but not in IEC 61010-1.

Conformity is checked by measurement as specified in PS-A.10.4.2, in normal condition and in the applicable single fault conditions of Annex B/RD and 5.3.1/RD, and also in any other single fault conditions that could cause a hazard as a result of excessive temperature.

Table PS-A16 – Insulation material of windings

Class of winding	NORMAL CONDITION, °C	SINGLE FAULT CONDITION, °C
Class A	105	150
Class B	130	175
Class E	120	165
Class F	155	190
Class H	180	210

PS-A.10.3 Other temperature measurements

The following other measurements are made, if applicable, for the purposes of other subclauses. Tests are made in normal condition unless stated.

a) The temperature of a field-wiring terminal box or compartment is measured if there is a possibility that it could exceed 60 °C at an ambient temperature of 40 °C, or the maximum rated ambient temperature if higher (in connection with the marking requirement of PS-A.5.1.8).

b) This is not applicable to power supplies.

c) The temperature of non-metallic enclosures is measured during the test of PS-A.10.5.1 (to establish a base temperature for the test of PS-A.10.5.2).

d) The temperature of parts made of insulating material which are used to support parts connected to the mains supply (to establish a temperature for test a) of 4.5.2/RD).

e) The temperature of terminals carrying a current exceeding 0,5 A and if substantial heat could be dissipated in case of poor contact.

PS-A.10.4.2 Power Supplies intended for installation in a cabinet or a wall

Such a power supply is built in as specified in the installation instructions, using walls of plywood painted matt black, approximately 10 mm thick when representing the walls of a cabinet, approximately 20 mm thick when representing the walls of a building.

PS-A.10.5 Resistance to heat

PS-A.10.5.1 Integrity of clearances and creepage distances

Clearances and creepage distances shall meet the requirements of PS-A.6.7 when the power supply is operated at an ambient temperature of 40 °C, or the maximum rated ambient temperature if higher.

Conformity, in cases of doubt if the power supply produces an appreciable amount of heat, is checked by operating it under the reference test conditions of PS-A.4.3.1, PS-A.4.3.2.8 and 1.4/RD, except that the ambient temperature is 40 °C, or the maximum rated ambient temperature if higher. After this test, clearances and creepage distances shall not have been reduced below the requirements of PS-A.6.7.

If the enclosure is non-metallic, the temperature of parts of the enclosure is measured during the above test for the purposes of PS-A.10.5.2.

PS-A.10.5.2 Non-metallic enclosures

After the test of 4.2.7/RD, the tests of PS-A.8.1.1 and PS-A.8.2.1 are repeated, and in case of doubt, the tests of PS-A.6.8 (without humidity preconditioning).

PS-A.11.5 Battery electrolyte

Batteries shall be so mounted that safety cannot be impaired by leakage of their electrolyte.

Conformity is checked by inspection.

PS-A.11.6 Specially protected Power supplies

After the tests of annex T/RD, the electric strength test is conducted in accordance with PS-A.6.8 (without humidity preconditioning) and accessible parts shall not exceed the limits of PS-A.6.3.1.

PS-A.13.2.2 Batteries and battery charging

Batteries shall not cause explosion or produce a fire hazard as a result of excessive charge or discharge, or if a battery is installed with incorrect polarity. If necessary, protection shall be incorporated in the power supply, unless the manufacturer's instructions specify that it is for use only with batteries which have built-in protection.

If an explosion or fire hazard could occur through fitting a battery of the wrong type (for example, if a battery with built-in protection is specified) there shall be a warning marking (see PS-A.5.2) on or near the battery compartment or mounting and a warning in the manufacturer's instructions. An acceptable marking is symbol 14 of Table PS-A1.

If the power supply has means for charging rechargeable batteries, and if non-rechargeable cells could be fitted and connected in the battery compartment, there shall be a marking (see PS-A.5.2) in or near the compartment. The marking shall warn against the charging of non-rechargeable batteries and indicate the type of rechargeable battery that can be used with the recharging circuit. An acceptable marking is symbol 14 of Table PS-A1.

The battery compartment shall be designed so that there is no possibility of explosion or fire caused by build-up of flammable gases.

Also see PS-A.11.5.

Conformity is checked by inspection, including inspection of battery data, to establish that failure of a single component cannot lead to an explosion or fire hazard. If necessary, a short circuit and an open circuit is made on any single component (except the battery itself) whose failure could lead to such a hazard.

For batteries intended to be replaced by the operator, an attempt is made to install a battery with its polarity reversed. No hazard shall arise.

PS-A.14.5 Mains voltage selecting devices

Power supplies shall be constructed so that a change from one voltage or one type of supply to another cannot occur accidentally. The marking of voltage selecting devices is specified in PS-A.5.1.3 d).

Conformity is checked by inspection and manual test.

PS-A.Annex A Measuring circuits for accessible current

PS-A.A.4 Current measuring circuit for wet contact

For wet contact the current is measured using the circuit of Figure PS-A.A.4. The current is calculated from:

$$I = \frac{U}{500}$$

where
I is the current in amperes;
U is the voltage, in volts, indicated by the voltmeter.

R1 = 375 Ω

R2 = 500 Ω

C1 = 0,22 µF

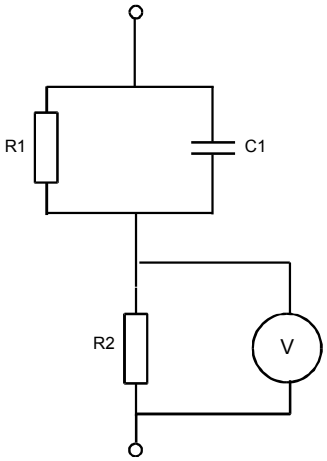


Figure PS-A.A4 – Current measuring circuit for wet contact

PS-A.Annex E Reduction of pollution degrees

Covered by IEC 61204-7, clause 2.10.7/RD, except that for IEC 61010-1, coated printed wiring boards are not acceptable for reducing pollution degree 3 to 1 (they are acceptable for reducing pollution degree 3 to 2). Coated printed wiring boards tested to 2.10.6/RD are not permitted to use the separation distances of table 2N/RD for use in products of IEC 61010-1.

Table PS-A.E.1 shows the reduction in pollution degree of the environment through the use of additional protection.

Table PS-A.E.1 – Reduction of pollution degree of internal environment through the use of additional protection

Additional protection	From pollution degree 2 of external environment to:	From pollution degree 3 of external environment to:
Enclosure IPx4 of IEC 60529	2	2 (Not acceptable for IEC 60950 and IEC 60950-1)
Enclosure IPx5 or IPx6 of IEC 60529	2	2 (Not acceptable for IEC 60950 and IEC 60950-1)
Enclosure IPx7 or IPx8 of IEC 60529	2	2
Hermetically sealed enclosure	1	1
Constantly heated	1 (Not acceptable for IEC 60950 and IEC 60950-1)	1 (Not acceptable for IEC 60950 and IEC 60950-1)
Encapsulated	1	1
Coated	1	2

PS-A.Annex F (normative) Routine tests

The manufacturer shall perform the tests of PS-A.F.1 to PS-A.F.3 on 100 % of power supplies produced which has both hazardous live parts and accessible conductive parts.

Unless it can be clearly shown that the result of tests cannot be invalidated by subsequent manufacturing stages, tests shall be made with the power supplies fully assembled. The power supply shall not be unwired, modified or disassembled for the test, but snap-on covers and friction-fit knobs may be removed if they would interfere with the tests. The power supply shall not be energized during the tests, but the mains switch shall be in the on-position.

Wrapping the power supply in foil is not required, nor is humidity preconditioning necessary.

PS-A.F.1 Protective earth

A continuity test is made between the earth pin of the appliance inlet or the mains plug of plug-connected power supplies, or the protective conductor terminal of permanently connected power supplies on the one side, and all accessible conductive parts which are required by PS-A.6.5.1.1 to be connected to the protective conductor terminal on the other side.

NOTE No value is specified for the test current.

PS-A.F.2 Mains circuits

A test voltage as specified in PS-A.6.8 (without humidity preconditioning) for basic insulation is applied between the mains terminals connected together on the one side, and all accessible conductive parts connected together on the other. For this test, the contacts of any output terminal intended to be connected to circuits of other equipment which are not hazardous live are considered to be accessible conductive parts.

The test voltage is raised to its specified value within 2 s and maintained for at least 2 s.

No breakdown or repeated flashover shall occur. Corona effects and similar phenomena are disregarded.

PS-A.F.3 Other circuits

A test voltage is applied between the terminals of floating input circuits, which can be hazardous live in normal use, connected together on the one side, and accessible conductive parts connected together on the other.

A test voltage is also applied between the terminals of floating output circuits, which can be hazardous live in normal use connected together on the one side, and accessible conductive parts connected on the other.

The value of the applied voltage in each case is 1,5 times the working voltage. If voltage limiting (clamping) devices operate below 1,5 times the working voltage, the value of the applied voltage is 0,9 times the clamping voltage, but not less than that of the working voltage.

NOTE In a power supply which has accessible conductive parts connected to the protective conductor terninal, a connection can be made to the earth pin of the appliance inlet or mains plug. During this test, the power supply should be electrically isolated from any external earthing means.

No breakdown or repeated flashover shall occur. Corona effects and similar phenomena are disregarded.

Annex PS-B
(Normative)

Requirements for power supply units for use in medical electrical equipment

PS-B.1 General

Power supply units used in Medical Electrical equipment shall comply with the additional requirements of this annex.

NOTE The following are the additional requirements to comply with IEC 60601-1 Edition 3. For the complete and actual text of the requirements, see IEC 60601-1 Edition 3. Some of the following requirements may not be applicable to component power supplies. However, consideration should be given to surfaces that may serve as enclosure in the end application. Alternatively, if a power supply unit is required to comply with IEC 60601-1 Edition 3 only, then the requirements of IEC 60601-1 Edition 3 alone may be used. However the power supply unit in that case may not comply with IEC 61204-7.

ANNEX PS-B: Under development.

Annex PS-C

Reserved for future use.

Annex PS-D
Normative)

Requirements for power supply units used in audio, video and similar household apparatus

PS-D.1 General

power supply units used in audio, video and similar household apparatus shall comply with the additional requirements of this annex.

NOTE The following are the additional requirements to comply with IEC 60065 Edition 7. For the complete and actual text of the requirements, see IEC 60065 Edition 7. Some of the following requirements may not be applicable to component power supplies. However, consideration should be given to surfaces that may serve as enclosure in the end application. Alternatively, if a power supply unit is required to comply with IEC 60065 Edition 7 only, then the requirements of IEC 60065 Edition 7 alone may be used. However the power supply unit in that case may not comply with IEC 61204-7.

Comparison of IEC 60065 Edition 7 with IEC 61204-7 (IEC60950 Edition 3 and IEC 60950-1 Edition 1)

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
1	General	1	PS-D.1	
1.1	Scope	1.1		
1.1.1	Examples of apparatus	1.1.1		Supply apparatus is covered
1.1.2	Supply voltage	1.1.1	PS-D.1.1.2	Limit scope to 250 V a.c. or d.c. and 433 V for 3-phase
1.1.3	2 000 m	1.1.2		
1.1.4	Overvoltage category 2	2.10.3.1/RD		Similar to IEC 61204-7
1.1.5	Exclusions	1.1.3		

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
1.2	References	Annex P/RD	PS-D.1.2*	* IEC 60027 IEC 60038 IEC 60068-2-3 IEC 60068-2-6 IEC 60068-2-32 IEC 60068-2-75 IEC 60167 IEC 60216 IEC 60249-2 IEC 60268-1 IEC 60317 IEC 60335-1 IEC 60384-1 IEC 60417 IEC 60454 IEC 60664-3 IEC 60691 IEC 60695-11-10 IEC 60707 IEC 60730 (all parts) IEC 60884 (all parts) IEC 60906 IEC 60998-2-2 IEC 60999-1 IEC 61051-2 IEC 61149 IEC 61260 IEC 61293 IEC 61558-1 IEC 61965 IEC 62151 IEC GUIDE 104 ISO 306 ITU-T Recommendation K17 ITU-T Recommendation K21
2.	Definitions	1.2/RD	PS-D.2	

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
2.1	Definitions in alphabetical order	1.2/RD	PS-D.2.1*	*Additional definitions not covered by 1.2/RD.
2.2.10	Portable apparatus	1.2.3.1/RD		
2.2.11	Transportable apparatus	1.2.3.3/RD		
2.3.1	Rated supply voltage	1.2.1.1/RD		
2.3.2	Operating voltage	1.2.9.6/RD		
2.3.3	Ripple free	1.2.13.4/RD		IEC 60950 and IEC 60950-1 are more onerous.
2.3.6	Rated current consumption	1.2.1.3/RD		
2.3.8	Required withstand voltage	1.2.9.8/RD		
2.3.9	Telecommunication network transient voltage	1.2.9.10/RD		
2.4.1	Mains	1.2.8.1/RD 1.2.8.2/RD*		* This applies to IEC 60950-1 only.
2.4.2	Permanently connected apparatus	1.2.5.3/RD		
2.4.3	Directly connected to the mains		PS-D.2.4.3	
2.4.4	Conductively connected to the mains		PS-D.2.4.4	
2.4.5	Terminal		PS-D.2.4.5	
2.4.6	Protective earthing terminal		PS-D.2.4.6	
2.4.7	Telecommunication network	1.2.13.8/RD		
2.4.8	Remote power feeding		PS-D.2.4.8	
2.4.9	TNV circuit	1.2.8.9/RD* 1.2.8.10/RD**		* IEC 60950 ** IEC 60950-1
2.4.10	TNV-0 circuit	1.2.8.6/RD* 1.2.8.7/RD**		* IEC 60950 ** IEC 60950-1
2.4.11	TNV-1 circuit	1.2.8.10/RD* 1.2.8.11/RD**		* IEC 60950 ** IEC 60950-1

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
2.4.12	TNV-2 circuit	1.2.8.11/RD * 1.2.8.12/RD **		* IEC 60950 ** IEC 60950-1
2.4.13	TNV-3 circuit	1.2.8.12/RD * 1.2.8.13/RD **		* IEC 60950 ** IEC 60950-1
2.6.1	Class I	1.2.4.1/RD		
2.6.2	Class II	1.2.4.2/RD		
2.6.3	Basic insulation	1.2.9.2/RD		
2.6.4	Double insulation	1.2.9.4/RD		
2.6.5	Supplementary insulation	1.2.9.3/RD		
2.6.6	Reinforced insulation	1.2.9.5/RD		
2.6.7	Protective separation	2.2.3.1/RD 2.2.3.2/RD		This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.6.8	Protective screening	2.2.3.2/RD		This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.6.9	Touch current	1.2.13.12/RD		
2.6.10	Hazardous live	1.2.8.4/RD* 1.2.8.5/RD**		* IEC 60950 ** IEC 60950-1
2.6.11	Clearance	1.2.10.1/RD		
2.6.12	Creepage distance	1.2.10.2/RD		
2.7.1	Isolating transformer	2.2.3.1/RD 2.2.3.2/RD		This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.7.2	Separating transformer	2.2.3.2/RD		This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.7.3	Thermal release		PS-D.2.7.3	
2.7.4	Thermal cut-out	1.2.11.3/RD		
2.7.5	Thermal link		PS-D.2.7.5	
2.7.6	Trip free			Not applicable
2.7.7	Micro-disconnection			Not applicable
2.7.8	PTC thermistor		PS-D.2.7.8	
2.7.9	Safety interlock	1.2.7.6/RD		
2.7.10	Manually operated mechanical switch			Not applicable

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
2.7.11	Mains switch	3.4/RD		This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.7.12	Printed board			Covered by IEC 60950 and IEC 60950-1.
2.7.13	Conductive pattern			Covered by IEC 60950 and IEC 60950-1.
2.7.14	Special battery		PS-D.2.7.14	
2.8.1	Type test	1.2.13.1/RD		
2.8.2	Routine test	1.2.13.3/RD		
2.8.3	Accessible	1.2.13.6/RD		
2.8.4	By hand			This term is not used in IEC 60950 and IEC 60950-1 but is covered.
2.8.5	Skilled person	1.2.13.5/RD		
2.8.6	Instructed person		PS-D.2.8.6	
2.8.7	User	1.2.13.6/RD		
2.8.8	Stand-by			Not applicable to power supplies.
2.8.9	Wood based material			Not applicable to power supplies.
2.8.10	Fire enclosure	1.2.6.2/RD		
2.8.11	Potential ignition source		PS-D.2.8.11	
3	General requirements			
3.1	General protection under normal and single fault conditions	1.3.2/RD		
3.2	Class I or II when supplied from mains	1.2.4/RD		
4	General test conditions	1.4/RD		
4.1	Conduct of tests	1.4/RD		
4.1.1	Type tests	1.4.2/RD		
4.1.2	Samples	1.4.3/RD		
4.1.3	Ambient temperature 15 to 35 oC Relative humidity to be 75%	1.4.12/RD		IEC 60950 and IEC 60950-1 consider normal ambient to be 25°C. Not specified in IEC60950 and IEC 60950-1, but 75 % is normal RH

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
4.1.4	Position of intended usage	1.3.6/RD	PS-D.4.1.4	
4.1.5	Supply characteristics	1.3.3/RD		
4.1.6	Pink noise			Not applicable to power supplies
4.1.7	a.c. values are r.m.s			Covered by IEC 60950 and IEC 60950-1
4.2	Normal operating conditions	1.4.4/RD		
4.2.1	Supply tolerances	1.4.5/RD	PS-D.4.2.1*	* but tolerance is +/-10% for all supplies.
4.2.2	Position of controls	1.4.4/RD		
4.2.3	Optional earth connection to isolated supply			Covered by IEC 60950 and IEC 60950-1
4.2.4	Audio amplifier			Not applicable to power supplies.
4.2.5	Apparatus using motors	1.2.2/RD		
4.2.6	Power supply supplying other apparatus	Annex C.1/RD		Annex C.1 is more onerous
4.2.7	Power supply for use within other specified equipment			Covered by IEC 60950 and IEC 60950-1
4.2.8	Antenna			Not applicable to power supplies.
4.2.9	Antenna positioners			Not applicable to power supplies.
4.2.10	Special supply apparatus			Not applicable to power supplies.
4.2.11	General supply apparatus			Not applicable to power supplies.
4.2.12	Legs and stands			Not applicable to power supplies.
4.3	Fault conditions	1.4.14/RD 5.3/RD		
4.3.1	Reduction of basic and supplementary clearances and creepage distances	2.10/RD		Reduction not permitted in IEC 61204-7
4.3.2	Short circuiting of parts across insulating materials	5.3.4/RD		Only functional insulation may be shorted. For others clearance, creepage and thickness through insulation has to be maintained.

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
4.3.3	Short or open circuit	1.4.14/RD 5.3/RD		
4.3.4	Short or open circuit	1.4.14/RD 5.3/RD		
4.3.5	Audio amplifier			Not applicable to power supplies.
4.3.6	Stalling of motors	Annex B/RD		
4.3.7	Continuous operation	1.4.14/RD 5.3/RD		
4.3.8	Alternative supply connection		PS-D.4.3.8	
4.3.9	Output connectors overload	1.4.14/RD 5.3/RD		
4.3.10	Vent opening blocking	5.3/RD		
4.3.11	Reverse polarity of batteries	4.3.8/RD		
4.3.12	Antenna			Not applicable to power supplies.
4.3.13	User settable voltage selecting device for input supply	5.3/RD		
4.3.14	User settable voltage selecting device for output voltage	1.4.101		
4.3.15	Apparatus supplied by general power supply			Not applicable to power supplies.
4.3.16	Battery charging circuit		PS-D.4.3.16	
5	Markings and instructions	1.7/RD	PS-D.5	Markings on the bottom of portable equipment acceptable if weight does not exceed 7 kg.
5.1	Identification and supply voltage	1.7/RD		
5.2	Terminals	1.7/RD	PS-D.5.2	Earth symbol only for the main protective earthing terminal

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
5.3	Exclamation symbol Component replacement	1.7.2/RD	PS-D.5.3	The symbol ISO 7000-4034 shall be placed next to the safety critical component in circuit diagrams and the equipment to indicate that such components shall be replaced by components specified in the documentation.
5.4	Language of instructions	1.7.12/RD		
5.4.1	Additional instructions	1.7.2/RD 1.7.15/RD		Some instructions are not applicable to power supplies.
5.4.2	All pole switch for permanently connected	1.7.2/RD		
6	Hazardous radiations			
6.1	Ionizing radiation			Not applicable to power supplies.
6.2	Laser radiation	4.3.13/RD* 4.3.13.5/RD **	PS-D.6.2	* IEC 60950 ** IEC 60950-1
6.2.1	Emission limits for laser radiation under normal operating conditions		PS-D.6.2.1	50 000 cycles on interlock
6.2.2	Emission limits for laser radiation under single fault conditions		PS-D.6.2.2	50 000 cycles on interlock
7	Heating under normal operating conditions	4.5./RD Table 4A/RD	PS-D.7 Table PS-D3	
7.1	General			
7.1.1	Accessible parts			
7.1.2	Parts other than windings, providing electrical insulation			
7.1.3	Parts acting as a support or a mechanical barrier			
7.1.4	Windings			
7.1.5	Parts not subject to a limit under .7.1 to 7.4 inclusive			

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
7.2	Heat resistance of insulating materials		PS-D.7.2	Temperature during test is 150 oC
8	Constructional requirements with regard to the protection against electric shock			
8.1	Examples of coatings not considered insulation	2.10.5.2/RD		
8.2	No electric shock when changing fuses, or setting the supply, etc.	2.1.1.1/RD		
8.3	Insulation to be non-hygroscopic	2.9.1/RD	PS-D.8.3	Different test to IEC 60950 and IEC 60950-1.
8.4	Hand removed covers	2.1.1/RD		
8.5	Basic insulation between earthed conductive parts and live parts for Class I Parts bridging basic insulation Earthing of accessible conductive parts	2.1.1.1/RD 2.1.1.7.100 1.5.7/RD 2.6/RD		IEC 60950 and IEC 60950-1 will require short circuiting a single component.
8.6	Double or reinforced insulation between accessible parts and live parts for Class II Bridging of parts	2.1.1.1/RD 1.5.7/RD		IEC 60950 and IEC 60950-1 will require short circuiting a single component.
8.7	Basic insulation only between unearthed accessible parts and live parts operating above 35 V peak to 71 V peak or above 60 V d.c. to 120 V d.c.			Not permitted by IEC 60950 and IEC 60950-1.

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
8.8	Construction and electric strength of insulations	2.10.5/RD		
8.9	Thickness of insulation of wires (between live parts and accessible parts)	3.1.4/RD		Reduction not permitted in IEC 60950 and IEC 60950-1
8.10	Insulation on conductors for Class II.	3.1.4/RD		
8.11	Detached wires	3.1.9/RD		
8.12	Size of conductors supplying mains socket outlets		PS-D.8.12	Conductors supplying mains socket outlets shall be same size as power supply cord conductors.
8.13	Windows, lenses and signal lamp covers to be secured positively if shock hazard exists	4.2.1/RD 4.3.4/RD		All covers required to be secured by positive means if shock hazard exists. 4.2.1/RD ensures that covers cannot be displaced in normal use or forseeable misuse.
8.14	Covers subject to forces to be secured positively if shock hazard exists if removed			Not applicable to power supplies.
8.15	Internal wiring to be secured and routed. No sharp edges.	3.1.2/RD		
8.16	Special supply apparatus not to be replaceable by general use apparatus without modification			Not applicable to power supplies.
8.17	Requirements for insulating winding wires for use without additional interleaved insulation	2.10.5.4/RD Annex U/RD		Wound components meeting the requirements of 8.18 of IEC 60065 Edition 7 are not acceptable for iec 60950 AND iec 60950-1.
8.18	Endurance test for wound components with insulating winding wires without additional interleaved insulation			Not acceptable for power supplies.

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
8.19	Disconnection from the mains	3.4/RD		
8.19.1	Disconnect devices	3.4.2/RD		
8.19.2	Switch position indications	1.7.8.3/RD		
8.20	Switches in mains cords	3.4.5/RD		
8.21	Components bridging contact gaps	1.5.6/RD 1.5.7/RD	PS-D.8.21*	*Contact gap of disconnect device is not allowed to be bridged by a single component under IEC 60950 and IEC 60950-1. However, other mains switches can comply with 8.21 of IEC 60065.
9	Electric shock hazard under normal operating conditions	2/RD		
9.1	Testing on the outside	2/RD		
9.1.1	General	2/RD		
9.1.1.1	Determination of hazardous live parts a) 35 V peak a.c. limit for SELV circuit b) Touch current limits c) Charge does not exceed 45 μC between 60 and 15 kV d) Energy does not exceed 350 mJ if V > 15 kV	2/RD 2.1/RD 2.4/RD 5.1/RD 2.4/RD 2.4/RD	PS-D.9.1.1.1a)	SELV shall not exceed 35V pk for IEC 60065.
9.1.1.2	Determination of accessible parts	2.1.1/RD		
9.1.2	Shafts of operating knobs, handles, levers and the like	2.1.1.6/RD 4.3.2/RD		
9.1.3	Openings of the enclosure		PS-D.9.1.3	
9.1.4	Terminals			Not applicable for power supplies.

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
9.1.5	Pre-set controls			Pre-set controls not to result in shock hazard when adjusted if marking is provided next to the hole. Not applicable to power supplies.
9.1.6	Withdrawl of mains plug		PS-D.9.1.6	
9.1.7	Resistance to external forces 50 N for 10 s 20 N for 10 s (test hook of Fig. 4) 250 N for 5 s	4.2.1/RD 4.2.4/RD	 PS-D.9.1.7 PS-D.9.1.7	
9.2	Removal of protective covers	2.1.1/RD		
10	Insulation requirements	2.9/RD 2.10/RD		
10.1	Surge test	7.3.2/RD*		* This test is only in IEC 60950-1 and so for power supplies this test must be carried out when required by the end equipment.
10.2	Humidity treatment	2.9.2/RD	PS-D.10.2	
10.3	Insulation resistance and dielectric strength	5.3/RD	PS-D.10.3	
10.3.1	Insulating materials		PS-D.10.3.1	
10.3.2	Insulation resistance and dielectric strength		PS-D.10.3.2	
11	Fault conditions	5.3/RD		
11.1	Electric shock hazard	2.3.3/RD 2.4/RD		IEC 60950 and IEC 60950-1 are more stringent.
11.2	Heating	5.3/RD	PS-D.11.2	Any flame shall extinguish within 10 s
11.2.1	Measurement of temperature rises	5.3/RD	PS-D.11.2.1 Table PS-D3	Fault tests at various current levels if a protective device opens
11.2.2	Accessible parts		PS-D.11.2.2 Table PS-D3	

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
11.2.3	Parts other than windings providing electrical insulation	5.3/RD	PS-D.11.2.3 Table PS-D3	
11.2.4	Parts acting as a support or a mechanical barrier	5.3/RD	PS-D.11.2.4 Table PS-D3	
11.2.5	Windings	5.3/RD	PS-D.11.2.5 Table PS-D3	
11.2.6	Parts not subject to a limit under 11.2.1 to 11.2.5 inclusive	5.3/RD	PS-D.11.2.6 Table PS-D3	
12	Mechanical strength	4.2/RD		
12.1	Complete power supply	5.3/RD		Not applicable to direct plug-in power supplies.
12.1.1	Bump test		PS-D.12.1.1	Applicable to stand alone power supplies only.
12.1.2	Vibration test		PS-D.12.1.2	
12.1.3	Impact test	4.2.5/RD		
12.1.4	Drop test	4.2.6/RD		
12.1.5	Stress relief test	4.2.7/RD		
12.2	Fixing of actuating elements		PS-D.12.2	
12.3	Remote control devices held in hand			Not applicable to power supplies
12.4	Drawers			Not applicable to power supplies
12.5	Antenna coaxial sockets			Not applicable to power supplies
12.6	Telescoping or rod antennas			Not applicable to power supplies
12.6.1	Physical securement			Not applicable to power supplies
13	Clearances and creepage distances			

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
13.1	General	2.10.1/RD 2.10.3/RD or Annex G/RD 2.10.4/RD		
13.2	Determination of operating voltage	2.10.2/RD		
13.3	Clearances	2.10.3/RD Annex G/RD		
13.3.1	General	2.10.3/RD Annex G/RD		
13.3.2	Clearances in circuits conductively connected to the mains	2.10.3.1/RD 2.10.3.2/RD		
13.3.3	Clearances in circuits not conductively connected to the mains	2.10.3.1/RD 2.10.3.3/RD		
13.3.4	Measurement of transient voltages	2.10.3.4/RD		
13.4	Creepage distances	2.10.4/RD		
13.5	Printed boards		PS-D.13.5	
13.5.1	Clearances and creepage distances on printed boards		PS-D.13.5.1	
13.5.2	Type B coated printed boards		PS-D.13.5.2	
13.6	Jointed insulation	2.10.8/RD		
13.7	Enclosed and sealed parts	2.10.7/RD	PS-D.13.7*	* Test procedure is same as in 2.9.7/RD. However, the clearance and creepage distances of Table 12 of IEC 60065 apply.
13.8	Insulating compound	2.10.8/RD		
14	Components	1.5/RD		
14.1	Resistors (fault tests)	5.3/RD		IEC 60950 and IEC 60950-1 is more stringent and requires the resistor to be shorted.
14.2	Capacitors and RC units	1.5.6/RD		

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
14.2.1 a)	Y2 and Y4 capacitors	1.5.6/RD		Capacitors bridging basic insulation.
14.2.1 b)	Y1 and Y2 capacitors	1.5.6/RD 1.5.7/RD		Capacitors bridging double or reinforced insulation.
14.2.2	X1 and X2 capacitors	1.5.6/RD		
14.2.3	X2 capacitors across the secondary of a transformer		PS-D.14.2.3	
14.2.4	Not used			
14.2.5	Capacitors and RC-units not covered by 14.2.1 to 14.2.4		PS-D.14.2.5	
14.3	Inductors and windings	Annex C.2/RD		
14.3.1	Marking		PS-D.14.3.1	
14.3.2	General (Separation requirements)	2.2.3.1/RD 2.2.3.2/RD 2.2.3.3/RD 2.9/RD		
14.3.3	Constructional requirements	2.10.4/RD		
14.3.3.1	All windings	2.10/RD		
14.3.3.2	Designs with more than one winding	Annex C.2/RD		
14.3.4	Separation between windings			
14.3.4.1	Windings of Class II construction	2.1/RD 2.2.3.1/RD		
14.3.4.2	Windings of Class I construction	2.1/RD 2.2.3.2/RD		
14.3.4.3	Windings of separating construction	2.1/RD 2.2.3.1/RD		
14.3.5	Insulation between hazardous live parts and accessible parts			

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
14.3.5.1	Windings of Class II construction	2.1/RD 2.2.3.1/RD		
14.3.5.2	Windings of Class I construction	2.1/RD 2.2.3.2/RD		
14.4	High voltage components and assemblies		PS-D.14.4	Test of V-1 or test of 14.4.1 and 14.4.2. This is more stringent than IEC 60950 and IEC 60950-1.
14.4.1	High voltage transformers and multipliers			Not needed
14.4.2	High voltage assemblies and other parts (Flammability test of V-1)			Not needed
14.5	Protective devices		PS-D.14.5	IEC60950 Edition 3 or IEC 60950-1 Edition 1 require double or reinforced only for disconnecting devices or interlock switches
14.5.1	Thermal releases		PS-D.14.5.1	
14.5.1.1	Thermal cutouts		PS-D.14.5.1.1	
14.5.1.2	Thermal links		PS-D.14.5.1.2	
14.5.1.3	Thermal interrupting devices		PS-D.14.5.1.3	
14.5.2	Fuse-links and fuseholders		PS-D.14.5.2	
14.5.2.1	Fuses to comply with IEC 60127		PS-D.14.5.2.1	
14.5.2.2	Markings		PS-D.14.5.2.2	
14.5.2.3	Fuses in the same circuit		PS-D.14.5.2.3	
14.5.2.4	Fuseholders	2.1/RD		
14.5.3	PTC thermistors		PS-D.14.5.3	
14.5.4	Protective devices not mentioned in 14.5.1, 14.5.2 or 14.5.3.	1.7/RD 2.7.3/RD		

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
14.6	Switches	1.5/RD	PS-D.14.6	Meet IEC 61058-1 or 14.6.1, 14.6.4 and 20.1.4
14.6.1	Testing of switches		PS-D.14.6.1	
14.6.2	Testing of switches		PS-D.14.6.2	
14.6.3	Testing of switches		PS-D.14.6.3	
14.6.4	Dielectric strength test		PS-D.14.6.4	
14.6.5	Mains switch controlling socket outlet		PS-D.14.6.5	
14.7	Safety interlocks	2.8/RD		
14.8	Voltage setting devices and the like	5.3/RD	PS-D.14.8	
14.9	Motors	Annex B/RD	PS-D.14.9	
14.9.1	Construction and tests	Annex B/RD	PS-D.14.9.1	
14.9.2	Effect of oil/grease	4.3.9/RD		
14.9.3	Moving parts	4.4/RD		
14.9.4	Special motors	Annex B/RD		
14.10	Batteries	4.3.8/RD		
14.10.1	Mounting	4.3.8/RD		
14.10.2	Replacement with non-rechargeable baterries	4.3.8/RD		
14.10.3	Normal and single faults	4.3.8/RD		
14.10.4	Battery mould stress relief		PS-D.14.10.4	
14.10.5	Battery drop test		PS-D.14.10.5	
14.11	Optocouplers		PS-D.14.11	
14.12	Surge suppression varistors		PS-D.14.12	
15	Terminals		PS-D.15	
15.1	Plugs and sockets	1.5/RD	PS-D.15.1	
15.1.1	Connection to mains	1.5/RD	PS-D.15.1.1	

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
15.1.2	Connectors other than mains	4.3.5/RD	PS-D.15.1.2	15.1.2 last paragraph is not required for power supplies.
15.1.3	Output terminals and connectors	4.3.5/RD	PS-D.15.1.3	
15.2	Provisions for protective earthing	2.6/RD		
15.3	Terminals for external flexible cords and permanent connection for the mains supply			
15.3.1	Permanently connected apparatus	3.3.1/RD		
15.3.2	Non-detachable cords	3.3.1/RD 3.3.2/RD	PS-D.15.3.2	Conductors of external cord not to be connected directly to the conductors of the printed board.
15.3.3	Threads of screws and nuts	3.3.3/RD		
15.3.4	Connections of mains supply cord to terminals	3.1.9/RD		
15.3.5	Terminals for external flexible cords	3.3.4/RD Table 3B/RD	Table PS-D15	
15.3.6	Terminal sizes	3.3.5/RD Table 3E/RD		
15.3.7	Terminal design	3.3.6/RD		
15.3.8	Contact pressure through insulating material	3.1.7/RD		
15.3.9	Proximity of terminals	3.3.7/RD 3.3.8/RD		
15.4	Devices forming a part of the mains plug	4.3.6/RD		
15.4.1	Torque test	4.3.6/RD		
15.4.2	Dimensions	4.3.5/RD 4.3.6/RD		
15.4.3	Mechanical strength	4.2.6/RD 4.3.6/RD	PS-D.15.4.3 b) and c).	

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
16	External flexible cords	3.2.5/RD		
16.1	Construction	3.2.5/RD		
16.2	Power supply cord conductor sizes	3.2.5/RD Table 3B/RD	PS-D.16.2 Table PS-D18	
16.3	Cords not complying with 16.1			Not applicable to power supplies
16.4	Temperature of insulation in cords		PS-D.16.4 Table PS-D3	
16.5	Strain relief	3.2.6/RD	PS-D.16.5	
16.6	Opening for strain relief	3.2.6/RD		
16.7	Transportable apparatus	4.6.4/RD	PS-D.16.7	
17	Electrical connections and mechanical fixings		PS-D.17	
17.1	Screw terminals for electrical connections	4.3.4/RD	PS-D.17.1	
17.2	Means for introducing screws into female threads	4.3.4/RD		
17.3	Captive screws		PS-D.17.3	
17.4	Mounting of parts	4.3.4/RD		
17.5	Contact pressure	3.1.6/RD		
17.6	Consolidation of strands by soldering	3.3.8/RD		
17.7	Cover fixing devices		PS-D.17.7	
17.8	Detachable legs/stands			Not applicable to power supplies
17.9	Internal pluggable connections		PS-D.17.9	
18	Mechanical strength of picture tubes and protection against the effects of implosion			Not applicable to power supplies

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
19	Stability and mechanical hazards	4.1/RD 4.2/RD		
19.1	10o tilt test	4.1/RD		
19.2	100 N downward force	4.1/RD		
19.3	100N horizontal force	4.1/RD		
19.4	Sharp edges/corners	4.3.1/RD		
19.5	Glass-shattering			Not applicable to power supplies
19.5.1	Test for 19.5			Not applicable to power supplies
19.6	Wall or ceiling mounting means	4.2.10/RD		
20	Resistance to fire	4.7/RD	PS-D.20	
20.1	Electrical components and mechanical parts	4.7.2/RD	PS-D.20.1	
20.1.1	Electrical components	4.7.3.3/RD 4.7.3.4/RD	PS-D.14 and PS-D.20.1.4	
20.1.2	Internal wiring	4.7.3.4/RD		
20.1.3	Printed boards	4.7.3.4/RD	PS-D.20.1.3	
20.1.4	Components and parts not covered by 20.1.1, 20.1.2 and 20.1.3	4.7.3.4/RD	PS-D.20.1.4	
20.2	Fire enclosure	4.7.3.2/RD	PS-D.20.2	
20.2.1	Potential ignition sources	4.7.2.1/RD	PS-D.20.2.1	
20.2.2	Openings in internal fire enclosures		PS-D.20.2.2	
20.2.3	Parts outside the fire enclosure	4.7.3.3/RD		
Annex A	Additional requirements for apparatus with protection against splashing water	Annex T/RD	Annex PS-D.A	

Clause in IEC 60065	Clause title/intent	Clause in IEC 61204-7		Comments b)
		Main body	Annex PS-D a)	
Annex B	Apparatus to be connected to telecommunication networks	2.3/RD 6/RD	Annex PS-D.B	9th and 13th paragraphs of Annex B are different.
Annex C	Band-pass filter for wide-band noise measurement			Not applicable to power supplies
Annex D	Measuring network for touch currents	Annex D/RD		
Annex E	Measurement of clearances and creepage distances	Annex F/RD		
Annex F	Table of electrochemical potentials	Annex J/RD		
Annex G	Flammability test methods	Annex A/RD	Annex PS-D.G	
Annex H	Insulated winding wires for use without interleaved insulation	Annex U/RD		
Annex J	Alternative method for determining minimum clearances	Annex G/RD		
Annex K	Impulse test generators	Annex N/RD		
Annex M	Examples of requirements for quality controlled programmes	Annex R/RD		
Annex N	Routine tests	5.2/RD	Annex PS-D.N	Certification issue

a) Clauses in this column are in Annex PS-D and contain the relevant information to comply with IEC 60065.

b) Information in this column contains a reason or an explanation.

PS-D.1 General

PS-D.1.1.2 Scope

This annex covers power supplies with a rated supply voltage not exceeding 250 V a.c. single phase or 250 V d.c., 433 V a. c. for other than single phase.

PS-D.1.2 Normative references

Annex P/RD applies with the addition of the following.

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60027 (all parts), Letter symbols to be used in electrical technology

IEC 60038:1983, IEC standard voltages

IEC 60068-2-3:1969, Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state

IEC 60068-2-6:1995, Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)

IEC 60068-2-32:1975, Environmental testing – Part 2: Tests – Test Ed: Free fall (Procedure 2)

IEC 60068-2-75:1997, Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests

IEC 60167:1964, Methods of test for the determination of the insulation resistance of solid insulating materials

IEC 60216 (all parts), Guide for the determination of thermal endurance properties of electrical insulating materials

IEC 60249-2 (all specifications), Base materials for printed circuits – Part 2: Specifications

IEC 60268-1:1985, Sound system equipment – Part 1: General

IEC 60317 (all parts), Specifications for particular types of winding wires

IEC 60335-1:2001, Household and similar electrical appliances – Safety – Part 1: General requirements

IEC 60384-1:1982, Fixed capacitors for use in electronic equipment – Part 1: Generic specification

IEC 60384-14:1993, Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains
Amendment 1 (1995)

IEC 60417 (all parts), Graphical symbols for use on equipment

IEC 60454 (all parts), Specifications for pressure-sensitive adhesive tapes for electrical purposes

IEC 60664-3:1992, Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings to achieve insulation coordination of printed board assemblies

IEC 60691:1993, Thermal links – Requirements and application guide

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

IEC 60707:1999, Flammability of solid non-metallic materials when exposed to flame sources – List of test methods

IEC 60730 (all parts), Automatic electrical controls for household and similar use.

IEC 60884 (all parts), Plugs and socket-outlets for household and similar purposes

IEC 60906 (all parts), IEC system of plugs and socket-outlets for household and similar purposes

IEC 60998-2-2:1991, Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units

IEC 60999-1:1999, Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm2 up to 35 mm2 (included)

IEC 61051-2:1991, Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors

IEC/TR2 61149:1995, Guide for safe handling and operation of mobile radio equipment

IEC 61260:1995, Electroacoustics – Octave-band and fractional-octave-band filters

IEC 61293:1994, Marking of electrical equipment with ratings related to electrical supply – Safety requirements

IEC 61558-1:1997, Safety of power transformers, power supply units and similar – Part 1: General requirements and tests
Amendment 1 (1998)

IEC 61965:2000, Mechanical safety of cathode ray tubes

IEC 62151:2000, Safety of equipment electrically connected to a telecommunication network

IEC Guide 104:1997, The preparation of safety publications and the use of basic safety publications and group safety publications

ISO 306:1994, Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)

ITU-T Recommendation K17:1988, Tests on power-fed repeaters using solid-state devices in order to check the arrangements for protection from external interference

ITU-T Recommendation K21:1996, Resistibility of telecommunication equipment installed in customer's premises to overvoltages and overcurrents

PS-D.2 Definitions

The following definitions apply in addition to 1.2/RD.

Definitions in alphabetical order of nouns

PS-D.2.4.3
DIRECTLY CONNECTED TO THE MAINS
electrical connection with the MAINS in such a way that a connection to either pole of the MAINS causes in that connection a permanent current equal to or greater than 9 A, protective devices in the apparatus being not short-circuited

NOTE A current of 9 A is chosen as the minimum breaking current of a 6 A fuse.

PS-D.2.4.4
CONDUCTIVELY CONNECTED TO THE MAINS
electrical connection with the MAINS in such a way that a connection through a resistance of 2 000 Ω to either pole of the MAINS causes in that resistance a permanent current greater than 0,7 mA (peak), the apparatus not being connected to earth

PS-D.2.4.5
TERMINAL
part of an apparatus by which connection is made to external conductors or other apparatus. It may contain several contacts

PS-D.2.4.6
PROTECTIVE EARTHING TERMINAL
TERMINAL to which parts are connected which are required to be connected to earth for safety reasons

PS-D.2.4.8
remote power feeding
supply of power to apparatus via a cable network, for example a telecommunication network or a cable distribution network for antenna signals

PS-D.2.7.3
THERMAL RELEASE
device which prevents the maintenance of excessively high temperatures in certain parts of the apparatus by disconnecting these parts from their supply

NOTE PTC thermistors (see 2.7.8) are not thermal releases in the sense of this definition.

PS-D.2.7.5
THERMAL LINK
THERMAL RELEASE without reset, which operates only once and then requires partial or complete replacement

PS-D.2.7.8
PTC THERMISTOR
thermally sensitive semiconductor resistor, which shows a step-like increase in its resistance when the increasing temperature reaches a specific value. The change of temperature is obtained either by the flow of current through the thermosensitive element, or by a change in the ambient temperature, or by a combination of both

PS-D.2.7.14
special battery
rechargeable battery or group of rechargeable batteries, identified by battery manufacturer's name and catalogue number, provided with the apparatus or recommended by the manufacturer

PS-D.2.8.6
INSTRUCTED PERSON
person adequately advised or supervised by SKILLED PERSONS to enable him or her to avoid dangers and to prevent risks which electricity may create

PS-D.2.8.11
potential ignition source
possible fault which can start a fire if the open-circuit voltage measured across an interruption or faulty contact exceeds a value of 50 V (peak) a.c. or d.c. and the product of the peak value of this voltage and the measured r.m.s. current under normal operating conditions exceeds 15 VA.

Such a faulty contact or interruption in an electrical connection includes those which may occur in conductive patterns on printed boards

NOTE An electronic protection circuit may be used to prevent such a fault from becoming a potential ignition source.

PS-D.4.1.4
Position of intended usage
Any position of intended use of the apparatus, normal ventilation not being impeded.

The temperature measurements shall be carried out with the apparatus positioned in accordance with the instructions for use provided by the manufacturer, or, in the absence of instructions, the apparatus shall be positioned 5 cm behind the front edge of an open-fronted wooden test box with 1 cm free space along the sides and top and 5 cm depth behind the apparatus.

Tests on apparatus, intended to be part of an assembly not provided by the apparatus manufacturer, shall be carried out according to the instructions for use provided by the apparatus manufacturer, specifically those dealing with proper ventilation.

The apparatus shall also comply with table PS-D3 when tested on an open bench.

PS-D.4.2.1 Supply tolerances

1.4.5/RD applies except the tolerances are ± 10% for all supplies.

PS-D.4.3.8 Alternative supply connection

The apparatus is connected simultaneously to alternative types of supply unless this is prevented by the construction.

PS-D.4.3.16 Battery charging circuit

For apparatus with a charging circuit, recharge a fully discharged special battery with one cell short-circuited.

NOTE See also PS-D.11.2 and 4.3.8/RD

PS-D.5 Markings and instructions

NOTE Additional requirements for marking and instructions are contained in 1.7/RD, 1.7.2/RD, 1.7.8.3/RD, 2.3/RD, 2.7.3/RD, 3.4.2/RD, 4.1/RD, PS-D.4.1.4, 4.2/RD, 4.2.10/RD, 4.3.1/RD, 6/RD, PS-D.14.3.1, PS-D.14.5.1.3, PS-D.14.5.2.2 and annex PS-D.B.

Markings shall be permanent, comprehensible and easily discernible on the apparatus when ready for use.

The information should preferably be on the exterior of the apparatus, excluding the bottom. It is, however, permissible to have it in an area that is easily accessible by hand, for example under a lid, or on the exterior of the bottom of a portable apparatus or an apparatus with a mass not exceeding 7 kg, provided that the location of the marking is given in the instructions for use.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and, at a different place or on a second sample, for 15 s with a piece of cloth soaked with petroleum spirit. After this the marking shall be legible; it shall not be easily possible to remove marking plates and they shall show no curling.

Petroleum spirit, to be used for reference purposes is defined as follows:

The petroleum spirit is an aliphatic solvent hexane having a maximum aromatics content of 0,1 % by volume, a kauri-butanol value of 29, an initial boiling point of approximately 65 °C, a dry-point of approximately 69 °C and a specific mass of approximately 0,7 kg/l.

Letter symbols for quantities and units shall be in accordance with IEC 60027.

Graphical symbols shall be in accordance with IEC 60417 and ISO 7000, as appropriate.
Compliance is checked by inspection.

PS-D.5.2 Terminals

Terminals shall be marked as follows:

a) The wiring terminal intended for connection of the protective earthing conductor associated with the supply wiring:

(IEC 60417-5019)

This symbol shall not be used for other earthing terminals.

b) Terminals which are hazardous live under normal operating conditions, except terminals for mains supply:

(IEC 60417-5036)

c) Output terminals provided for supply of other apparatus except mains supply shall be marked with the nominal output voltage and, in addition, the maximum output current, if with the most unfavourable load temperature rises higher than those allowed in table PS-D3 can occur, unless the terminals are marked with the type references of the apparatus which are permitted to be connected.

   Socket-outlets providing mains power to other apparatus shall be marked with the power and current which may be drawn.

   If there is only one terminal provided for supply of other apparatus, the marking may be put on the apparatus at any place, taking into account the first paragraphs of clause PS-D.5.

Compliance is checked by inspection.

PS-D.5.3
Exclamation symbol

Where in a manufacturer's service documentation, for example in circuit diagrams or lists of components, a symbol is used to indicate that a specific component shall be replaced only by the component specified in that documentation for safety reasons, the following symbol shall be used:

(ISO 7000-0434)

This symbol may also be put adjacent to the relevant component.
This symbol shall not be placed on components.
Compliance is checked by inspection.

PS-D.6.2
Laser radiation

An apparatus containing a laser system shall be so constructed that personal protection against laser radiation is provided under normal operating conditions and under fault conditions.

An apparatus containing a laser system is exempt from all further requirements of this subclause if

– classification by the manufacturer according to IEC 60825-1, clauses 3, 8 and 9 shows that the approachable emission level does not exceed class 1 under all conditions of operation, maintenance, service and failure, and

– it does not contain an embedded laser according to IEC 60825-1.

NOTE 1 Information about the measuring equipment is given in IEC 61040.

NOTE 2 The term "approachable emission level" denotes "accessible emission limit (AEL)" in the sense of IEC 60825-1.

Apparatus shall be classified and labelled in accordance with the approachable emission level measured under fault conditions, except that for apparatus not exceeding class 1, 5.2 of IEC 60825-1, does not apply.

All controls adjustable from the outside by hand or any object such as a tool or a coin, and those internal adjustments or pre-sets which are not locked in a reliable manner, are adjusted so as to give maximum radiation.

NOTE 3 Soldered joints and paint locking are examples of adequate locking.

The laser radiation emitted by redirection as mentioned in IEC 60825-1, 3.32 b), shall not be measured for a laser system of class 1.

Compliance is met by satisfying the relevant requirements as specified in IEC 60825-1 with the following modifications and additions:

PS-D.6.2.1 Emission limits under normal operating conditions

a) The apparatus shall meet under normal operating conditions, the approachable emission limits of class 1 as specified in IEC 60825-1, table 1. Time basis of the classification is 100 s.

   Compliance is checked by performing the relevant measurements as specified in IEC 60825-1, 8.2.

b) If the apparatus incorporates a laser system which meets, under normal operating conditions, the approachable emission limits of class 1, the requirements mentioned under c) and d) do not apply.

c) Adequate measures shall be taken to prevent the opening of any cover by hand giving access to laser radiation in excess of class 1 limits.

   Compliance is checked by inspection and measurement.

d) Where safety is dependent on the proper functioning of a mechanical safety interlock, this interlock shall be fail-safe (in the failure mode the apparatus is rendered inoperative or non hazardous), or shall withstand a switching test of 50 000 cycles of operation with current and voltage applied as under normal operating conditions.

   Compliance is checked by inspection or test.

PS-D.6.2.2 Emission limits under single fault conditions

a) When the apparatus is operated under fault conditions as specified in 4.3, the approachable emission level from the apparatus shall be not higher than class 3R outside the wavelength range of 400 nm to 700 nm and not higher than five times the limit for class 1 within the wavelength range of 400 nm to 700 nm.

NOTE The class 3R limits are as specified in IEC 60825-1, table 3.

   Compliance is checked by performing the relevant measurements as specified in IEC 60825-1, 8.2

b) If the apparatus incorporates a laser system which meets, under fault conditions, the approachable emission limits given in PS-D.6.2.2 a), the requirements mentioned under c) and d) do not apply.

c) Adequate measures shall be taken to prevent the opening of any cover by hand giving access to laser radiation in excess of the limits given in PS-D.6.2.2 a).

   Compliance is checked by inspection and measurement.

d) Where safety is dependent on the proper functioning of a mechanical safety interlock, this interlock shall be fail-safe (in the failure mode the apparatus is rendered inoperative or non hazardous), or shall withstand a switching test of 50 000 cycles of operation with current and voltage applied as under normal operating conditions.

Compliance is checked by inspection or test.

PS-D.7 Heating under normal operating conditions

PS-D.7.1 General

During intended use, no part of the apparatus shall attain an excessive temperature.

Compliance is checked by measuring the temperature rises under normal operating conditions when a steady state has been attained.

NOTE 1 In general, a steady state is assumed to be attained after 4 h of operation.

Temperature rises are determined:

– in the case of winding wires, by the change in resistance method or any other method giving the average temperature of the winding wires;

NOTE 2 Care should be taken to ensure that during the measurement of the resistance of winding wires, the influence of circuits or loads connected to these winding wires is negligible.

– in other cases, by any suitable method.

Temperature rises shall not exceed the values specified in PS-D.7.1.1 to PS-D.7.1.5 inclusive.

Any single protective device or component of a protective circuit operating during the test shall be defeated, except for
a) thermal cut-outs with automatic reset complying with PS-D.14.5.1,

b) ptc thermistors complying with PS-D.14.5.3.

Consequently, if continuous operation of an audio amplifier is not possible, the amplifier shall also be operated at the maximum possible signal level permitting continuous operation.

PS-D.7.1.1 Accessible parts

The temperature rise of accessible parts shall not exceed the values given in table PS-D3, item a), "Normal operating conditions".

PS-D.7.1.2 Parts, other than windings, providing electrical insulation

The temperature rise of insulating parts, other than windings, providing basic, supplementary, or reinforced insulation, and of insulating parts, the failure of which would cause an infringement of the requirements of 2/RD or a fire hazard, shall not exceed the values given in table PS-D3, item b) "Normal operating conditions", taking into account condition d) of table PS-D3.

If an insulating part is used to establish a clearance or to contribute to a creepage distance and its permissible temperature rise is exceeded, then the relevant area of the insulating part is disregarded when compliance with clauses 1.5.6/RD, 1.5.7/RD, 1.7.8.3/RD, 2.1.1/RD, 2.6/RD, 2.9.1/RD, 2.10.5/RD, 3.1/RD, 3.4/RD, 4.2.1/RD, 4.3.4/RD, Annex U/RD, PS-D.8.3, PS-D.8.12, PS-D.21, 2.3.3/RD, 2.4/RD and 5.3/RD is checked.

PS-D.7.1.3 Parts acting as a support or a mechanical barrier

The temperature rise of parts, a mechanical failure of which would cause an infringement of the requirements of 2/RD, shall not exceed the value given in table PS-D3, item c) "Normal operating conditions".

PS-D.7.1.4 Windings

The temperature rise of windings comprising insulation providing protection against electric shock or fire hazard shall not exceed the values given in table PS-D3, items b) and d) "Normal operating conditions".

If an insulating part is used to establish a clearance or to contribute to a creepage distance and its permissible temperature rise is exceeded, then the relevant area of the insulating part is disregarded when compliance with clauses 1.5.6/RD, 1.5.7/RD, 1.7.8.3/RD, 2.1.1/RD, 2.6/RD, 2.9.1/RD, 2.10.5/RD, 3.1/RD, 3.4/RD, 4.2.1/RD, 4.3.4/RD, Annex U/RD, PS-D.8.3, PS-D.8.12, PS-D.21, 2.3.3/RD, 2.4/RD and 5.3/RD is checked.

NOTE If the insulation is incorporated in a winding in such a way that its temperature rise cannot be measured directly, the temperature is assumed to be the same as that of the winding wire.

PS-D.7.1.5 Parts not subject to a limit under PS-D.7.1.1 to PS-D.7.1.4 inclusive

According to the nature of the material, the temperature rise of the part shall not exceed the values given in table PS-D3, item e), "Normal operating conditions".

Table PS-D3 – Permissible temperature rise of parts of the power supply

Parts of the apparatus	Normal operating conditions K	Fault conditions K
a) Accessible parts		
Knobs, handles, etc. if		
– metallic	30	65
– non-metallic c	50	65
Enclosures if		
– metallic a	40	65
– non-metallic b + c	60	65
b) Parts providing electrical insulation d		
Supply cords and wiring insulation with		
– polyvinyl chloride or synthetic rubber		
– not under mechanical stress	60	100
– under mechanical stress	45	100
– natural rubber	45	100
Other insulations of:		
– thermoplastic materials e	f)	f)
– non-impregnated paper	55	70
– non-impregnated cardboard	60	80
– impregnated cotton, silk, paper and textile	70	90
– laminates based on cellulose or textile, bonded with		
– phenol-formaldehyde, melamine-formaldehyde, phenol-furfural or	85	110
polyester	120	150
– epoxy		
– mouldings of		
– phenol-formaldehyde or phenol-furfural, melamine and melamine	100	130
phenolic compounds with	110	150
– cellulose fillers	95	150
– mineral fillers	95	150
– thermosetting polyester with mineral fillers		
– alkyd with mineral fillers	95	150
– composite materials of	100	150
– polyester with glass-fibre reinforcement	145	190
– epoxy with glass-fibre reinforcement		
– silicone rubber		
c) Parts acting as a support or a mechanical barrier including the inside		
of enclosures d	60	90
Wood and wood-based materials	f)	f)
Thermoplastic materials e	d)	d)
Other materials		
d) Winding wires d + g		
– insulated with		
– non-impregnated silk, cotton, etc.	55	75
– impregnated silk, cotton, etc.	70	100
– oleoresinous materials	70	135
– polyvinyl-formaldehyde or polyurethane resins	85	150
– polyester resins	120	155
– polyesterimide resins	145	180
e) Other parts		

These temperature rises apply to parts not covered by items a), b), c) and d):		
Parts of wood and wood-based material	60	140
Lithium batteries	40	50
Resistors and parts of metal, glass, ceramic, etc.	No limit	No limit
All other parts	200	300

For conditions see the following page.

Table PS-D3 (continued)

Conditions applicable to table PS-D3

a For tropical climates, permissible temperature rises of 10 K less than those specified in this table are required.

The values of the temperature rises are based on a maximum ambient temperature of 35 °C for moderate climates and of 45 °C for tropical climates.

Where the temperatures are thermostatically limited by a thermal cut-out with automatic reset or a ptc thermistor, the measured temperature on the part shall not exceed 35 °C plus the permitted rise of table PS-D3.

b For parts not likely to be touched during intended use, temperature rises up to 65 K are allowed under normal operating conditions. The wooden test box of PS-D.4.1.4 shall not be used when evaluating access to parts likely to be touched. The following parts are considered not likely to be touched:

– rear and bottom panels, except those incorporating switches or controls handled during normal use,

– external heatsinks and metallic parts directly covering external heatsinks, except those on surfaces incorporating switches or controls handled during normal use,

– parts of the top surface which are more than 30 mm below the general plane of the top surface.

For outside parts of metal which are covered with plastic material, the thickness of which is at least 0,3 mm, a temperature rise which corresponds to the permissible temperature rise of the insulating material is allowed.

c 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.

d For the purpose of this standard, the permissible temperature rises are based on service experience in relation to the thermal stability of the materials. The materials quoted are examples. For materials for which higher temperature limits are claimed, and for materials other than those listed, the maximum temperatures shall not exceed those which have been proved to be satisfactory, for example in accordance with IEC 60085.

e Natural rubber and synthetic rubbers are not considered as being thermoplastic materials.

f Due to their wide variety, it is not possible to specify a generic permissible temperature rise for thermoplastic materials. In order to determine the softening temperature of a specific thermoplastic material, the softening temperature as determined by the test B50 of ISO 306 shall be used. If the material is not known or if the actual temperature of the parts exceeds the softening temperature, the test described under 1) shall be used.

1) the softening temperature of the material is determined on a separate specimen, under the conditions specified in ISO 306 with a heating rate of 50 °C/h and 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.

2) the temperature limits to be considered for determining the temperature rises are:

– under normal operating conditions, a temperature of 10 K below the softening temperature;

– under fault conditions, the softening temperature itself.

If the required softening temperature exceeds 120 °C, condition c shall be taken into account.

g For switch mode transformers temperature rises may be measured with a thermocouple placed as close as practicable to the winding. The permitted temperature rise shall be 10 K less than that given in table PS-D3.

PS-D.7.2 Heat resistance of insulating material

Insulating material supporting parts conductively connected to the mains shall be resistant to heat if, during intended use, these parts carry a steady-state current exceeding 0,2 A and can generate substantial heat due to imperfect contact.

Compliance is checked by subjecting the insulating material to the test specified in table PS-D3, condition f.

The softening temperature of the insulating material shall be at least 150 °C.

In those cases where two groups of conductors, each supported by insulating parts, can be rigidly connected or joined together, for example by plug and socket, only one of the insulating parts need meet the test. Where one of the insulating parts is fixed in the apparatus, this part shall meet the test.

NOTE 1 Examples of parts which can generate substantial heat during intended use are contacts of switches and of voltage setting devices, screw terminals and fuse holders.

NOTE 2 This test need not be performed on parts which are in accordance with a relevant IEC standard.

PS-D.8.3 Insulation to be non-hygroscopic

The insulation of hazardous live parts shall not be provided by hygroscopic materials.

Compliance is checked by inspection and, in case of doubt, by the following test.
A specimen of the material, as specified in IEC 60167, clause 9, is subjected to a temperature of (40 ± 2) °C, and a relative humidity of 90 % to 95 %, the conditioning period being:

– 7 days (168 h) for apparatus to be used under tropical conditions;

– 4 days (96 h) for other apparatus.

Within 1 min after this preconditioning, the specimen shall withstand the tests of PS-D.10.3 without the humidity treatment according to PS-D.10.2.

PS-D.8.12 Size of conductors supplying mains socket outlets

Conductors of internal wiring connecting mains socket-outlets incorporated in the apparatus to the mains terminals either directly or via a mains switch shall comply with the cross-sectional area requirements of 3.2.5/RD, Table 3B/RD and Table PS-D18.

Compliance is checked by inspection.

PS-D.8.21 Components bridging contact gaps

Where resistors, capacitors or RC-units are used for bridging contact gaps of switches conductively connected to the mains, the components shall comply with 1.5.6/RD.

Compliance is checked by inspection.

PS-D.9.1.1.1. Determination of hazardous live parts

In order to verify that a part or a contact of a terminal is hazardous live, the following measurements are carried out between any two parts or contacts, then between any part or contact and either pole of the supply source used during the test. Discharges shall be measured to the terminal provided for connecting the apparatus to the supply source, immediately after the interruption of the supply.

NOTE 1 For discharges between the poles of the mains plug, see PS-D.9.1.6.

The part or contact of a terminal is hazardous live if

a) the open-circuit voltage exceeds

   – 35 V (peak) a.c. or 60 V d.c.,

– for audio signals of professional apparatus, 120 V r.m.s.,
– for audio signals of other than professional apparatus, 71 V r.m.s.;

If the voltage limits in a) are exceeded, provisions 2.4/RD apply.

PS-D.9.1.3 Openings of the enclosure

The apparatus shall be so designed that suspended foreign bodies cannot become hazardous live, when introduced through ventilation or other holes.

Compliance is checked by applying to the holes a metal test pin having a diameter of 4 mm and a length of 100 mm. The test pin is suspended freely from one end, the penetration is limited to the length of the test pin.

The test pin shall not become hazardous live.

PS-D.9.1.6 Withdrawal of mains plug

Apparatus intended to be connected to the mains by means of a mains plug shall be so designed that there is no risk of an electric shock from stored charge on capacitors, when touching the pins or contacts of the plug after its withdrawal from the socket-outlet.

NOTE For the purpose of this subclause, male interconnection couplers and male appliance couplers are regarded as mains plugs.

Compliance is checked by measurement according to PS-D.9.1.1.1 a) or 2.4/RD or by calculation.

The mains switch, if any, is in the off-position, unless it is more unfavourable in the on-position.

Two seconds after withdrawal of the mains plug, the pins or contacts of the plug shall not be hazardous live.

The test may be repeated up to 10 times to obtain the most unfavourable situation.

If the nominal capacitance across the mains poles does not exceed 0,1 μF, no test is conducted.

PS-D.9.1.7 Resistance to external forces

The enclosure of the apparatus shall be sufficiently resistant to external forces.

Compliance is checked by the following tests:

a) by means of a rigid test finger according to IEC 61032, test probe 11, a force of 50 N ± 5 N, directed inwards, is applied for 10 s to different points of the enclosure including openings and textile coverings.

   The force shall be so exerted by the tip of the test finger as to avoid wedge or lever action.

   During the test, the enclosure shall not become hazardous live, hazardous live parts shall not become accessible, textile coverings shall not touch hazardous live parts;

b) by means of a test hook as shown in figure PS-D4, a force of 20 N ± 2 N, directed outwards, is applied for 10 s at all points where this is possible.

   During the test, hazardous live parts shall not become accessible;

c) external conductive enclosures and conductive parts of an external enclosure shall be subjected for 5 s to a steady force of (250 ± 10) N for floor-standing apparatus or (100 ± 10) N for other apparatus, applied to the enclosure or to a part of the enclosure fitted to the apparatus, by means of a suitable test tool providing contact over a circular plane surface 30 mm in diameter.

NOTE 1 Contacts of terminals are not considered to be a conductive part of the external enclosure.

After the tests, the apparatus shall show no damage in the sense of this standard.

NOTE 2 The apparatus need not be connected to the supply source during the tests.

PS-D.10.2 Humidity treatment

The safety of the apparatus shall not be impaired by humidity conditions which may occur in the intended use.

Compliance is checked by the humidity treatment described in this subclause, followed immediately by the tests of PS-D.10.3.

Cable entries, if any, are left open. If knock-outs are provided, they are opened.

Electrical components, covers and other parts which can be removed by hand are removed and subjected, if necessary, to the humidity treatment with the main part.

The humidity treatment is carried out in a humidity chamber containing air with a relative humidity of 93 +~~2~~3 %.

The temperature of the air, at all places where the apparatus can be located, is maintained at 30 ~~0~~2 °C.

Apparatus intended to be used in tropical climates are subjected to a temperature of 40+~~2~~2 °C and a relative humidity of 93 +~~2~~3 %.

Before being placed in the chamber, the apparatus is brought to a temperature between the specified temperature and a 4 K higher temperature.

The apparatus is kept in the chamber for

– 5 days (120 h) for apparatus intended to be used in tropical climates,

– 2 days (48 h) for other apparatus.

NOTE 1 In most cases, the apparatus may be brought to the specified temperature by keeping it at this temperature for at least 4 h before the humidity treatment.

NOTE 2 The air in the chamber should be stirred and the chamber should be so designed that mist or condensed water will not precipitate on the apparatus.

NOTE 3 During this test, the apparatus should not be energized.

After this treatment, the apparatus shall show no damage in the sense of this standard.

PS-D.10.3 Insulation resistance and dielectric strength

PS-D.10.3.1 Insulating materials

The insulation of the insulating materials shall be adequate.

Compliance is checked in accordance with PS-D.10.3.2, and, unless otherwise stated, immediately after the humidity treatment according to PS-D.10.2.

NOTE In order to facilitate dielectric strength testing, components and subassemblies may be tested separately.

PS-D.10.3.2 Insulation resistance and dielectric strength

The insulations listed in table PS-D5 shall be tested:

– for insulation resistance with 500 V d.c.; and

– for dielectric strength as follows:

- insulations stressed with d.c. voltage (ripple free) are tested with a d.c. voltage;
- insulations stressed with a.c. voltage are tested with an a.c. voltage at mains frequency.

However, where corona, ionization, charge effects or the like may occur, a d.c. test voltage is recommended.

NOTE 1 Where there are capacitors across the insulation under test, it is recommended that d.c. test voltages are used.

Test voltages shall be as specified in table PS-D5 for the appropriate grade of insulation (basic, supplementary or reinforced insulation) and for the operating voltage U across the insulation.

For the purpose of determining the operating voltage U, the following applies:

– the apparatus is fed by its rated supply voltage;
– in case of a.c. voltages, the true peak value including periodic and non-periodic superimposed pulses with a half-value time longer than 50 ns shall be measured;
– in case of d.c. voltages, the peak value of any superimposed ripple shall be included;
– periodic and non-periodic transients with a half-value time not exceeding 50 ns shall be disregarded;
– unearthed accessible conductive parts shall be assumed to be connected to an earth terminal or to a protective earthing terminal or contact;
– where a transformer winding or other part is floating, i.e. not connected to a circuit which establishes its potential relative to earth, it shall be assumed to be connected to an earth terminal or to a protective earthing terminal or contact at the point which results in the highest operating voltage being obtained;
– where double insulation is used, the operating voltage across the basic insulation shall be determined by imagining a short-circuit across the supplementary insulation, and vice versa. For insulation between transformer windings, the short-circuit shall be assumed to take place at the point at which the highest operating voltage is produced across the other insulation;
– for insulations between two transformer windings, the highest voltage between any two points in the two windings shall be used, taking into account external voltages to which the windings may be connected;
– for insulations between a transformer winding and another part, the highest voltage between any point of the winding and the other part shall be used.

The test voltages shall be obtained from a suitable source so designed that, when the output terminals are short-circuited after the test voltage has been adjusted to the appropriate level, the output current is at least 200 mA.

An over-current device shall not trip when the output current is less than 100 mA.

Care shall be taken that the value of the test voltage applied is measured within ±3 %.

Initially, not more than half of the prescribed test voltage is applied, then it is raised rapidly to the full value which is held for 1 min.

The measurements of the insulation resistance and the dielectric strength tests are made in the humidity chamber, or in the room in which the apparatus was brought to the prescribed temperature, after the reassembly of those parts which may have been removed.

The apparatus is deemed to comply with the requirement, if the insulation resistance measured after 1 min is not less than the values given in table 5 and no flash-over or breakdown occurs during the dielectric strength test.

When testing enclosures of insulating material, a metal foil is pressed tightly against accessible parts.

For apparatus incorporating both reinforced insulation and lower grades of insulation, care shall be taken that the voltage applied to the reinforced insulation does not overstress basic or supplementary insulation.

NOTE 2 Accessible conductive parts may be connected together during the dielectric strength test.

NOTE 3 An instrument to carry out the dielectric strength test on thin sheets of insulating material is described in figure PS-D6.

NOTE 4 The test is not made on insulation the short-circuiting of which does not cause any electric shock hazard, for example in the case where one end of a secondary winding of an isolating transformer is connected to an accessible conductive part, the other end need not meet any insulation requirement with regard to the same accessible conductive part.

Resistors, capacitors and RC-units complying with 5.3/RD, 1.5.6/RD and 1.5.7/RD respectively, connected in parallel with the insulations to be tested, are disconnected. Inductors and windings which otherwise would prevent the test from being made, are also disconnected.

Table PS-D5 – Test voltages for dielectric strength test and values for insulation resistance

<table>
<tr><th>Insulation</th><th>Insulation resistance</th><th>AC test voltage (peak) or DC test voltage</th></tr>
<tr><td>1 Between parts of different polarity directly connected to the mains.</td><td>2 MΩ</td><td>For rated mains voltages ≤150 V (r.m.s.): 1 410 V
For rated mains voltages >150 V (r.m.s.): 2 120 V</td></tr>
<tr><td>2 Between parts separated by basic insulation or by supplementary insulation.</td><td>2 MΩ</td><td>Curve A of figure PS-D7</td></tr>
<tr><td>3 Between parts separated by reinforced insulation.</td><td>4 MΩ</td><td>Curve B of figure PS-D7</td></tr>
<tr><td colspan="3">NOTE Curves A and B of figure PS-D7 are defined by the following points:
<table>
<tr><th rowspan="2">Operating voltage U (peak)</th><th colspan="2">Test voltage (peak)</th></tr>
<tr><th>Curve A</th><th>Curve B</th></tr>
<tr><td>35 V</td><td>707 V</td><td>1 410 V</td></tr>
<tr><td>354 V</td><td></td><td>4 240 V</td></tr>
<tr><td>1 410 V</td><td>3 980 V</td><td></td></tr>
<tr><td>10 kV</td><td>15 kV</td><td>15 kV</td></tr>
<tr><td>>10 kV</td><td>1,5U V</td><td>1,5U V</td></tr>
</table></td></tr>
</table>

PS-D.11.2 Heating

When the apparatus is operated under fault conditions, no part shall reach such a temperature that:

– there is a danger of fire to the surroundings of the apparatus;
– safety is impaired by abnormal heat developed in the apparatus.

Compliance is checked by the tests of PS-D.11.2.1.

During the tests, any flame inside the apparatus shall extinguish within a period of 10 s.

During the test, solder may soften or become fluid as long as the apparatus does not become unsafe within the sense of this standard.

In addition, solder terminations shall not be used as a protective mechanism with the exception of solder which is intended to melt, for example that of thermal links.

PS-D.11.2.1 Measurement of temperature rises

The apparatus is operated under fault conditions and the temperature rises are measured after a steady state has been attained, but not later than after 4 h operation of the apparatus.

During this period, the apparatus shall meet the requirements of PS-D.11.2.2 up to and including PS-D.11.2.6.

In the case where an applied fault condition results in the interruption of the current before steady state has been reached, the temperature rises are measured immediately after the interruption.

If the temperature is limited by fuses, the following additional test is carried out if necessary in relation to the characteristic of the fuse.

The fuse-link is short-circuited during the test and the current passing through both the fuse-link and the short-circuit link under the relevant fault condition, is measured:

– if this current remains less than 2,1 times the rated current of the fuse-link, the temperatures are measured after a steady state has been attained;
– if this current is either immediately 2,1 times the rated current of the fuse-link or more, or reaches this value after a period of time equal to the maximum pre-arcing time for the relevant current through the fuse-link under consideration, both the fuse-link and the short-circuit link are removed after an additional time corresponding to the maximum pre-arcing time of the fuse-link under consideration and the temperatures are measured immediately.

If the fuse resistance influences the current of the relevant circuit, the maximum resistance value of the fuse-link shall be taken into account when establishing the value of the current.

NOTE The above test is based on the fusing characteristics specified in IEC 60127, which also gives the information necessary to calculate the maximum resistance value.

In determining the current through the fuse, consideration should be given to the fact that this current may vary as a function of time. It should therefore be measured as soon as possible after switching on, taking into account any delay time for full operation of the circuit under consideration.

If a temperature rise exceeding the value given in table PS-D3 is due to the short-circuiting of an insulation, the apparatus is not deemed to be unsatisfactory, but this insulation shall withstand a dielectric strength test as described in PS-D.10.3.

If a temperature rise exceeding the value given in table PS-D3 is due to the short-circuiting or disconnecting of a resistor, a capacitor, an RC-unit, an optocoupler or an inductor, the apparatus is deemed to be satisfactory if the component complies with the relevant requirements of clause 1.5/RD (see 1.4.14/RD and 5.3/RD).

If a temperature rise exceeding the value given in table PS-D3 is due to the disconnection of a resistor, the overload test specified in 5.3/RD is repeated on the resistor mounted in the apparatus, including the connections made by the manufacturer. During this test, the connections shall not fail.

PS-D.11.2.2 Accessible parts

The temperature rise of accessible parts shall not exceed the values given in table PS-D3, item a) "Fault conditions".

PS-D.11.2.3 Parts, other than windings, providing electrical insulation

The temperature rise of insulating parts, other than windings, the failure of which would cause an infringement of the requirements of 2.3.3/RD, 2.4/RD, PS-D.11.2.2, PS-D.11.2.4 and PS-D.11.2.6, shall not exceed the values given in table PS-D3, item b) "Fault conditions", with the following exceptions.

– For printed boards, the temperature rise may exceed, for a maximum period of 5 min, the values given in table PS-D3, item b) "Fault conditions", by not more than 100 K.

– For printed boards withstanding the flame test described in PS-D.20.1.3, the temperature rise may exceed

  a) the values given in table PS-D3, item b) "Fault conditions", by not more than 100 K on one or more small areas providing that the total area does not exceed 2 cm² for each fault condition and no electric shock hazard is involved, or

  b) for a maximum period of 5 min, the values given in table PS-D3, item b) "Fault conditions", up to the temperature rise value given for "other parts" in table PS-D3, item e) "Fault conditions", on one or more small areas, providing that the total area does not exceed 2 cm² for each fault condition and no electric shock hazard is involved.

If a temperature rise value is exceeded and if there is doubt as to whether or not an electric shock hazard exists, a short-circuit is applied between the conductive parts concerned and the tests of 2.3.3/RD and 2.4/RD are repeated.

If conductors on printed boards are interrupted, peeled or loosened during the test, the apparatus is still deemed to be satisfactory if all of the following conditions are met:
– the printed board complies with PS-D.20.1.3;
– the interruption is not a potential ignition source;
– the apparatus complies with the requirements of this subclause with the interrupted conductors bridged;
– any peeled or loosened conductor does not reduce the clearances and creepage distances between hazardous live parts and accessible parts below the values specified in clause 2.10.1/RD to 2.10.4/RD, 2.10.7/RD, 2.10.8/RD, PS-D.13.5. and PS-D.13.7.

For class I apparatus, the continuity of any protective earthing connection shall be maintained; loosening of such a conductor is not allowed.

PS-D.11.2.4 Parts acting as a support or a mechanical barrier.

The temperature rise of parts whose mechanical failure may cause an infringement of the requirements of 2/RD shall not exceed the values given in table PS-D3, item c) "Fault conditions".

PS-D.11.2.5 Windings

The temperature rise of windings shall not exceed the values given in table PS-D3, items b) and d) "Faault conditions", with the following exceptions.
– If the temperature is limited due to the operation of replaceable or resettable protective devices, the temperature rises may be exceeded until 2 min after the operation of the device.

  In the case of windings providing protection against electric shock or where a fault could result in a fire hazard, the test is carried out three times and the winding is then subjected to the dielectric strength test of PS-D.10.3 without the humidity treatment of PS-D.10.2, starting within 1 min after the temperature rise measurement.

  No failure is allowed.

– If the temperature is limited due to the operation of an integral non-resettable or a non-replaceable protective device or due to the open circuiting of a winding, the temperature rises may be exceeded, but the test shall be carried out three times using new components.

  In the case of windings providing protection against electric shock or where a fault could result in a fire hazard, the winding is then in each case subjected to the dielectric strength test of PS-D.10.3 without the humidity treatment of PS-D.10.2, starting within 1 min after the temperature rise measurement.

  No failure is allowed.

– Higher temperature rises are allowed for windings, provided a failure of their insulation cannot cause an electric shock hazard or a fire hazard and that they are not connected to sources capable of supplying power in excess of 5 W under normal operating conditions.

– If a temperature rise value is exceeded and if there is doubt as to whether or not a hazard exists, the insulation concerned is short-circuited and the tests of 2.3.3/RD, 2.4/RD and PS-D.11.2.2 are repeated.

NOTE If the insulation is incorporated in a winding in such a way that its temperature rise cannot be measured directly, the temperature is assumed to be the same as that of the winding wire.

PS-D.11.2.6 Parts not subject to a limit under PS-D.11.2.1 to PS-D.11.2.5 inclusive

According to the nature of the material, the temperature rise of the part shall not exceed the values given in table PS-D3, item e), "Fault conditions".

PS-D.12.1.1 Bump test

Apparatus with a mass exceeding 7 kg are subjected to the following test.

The apparatus is placed on a horizontal wooden support, which is allowed to fall 50 times from a height of 5 cm onto a wooden table.

After the test, the apparatus shall show no damage in the sense of this standard.

PS-D.12.1.2 Vibration test

Transportable apparatus intended to be used for audio amplification of musical instruments, portable apparatus and apparatus having a metal enclosure, are subjected to a vibration endurance conditioning by sweeping, as specified in IEC 60068-2-6.

The apparatus is fastened in its intended positions of use to the vibration-generator by means of straps round the enclosure. The direction of vibration is vertical, and the severity is:

– Duration 30 min
– Amplitude 0,35 mm
– Frequency range 10 Hz ... 55 Hz ... 10 Hz
– Sweep rateapproximately 1 octave/min.

After the test, the apparatus shall show no damage in the sense of this standard, in particular, no connection or part the loosening of which might impair safety shall have loosened.

PS-D.12.2 Fixing of actuating elements

Actuating elements, for instance knobs, push-buttons, keys and levers, shall be so constructed and fastened that their use will not impair the protection against electric shock. Compliance is checked by the following tests.

Fixing screws, if any, are loosened and then tightened with 2/3 of the torque given in table PS-D20 and finally loosened for 1/4 turn.

The actuating elements are then subjected for 1 min to a torque corresponding to a force of 100 N applied at the periphery, but not more than 1 Nm and, for 1 min, to an axial pull of 100 N. If the mass of the apparatus is less than 10 kg, the pulling force is limited to the value corresponding to the mass of the apparatus but not less than 25 N.

For actuating elements such as push-buttons, keys and the like, on which only a pressure is exerted during intended use and which do not protrude more than 15 mm from the surface of the apparatus, the pulling force is limited to 50 N.

After these tests, the apparatus shall show no damage in the sense of this standard.

PS-D.13.5 Printed Boards

PS-D.13.5.1 Clearances and creepage distances on printed boards

The minimum clearances and creepage distances between conductors, one of which may be conductively connected to the mains, on printed boards complying with the pull-off and peel strength requirements of IEC 60249-2 are given in figure PS-D10, and for which the following applies:

– these distances only apply as far as overheating is concerned (see PS-D.11.2) to the conductors themselves, not to mounted components or associated solder connections.
– coatings of lacquer or the like, except coatings according to IEC 60664-3, are ignored when measuring the distances.

PS-D.13.5.2 Type B coated printed boards

For type B coated printed boards, insulation between conductors shall comply with the requirements of IEC 60664-3. This applies only to basic insulation.

NOTE For such printed boards, clearances and creepage distances under the coating do not exist.

PS-D.13.7 Enclosed and sealed parts

2.10.7/RD applies, except that the minimum clearances and creepage distances of table PS-D12 must be applied.

Table PS-D12 – Minimum clearances and creepage distances (enclosed, enveloped or hermetically sealed constructions)

operating voltage up to and including V (peak) a.c. or V d.c.	Minimum clearances and creepage distances mm
35	0,2
45	0,2
56	0,3
70	0,3
90	0,4
110	0,4
140	0,5
180	0,7
225	0,8
280	1,0
360	1,1
450	1,3
560	1,6
700	1,9
900	2,3
1 120	2,6
1 400	3,2
1 800	4,2
2 250	5,6
2 800	7,5
3 600	10,0
4 500	12,5
5 600	16,0
7 000	20,0
9 000	25,0
11 200	32,0
14 000	40,0

NOTE 1 The values are applicable to both basic and supplementary insulation.

NOTE 2 The values for reinforced insulation shall be twice the values in the table.

NOTE 3 A minimum CTI (comparative tracking index) of 100 is required for the insulating materials used. The CTI rating refers to the value obtained in accordance with IEC 60112, solution A.

NOTE 4 Linear interpolation between the nearest two points is allowed, the calculated spacing being rounded to the next higher 0,1 mm increment.

PS-D.14.2.3 X2 capacitors across the secondary of a transformer

Capacitors or RC-units across a secondary winding of a transformer with mains frequency output, the short-circuiting of which would cause an infringement of the requirements with regard to overheating, shall withstand the tests for subclass X2 capacitors or RC-units as specified in IEC 60384-14, table II.

The characteristics of the capacitors or RC-units shall be appropriate for their function in the apparatus under normal operating conditions.

PS-D.14.2.5 Capacitors or RC-units not covered by 1.5.6/RD, 1.5.7/RD and PS-D.14.2.3

NOTE - If X1 or X2 capacitors or RC-units are used in places other than required in 1.5.6/RD, these X1 or X2 capacitors or RC-units are considered to be covered by 1.5.6/RD as well.

a) Capacitors or RC-units with a volume exceeding 1 750 mm3 used in circuits where, when the capacitor or RC-unit is short-circuited, the current through the short circuit exceeds 0,2 A, shall comply with the passive flammability requirements according to 4.38 of IEC 60384-1, flammability category B or better.

b) When the distance between potential ignition sources and capacitors or RC-units with a volume exceeding 1 750 mm3 does not exceed the values specified in table PS-D13, then these capacitors or RC-units shall comply with the relevant passive flammability requirements according to 4.38 of IEC 60384-1, as specified in table PS-D13 or better. No passive flammability requirements apply to these capacitors and RC-units when they are shielded by a barrier as specified in PS-D.20.1.4 from the potential ignition source.

This subclause is not applicable to metal-cased capacitors and RC-units. Thin coatings on such a case are ignored.

Table 13 – Flammability category related to distance from potential ignition sources

Open circuit voltage of the potential ignition source V (peak) a.c. or d.c.	Distance from potential ignition sources to the capacitor or RC-unit downwards or sideways less than a mm	Distance from potential ignition sources to the capacitor or RC-unit upwards less than a mm	Passive flammability category according to IEC 60384-1
>50 and ≤4 000	13	50	B
>4 000	see 20.2		
a See figure PS-D13.			

Compliance is checked according to 4.38 of IEC 60384-1.

PS-D.14.3.1 Marking

Inductors the failure of which can impair the safety of an apparatus, for example isolating transformers, shall be marked with the manufacturer's name or trademark and with a type or catalogue reference. The manufacturer's name and the type reference may be replaced by a code number.

Compliance is checked by inspection.

PS-D.14.4 High voltage components and assemblies

NOTE For high voltage cables, reference is made to 4.7.3.4/RD

Components operating at voltages exceeding 4 kV (peak) and spark gaps provided to protect against overvoltages, if not otherwise covered by PS-D.20.1.3, shall not give rise to danger of fire to the surroundings of the apparatus, or to any other hazard within the sense of this standard.

Compliance is checked by meeting the requirement for category V-1 according to IEC 60707.

PS-D.14.5. Protective devices

The application of protective devices shall be in accordance with their rated values.

External clearances and creepage distances of protective devices and their connections shall meet the requirements for basic insulation of clause 2.10.1/RD, 2.10.2/RD, 2.10.3/RD, 2.10.4/RD and PS-D.13.5 for the voltage across the device when opened.

Compliance is checked by measurement or calculation.

PS-D.14.5.1 Thermal releases

Thermal releases used in order to prevent the apparatus from becoming unsafe within the sense of this standard shall comply with PS-D.14.5.1.1, PS-D.14.5.1.2 or PS-D.14.5.1.3 respectively, whichever is applicable.

PS-D.14.5.1.1 Thermal cut-outs

Thermal cut-outs shall meet one of the following requirements:

a) The thermal cut-out when tested as a separate component, shall comply with the requirements and tests of IEC 60730 series as far as applicable.

   For the purpose of this standard, the following applies:

   – the thermal cut-out shall be of type 2 action (see 6.4.2 of IEC 60730-1);
   – the thermal cut-out shall have at least micro-disconnection (type 2B) (see 6.4.3.2 and 6.9.2 of IEC 60730-1);
   – the thermal cut-out shall have a trip-free mechanism in which contacts cannot be prevented from opening against a continuation of a fault (type 2E) (see 6.4.3.5 of IEC 60730-1);
   – the number of cycles of automatic action shall be at least
     - 3 000 cycles for thermal cut-outs with automatic reset used in circuits which are not switched-off when the apparatus is switched-off (see 6.11.8 of IEC 60730-1),
     - 300 cycles for thermal cut-outs with automatic reset used in circuits which are switched-off together with the apparatus and for thermal cut-outs with no automatic reset which can be reset by hand from the outside of the apparatus (see 6.11.10 of IEC 60730-1),
     - 30 cycles for thermal cut-outs with no automatic reset and which cannot be reset by hand from the outside of the apparatus (see 6.11.11 of IEC 60730-1);
   – the thermal cut-out shall be tested as designed for a long period of electrical stress across insulating parts (see 6.14.2 of IEC 60730-1);
   – the thermal cut-out shall meet the ageing requirements for an intended use of at least 10 000 h (see 6.16.3 of IEC 60730-1);
   – with regard to the dielectric strength, the thermal cut-out shall meet the requirements of 10.3 of this standard, except across the contact gap, and except between terminations and connecting leads of the contacts, for which 13.2 to 13.2.4 of IEC 60730-1 applies.

   The characteristics of the thermal cut-out with regard to:
   – the ratings of the thermal cut-out (see IEC 60730-1, clause 5);
   – the classification of the thermal cut-out according to
     - nature of supply (see 6.1 of IEC 60730-1),
     - type of load to be controlled (see 6.2 of IEC 60730-1),
     - degree of protection provided by enclosures against ingress of solid objects and dust (see 6.5.1 of IEC 60730-1),
     - degree of protection provided by enclosures against harmful ingress of water (see 6.5.2 of IEC 60730-1),
     - pollution situation for which the thermal cut-out is suitable (see 6.5.3 of IEC 60730-1),
     - maximum ambient temperature limit (see 6.7 of IEC 60730-1);

   shall be appropriate for the application in the apparatus under normal operating conditions and under fault conditions.

   Compliance is checked according to the test specifications of IEC 60730 series, by inspection and by measurement.

b) The thermal cut-out, when tested as a part of the apparatus shall

– have at least micro-disconnection according to IEC 60730-1, withstanding a test voltage according to 13.2 of IEC 60730-1, and
– have a trip-free mechanism in which contacts cannot be prevented from opening against a continuation of a fault, and
– be aged for 300 h at a temperature corresponding to the ambient temperature of the thermal cut-out when the apparatus is operated under normal operating conditions at an ambient temperature of 35 °C (45 °C for apparatus intended for use in tropical climates), and
– be subjected to a number of cycles of automatic action as specified under a) for a thermal cut-out tested as a separate component, by establishing the relevant fault conditions.

The test is made on three specimens.

No sustained arcing shall occur during the test.

After the test, the thermal cut-out shall show no damage in the sense of this standard. In particular, it shall show no deterioration of its enclosure, no reduction of clearances and creepage distances and no loosening of electrical connections or mechanical fixings.

Compliance is checked by inspection and by the specified tests in the given order.

PS-D.14.5.1.2 Thermal links

Thermal links shall meet one of the following requirements:

a) The thermal link, when tested as a separate component, shall comply with the requirements and tests of IEC 60691.

The characteristics of the thermal link with regard to

– the ambient conditions (see 6.1 of IEC 60691),
– the circuit conditions (see 6.2 of IEC 60691),
– the ratings of the thermal link (see 8 b) of IEC 60691),
– the suitability for sealing in or use with impregnating fluids or cleaning solvents (see 8 c) of IEC 60691);

shall be appropriate for the application in the apparatus under normal operating conditions and under fault conditions.

The dielectric strength of the thermal link shall meet the requirements of PS-D.10.3 of this standard except across the disconnection (contact parts) and except between terminations and connecting leads of the contacts, for which 11.3 of IEC 60691 applies.

Compliance is checked according to the test specifications of IEC 60691, by inspection and measurement.

b) The thermal link, when tested as a part of the apparatus shall be

– aged for 300 h at a temperature corresponding to the ambient temperature of the thermal link when the apparatus is operated under normal operating conditions at an ambient temperature of 35 °C (45 °C for apparatus intended for use in tropical climates), and
– subjected to such fault conditions of the apparatus which cause the thermal link to operate. During the test, no sustained arcing and no damage in the sense of this standard shall occur, and
– capable of withstanding two times the voltage across the disconnection and have an insulation resistance of at least 0,2 MΩ, when measured with a voltage equal to two times the voltage across the disconnection.

The test is made three times, no failure is allowed.

The thermal link is replaced, partially or completely, after each test.

NOTE When the thermal link cannot be replaced partially or completely, the complete component part comprising the thermal link, for example a transformer, should be replaced.

Compliance is checked by inspection and by the specified tests in the given order.

PS-D.14.5.1.3 Thermal interrupting devices

Thermal interrupting devices which are intended to be reset by soldering shall be tested according to PS-D.14.5.1.2 b).

However, the interrupting element is not replaced after operation, but reset according to the instructions of the apparatus manufacturer or, in absence of instructions, soldered with standard 60/40 tin/lead solder.

NOTE Examples of interrupting devices which are intended to be reset by soldering, are thermal releases, integrated, on power resistors, for example externally.

PS-D.14.5.2 Fuse-links and fuse holders

PS-D.14.5.2.1 Fuses to comply with IEC 60127

Fuse-links, directly connected to the mains, used in order to prevent the apparatus from becoming unsafe within the sense of this standard shall comply with the relevant part of IEC 60127, unless they have a rated current outside the range specified in that standard.

In the latter case, they shall comply with the relevant part of IEC 60127 as far as applicable.

For marking see PS-D.14.5.2.2.

Compliance is checked by inspection.

14.5.2.2 Markings

For fuse-links according to IEC 60127, the following marking shall be located on each fuse-holder or close to the fuse-link, in the given order:

– a symbol denoting the relative prearcing time/current characteristic;

  examples are:

  F, denoting quick acting;

  T, denoting time lag;

– the rated current in milliamperes for rated currents below 1 A, and in amperes for rated currents of 1 A or more;

– a symbol denoting the breaking capacity of the assigned fuse-link;

  examples are:

  L, denoting low breaking capacity;

  E, denoting enhanced breaking capacity;

  H, denoting high breaking capacity.

  Examples of marking: T 315 L or T 315 mA L

  F 1,25 H or F 1,25 A H

– the voltage rating of the fuse, where a fuse with a lower rated voltage could be fitted in error.

However, it is permissible to locate the marking elsewhere, in or on the apparatus, provided that it is obvious to which fuseholder the marking applies.

The marking requirements apply also if the fuse-links have a rated current outside the range specified in IEC 60127.

Compliance is checked by inspection.

PS-D.14.5.2.3 Fuses in the same circuit

Fuse holders, so designed that fuse-links can be connected in parallel in the same circuit, shall not be used.

Compliance is checked by inspection.

PS-D.14.5.3 PTC thermistors

ptc thermistors used in order to prevent the apparatus from becoming unsafe within the sense of this standard shall comply with clauses 15, 17, J15 and J17 of IEC 60730-1.

Compliance is checked by inspection and by the tests of PS-D.11.2 of this standard.

For ptc thermistors whose power dissipation exceeds 15 W for the rated zero-power resistance at an ambient temperature of 25 °C, the encapsulation or tubing shall comply with the flammability category V-1 or better according to IEC 60707.

Compliance is checked according to IEC 60707.

PS-D.14.6 Switches

PS-D.14.6.1 Testing of switches

NOTE Switches controlling currents up to 0,2 A r.m.s. a.c. or d.c. need not meet any specification, provided that the voltage across the open switch contacts does not exceed 35 V (peak) a.c. or 24 V d.c.

Manually operated mechanical switches controlling currents exceeding 0,2 A r.m.s. a.c. or d.c. shall meet one of the following requirements if the voltage across the open switch contacts exceeds 35 V (peak) a.c. or 24 V d.c.:

a) The switch tested as a separate component, shall comply with the requirements and tests of IEC 61058-1, whereby the following applies:
   - the number of operating cycles shall be 10 000 (see 7.1.4.4 of IEC 61058-1);
   - the switch shall be suitable for use in a normal pollution situation (see 7.1.6.2 of IEC 61058-1);
   - as regards resistance to heat and fire, the switch shall conform to the requirements for level 3 (see 7.1.9.3 of IEC 61058-1);
   - deviating from 13.1 of IEC 61058-1, for a.c. and d.c. mains switches the speed of contact making and breaking shall be independent of the speed of actuation. Moreover, mains switches shall comply with the flammability category V-0.

   The characteristics of the switch with regard to:
   - the ratings of the switch (see IEC 61058-1, clause 6);
   - the classification of the switch according to:
     - nature of supply (see 7.1.1 of IEC 61058-1),
     - type of load to be controlled by the switch (see 7.1.2 of IEC 61058-1),
     - ambient air temperature (see 7.1.3 of IEC 61058-1);

   shall be appropriate for the function of the switch under normal operating conditions.

   Compliance is checked according to test specifications of IEC 61058-1, by inspection and by measurements.

   If th2 switch is a mains switch which controls mains socket-outlets, the total rated current and the peak surge current of the socket-outlets as specified in PS-D.14.6.5 shall be taken into account for the measurement.

b) The switch tested as part of the apparatus working under normal operating conditions, shall meet the requirements of PS-D.14.6.2, PS-D.14.6.5 and PS-D.20.1.4, and moreover:
   - switches controlling currents exceeding 0,2 A r.m.s. a.c. or d.c. shall meet the requirements of PS-D.14.6.3 and PS-D.14.6.4 if the voltage across the open switch contacts exceeds 35 V (peak) a.c. or 24 V d.c. ;

- switches controlling currents exceeding 0,2 A r.m.s. a.c. or d.c. shall meet the requirements of PS-D.14.6.3 if the voltage across the open switch contacts does not exceed 35 V (peak) a.c. or 24 V d.c.;
- switches controlling currents up to 0,2 A r.m.s. a.c. or d.c. shall meet the requirements of PS-D.14.6.4. if the voltage across the open switch contacts exceeds 35 V (peak) a.c. or 24 V d.c.;
- mains switches shall comply with clause PS-D.G.1.1 of annex PS-D.G.

PS-D.14.6.2 Testing of switches

A switch tested according to PS-D.14.6.1 b) shall withstand, without excessive wear or other harmful effects, the electrical, thermal and mechanical stresses that occur during intended use and shall have a mechanism complying with the requirements for d.c. switches in IEC 61058-1, subclause 13.1. Moreover, for mains switches the speed of contact making and breaking shall be independent of the speed of actuation.

Compliance is checked according to IEC 61058-1, subclause 13.1, and by the following endurance test:

The switch is subjected to 10 000 cycles of operation with a sequence according to IEC 61058-1, subclause 17.1.2, excluding the increased-voltage test at accelerated speed specified in IEC 61058-1, subclause 17.2.4, and under electrical and thermal conditions given by the normal operating conditions of the apparatus.

The test is made on three specimens, no failure is allowed.

PS-D.14.6.3 Testing of switches

A switch tested according to PS-D.14.6.1 b) shall be so constructed that it does not attain excessive temperatures during intended use. The materials used shall be such that the performance of the switch is not adversely affected by the operation during intended use of the apparatus. In particular, the material and design of the contacts and terminations shall be such that their oxidation or other deterioration does not adversely affect the operation and performance of the switch.

Compliance is checked in the on-position under normal operating conditions and according to IEC 61058-1, subclause 16.2.2 d), l) and m), taking into account the total rated current I of mains socket-outlets, if any, and the peak surge current according to PS-D.14.6.5.

The temperature rise at the terminations shall not exceed 55 K during this test.

PS-D.14.6.4 Dielectric strength test

A switch tested according to PS-D.14.6.1 b) shall have adequate dielectric strength.

Compliance is checked by the following tests:

The switch shall withstand a dielectric strength test as specified in PS-D.10.3, without being previously subjected to the humidity treatment, the test voltage being decreased to 75 % of the corresponding test voltage specified in PS-D.10.3, but not less than 500 V r.m.s. (700 V peak).

- The test voltage is applied in the on-position between hazardous live parts and accessible conductive parts or parts which are connected to accessible conductive parts, and in addition between the poles in case of a multipole switch.
- The test voltage is applied in the off-position across each contact gap. During the test, resistors, capacitors and RC-units in parallel to a contact gap may be disconnected.

PS-D.14.6.5 Mains switch controlling socket outlet

If the switch is a mains switch which controls mains socket-outlets, the endurance test is carried out with an additional load connected to the socket-outlets, consisting of the circuit shown in IEC 61058-1, figure 9, taking into account IEC 61058-1, figure 10.

The total rated current of the additional load shall correspond to the marking of the socket-outlets, see PS-D.5.2 c). The peak surge current of the additional load shall have a value as shown in table PS-D14.

Table PS-D14 – Peak surge current

Total rated current of the socket-outlets controlled by the switch A	Peak surge current A
Up to and including 0,5	20
Over 0,5 up to and including 1,0	50
Over 1,0 up to and including 2,5	100
Over 2,5	150

After the test, the switch shall show no damage in the sense of this standard. In particular, it shall show no deterioration of its enclosure, no reduction of clearances and creepage distances and no loosening of electrical connections or mechanical fixings.

Compliance is checked by inspection and by the tests specified in PS-D.14.6.3 and/or PS-D.14.6.4 in the given order.

PS-D.14.8 Voltage setting devices and the like

The apparatus shall be so constructed that changing the setting from one voltage to another or from one nature of supply to another is unlikely to occur accidentally.

Compliance is checked by inspection and by manual test.

NOTE Changing of the setting which necessitates consecutive movements by hand is deemed to comply with this requirement.

PS-D.14.9 Motors

PS-D.14.9.1 Construction and tests

Motors shall be so constructed as to prevent, in prolonged intended use, any electrical or mechanical failure impairing compliance with this standard. The insulation shall not be affected and contacts and connections shall be such that they do not work loose by heating, vibration, etc.

Compliance is checked by the following tests carried out on the apparatus under normal operating conditions.

a) The apparatus is connected to 1,1 times the rated supply voltage and to 0,9 times the rated supply voltage, each time for 48 h. Motors for short-time or intermittent operation are connected for periods in accordance with the operating time if limited by the construction of the apparatus.

   In case of short-time operation, suitable cooling intervals are inserted.

NOTE 1 It may be convenient to carry out this test immediately after the test of PS-D.7.1.

b) The motor is started 50 times while the apparatus is connected to 1,1 times the rated supply voltage and 50 times while connected to 0,9 times the rated supply voltage, each period of connection being at least 10 times the period from start to full speed, but not less than 10 s.

   The intervals between starts shall be not less than three times the period of connection.

If the apparatus provides for more than one speed, the test is carried out at the most unfavourable speed.

After these tests, the motor shall withstand the dielectric strength of PS-D.10.3, no connection shall have loosened and there shall be no deterioration impairing the safety.

NOTE 2 For induction motors with power supplied to the stator only, see also 2.2.3/RD and 2.9/RD.

PS-D.14.10.4 Battery mould stress relief

A special battery, in which containment of the electrolyte is dependent upon a thermoplastic material, shall not release electrolyte due to stresses caused by the moulding process if the electrolyte can contact insulation or enter a user serviceable compartment.

Compliance is checked by the following test.

The battery is to be placed in an air-circulating oven, maintained at a temperature of 70 °C, for a period of 7 h. Following the oven conditioning, the battery shall be examined for electrolyte that has been released.

PS-D.14.10.5 Battery drop test

A user-serviceable special battery shall not release electrolyte as a result of being dropped.

Compliance is checked by the following test.

Three samples are each to be subjected to a single drop through a distance of 1 m to strike a hardwood surface as described in 4.2.6/RD, 4.3.6/RD and PS-D.15.4.3. Following the drop test, each battery is to be examined for electrolyte that has been released.

PS-D.14.11 Optocouplers

Optocouplers shall comply with the constructional requirements of 1.5.6/RD, 1.5.7/RD, 1.7.8.3/RD, 2.1.1/RD, 2.6/RD, 2.9.1/RD, 2.10.5/RD, 3.1/RD, 3.4/RD, 4.2.1/RD, 4.3.4/RD, Annex U/RD, PS-D.8.3, PS-D.8.12, PS-D.21, 2.3.3/RD, 2.4/RD and 5.3/RD.

Internal and external clearances and creepage distances of optocouplers shall comply with 2.10.1/RD, 2.10.3/RD, Annex G/RD and 2.10.4/RD. As an alternative, it is permitted to use 2.10.8/RD for testing jointed insulation.

PS-D.14.12 Surge suppression varistors

Surge suppression varistors used in order to prevent mains overvoltages coming into the apparatus shall comply with IEC 61051-2.

Such components shall not be connected between parts connected to the mains and accessible conductive parts or parts connected to them, except for earthed parts of permanently connected apparatus.

Reference is made to IEC 61051-2 where the following requirements apply:

– preferred climatic categories (2.1.1 of IEC 61051-2)
  - maximum lower temperature: –10 °C
  - minimum upper temperature: +85 °C
  - minimum duration of climatic tests: 21 days
– maximum continuous voltages (2.1.2 of IEC 61051-2)

  The minimum value of the maximum continuous a.c. voltage shall be 1,2 times the rated supply voltage of the apparatus.
– current pulse rating (IEC 61051-2, subclause 2.1.2)

Surge suppression varistors shall withstand a combination pulse of 6 kV/3 kA with voltage waveform of 1,2/50 μs and current waveform of 8/20 μs.

Compliance is checked by applying the test of IEC 61051-2, group 1. After the test, the varistor voltage (as defined in IEC 61051) shall not have changed by more than 10 % when measured with the manufacturer's specified current.

– fire hazard (IEC 61051-2, table I, group 6)

The coating of surge suppression varistors shall have a flammability category V-0 or better according to IEC 60707.

Compliance is checked according to IEC 60707.

– thermal stress

For apparatus with nominal mains voltage of <150 V, the apparatus and a test resistor connected in series with the apparatus shall be energised from an a.c. source of 250 V.

The voltage source shall be applied for 4 h or until the circuit path through the varistor opens for each of the test series resistance values: 2 000 Ω, 500 Ω, 250 Ω, 50 Ω. A separate apparatus shall be used for each resistor value, unless damage from the previous test has been repaired.

At the end of each test, the apparatus shall comply with 2.3.3/RD, 2.4/RD, 5.3/RD and PS-D.11.2.

PS-D.15 Terminals

PS-D.15.1 Plugs and sockets

PS-D.15.1.1 Connection to mains

Plugs and appliance couplers for the connection of the apparatus to the mains and socket-outlets and interconnection couplers for providing mains power to other apparatus shall comply with the relevant IEC standards for plugs and socket-outlets, appliance couplers or interconnection couplers.

Examples of the relevant IEC publications are: IEC 60083 [1], IEC 60320, IEC 60884 and IEC 60906.

NOTE 1 In Australia, Denmark, Israel, Japan, New Zealand, South Africa, Switzerland and the United Kingdom, special national conditions are valid for plugs and socket-outlets.

NOTE 2 In South Africa, where a cordset is used as the means of connection to the supply mains, this cordset may be provided with a rewirable plug, provided that the plug complies with the national regulations.

mains socket-outlets and interconnection couplers mounted on class II apparatus shall only permit connection of other class II apparatus.

mains socket-outlets and interconnection couplers mounted on class I apparatus shall either allow connection of class II apparatus only or shall be provided with protective earthing contacts which are reliably connected to the protective earthing terminal or contact of the apparatus.

NOTE 3 For class I apparatus, provision for both kinds of socket-outlets and interconnection couplers is allowed on the same apparatus.

NOTE 4 Socket-outlets allowing only the connection of class II apparatus can be designed, for instance, similar to IEC 60906-1, standard sheets 3-1 or 3-2, or according to IEC 60320-2-2, standard sheets D or H.

For apparatus with socket-outlets providing mains power to other apparatus, measures shall be taken to ensure that plugs or appliance inlets for the connection of the apparatus to the mains cannot be overloaded, if the rated current of the plug or appliance connector is less than 16 A.

NOTE 5 Marking of the socket-outlets is not considered to be a suitable measure to prevent overloading.

Internal wiring of socket-outlets providing mains power to other apparatus shall have a nominal cross-sectional area as specified in 3.2.5/RD and table PS-D18 for external flexible cords, except where the apparatus complies with 2.3.3/RD, 2.4/RD, 5.3/RD and PS-D.11.2, when the condition of 1.4.14/RD and 5.3/RD is applied.

Compliance is checked according to the relevant standards, by inspection and according to 3.2.5/RD and table PS-D18.

PS-D.15.1.2 Connectors other than mains

Connectors other than for connecting mains power, shall be so designed that the plug has such a shape that insertion into a mains socket-outlet or appliance coupler is unlikely to occur.

NOTE Examples of connectors meeting this requirement are those constructed according to IEC 60130-2, IEC 60130-9 [2], IEC 60169-2 or IEC 60169-3 [3], when used as prescribed. An example of a connector not meeting the requirements of this subclause is the so-called "banana" plug.

Sockets for audio and video circuits of load transducers indicated with the symbol of PS-D.5.2 b) shall be so designed, that a plug for antenna and earth, for audio and video circuits of load transducers and source transducers and for data and similar circuits which are not indicated with the symbol of PS-D.5.2 b), cannot be inserted into them.

Compliance is checked by inspection.

PS-D.15.1.3 Output terminals and connectors

Terminals and connectors used in output circuits of supply apparatus, whose output voltage is not a standard nominal mains voltage according to IEC 60038, table I, shall not be compatible with those specified for household and similar general purposes, for example those described in IEC 60083 [1], IEC 60320, IEC 60884, IEC 60906.

Compliance is checked by inspection and by manual tests.

The terminal or connector shall be designed for the loading which may appear under normal operating conditions and during intended use.

Compliance is checked according to IEC 60320 as far as safety is concerned, for instance with regard to shock hazard and heating.

PS-D.15.3.2 Non-detachable cords

For apparatus with non-detachable mains supply cords, the connection of the individual conductors to the internal wiring of the apparatus shall be accomplished by any means that will provide a reliable electrical and mechanical connection, except that the supply conductors and the protective earthing conductor of a non-detachable mains cord or cable shall not be soldered directly to the conductors of a printed board.

Soldered, crimped and similar connections may be used for the connection of external conductors. For soldered or crimped connections, barriers shall be provided so that clearances and creepage distances cannot be reduced to less than the values specified in 2.10.1/RD, 2.10.2/RD, 2.10.3/RD, 2.10.4/RD, 2.10.7/RD, 2.10.8/RD, PS-D.13.5 and annex G/RD respectively, should the conductor break away at a soldered joint or slip out of a crimped connection. Alternatively, the conductors shall be positioned or fixed in such a way that reliance is not placed upon the connection alone to maintain the conductors in position.

Compliance is checked by inspection, and, in case of doubt, by applying a pull of 5 N in any direction to the connection.

Table PS-D15 – Nominal cross-sectional area to be accepted by terminals

Rated current consumption of the apparatus a A	Nominal cross-sectional area mm²
Up to and including 3	0,5 to 0,75
Over 3 up to and including 6	0,75 to 1
Over 6 up to and including 10	1 to 1,5

Over 10 up to and including 16	1,5 to 2,5
a The rated current consumption includes currents which can be drawn from socket-outlets providing mains power for other apparatus.	

PS-D.15.4.3 Mechanical strength

4.2.6/RD and 4.3.6/RD apply with the addition of the following requirements.

Compliance is checked by inspection and by the following tests:

b) The pins shall not turn when a torque of 0,4 Nm is applied, first in one direction for 1 min and then in the opposite direction for 1 min.

NOTE 3 This test is not carried out if rotation of the pins does not impair safety in the sense of this standard.

c) A pull force as given in table 17 is applied, without jerks, for 1 min on each pin in turn, in the direction of the longitudinal axis of the pin.

The pull force is applied within a heating cabinet at a temperature of (70 ± 2) °C, 1 h after the device has been placed in the heating cabinet.

After the test, the device is allowed to cool down to ambient temperature, no pin shall have been displaced in the body of the device by more than 1 mm.

Table PS-D17 – Pull force on pins

Ratings of the equivalent plug type	Number of poles	Pull force N
Up to and including 10 A	2	40
130/250 V	3	50
Over 10 A up to and including 16 A	2	50
130/250 V	3	54
Over 10 A up to and including 16 A	3	54
440 V	More than 3	70

For the purpose of this test, protective earthing contacts, irrespective of their number, are considered as one pole.

Tests b) and c) are made separately, each with new samples.

PS-D.16.2 Power supply cord conductor sizes

Power supply cord conductors shall have a nominal cross-sectional area not less than those shown in table PS-D18.

Table PS-D18 – Nominal cross-sectional areas of external flexible cords

Rated current consumption of the apparatus a A	Nominal cross-sectional area mm^2
Up to and including 3	0,5 b
Over 3 up to and including 6	0,75
Over 6 up to and including 10	1
Over 10 up to and including 16	1,5
a The rated current consumption includes currents which can be drawn from the socket-outlets providing mains power for other apparatus.	
b This nominal cross-sectional area is allowed only for class II apparatus and provided that the length of the supply cord, measured between the point where the cord or the cord guard enters the apparatus, and the	

entry to the plug, does not exceed 2 m.

For higher currents, reference is made to IEC 60950, table 3B.

Compliance is checked by measurement.

NOTE In the USA and Canada a minimum cross-sectional area of 0,81 mm² is required.

PS-D.16.4 Temperature of insulation in cords

Refer to table PS-D3.

PS-D.16.5 Strain relief

The apparatus shall allow the external flexible cords, comprising one or more hazardous live conductors, to be so connected that the connecting points of the conductors are relieved from strain, that the outer covering is protected from abrasion, and that the conductors are prevented from twisting.

Moreover, it shall not be possible to push an external cord back into the apparatus through its aperture if this can impair safety in the sense of this standard.

The method by which the relief from strain and the prevention of twisting is provided shall be clearly seen.

Makeshift methods, such as tying the cord into a knot or tying the cord with a string, are not permitted.

The devices for strain and twist relief shall either be made of insulating material, or have a fixed covering of insulating material other than natural rubber, if an insulation fault of the cord may make accessible conductive parts hazardous live.

For class I apparatus, the arrangement of the terminals for the mains supply flexible cord, or the length of the conductors between the device for strain and twist relief and the terminals, shall be such that the hazardous live conductors become taut before the conductor connected to the protective earthing terminal, in case the cord slips out of the device for strain and twist relief.

Compliance is checked by inspection and by the following test.

The test is made with the type of flexible cord attached to the apparatus.

The apparatus is fitted with its flexible cord, the device for strain and twist relief being appropriately used. The conductors are introduced into the terminals, and the terminal screws, if any, are slightly tightened, so that the conductors cannot easily change their position.

After this preparation, pushing the cord further into the apparatus shall not be possible or shall cause no hazard in the sense of this standard.

A mark is made on the cord, under strain, near the aperture, and the flexible cord is subjected 100 times to a pull of 40 N for a duration of 1 s each. The pull shall not be applied in jerks.

Immediately afterwards, the cord is subjected for a period of 1 min to a torque of 0,25 Nm.

During the test, the cord shall not be displaced by more than 2 mm, the measurement being made while the cord is still under strain. The ends of the conductors shall not be noticeably displaced in the terminals and no damage to the flexible cord shall be caused by the device for strain and twist relief.

PS-D.16.7 Transportable power supplies

Transportable power supplies shall have an appliance inlet according to IEC 60320-1 for connection to the mains by detachable cord sets or shall have a means of stowage to protect the mains cord when not in use, for example a compartment, hooks or pegs.

Compliance is checked by inspection.

PS-D.17 Electrical connections and mechanical fixings

PS-D.17.1 Screw terminals for electrical connections

Screw terminals providing electrical contact and screw fixings which during the life of the apparatus will be loosened and tightened several times shall have adequate strength.

Screws exerting contact pressure and screws with a nominal diameter less than 3 mm which form part of the above-mentioned screw fixings shall screw into a metal nut or a metal insert.

However, screws having a nominal diameter less than 3 mm, which do not exert contact pressure, need not be screwed into metal, provided that the screw fixing withstands the torque specified in table PS-D20 for screws of 3 mm diameter.

Screw fixings which during the life of the apparatus will be loosened and tightened several times include terminal screws, screws for fixing covers (as far as they must be loosened to open the apparatus), screws for fixing handles, knobs, legs, stands and the like.

Compliance is checked by the following test.

The screws are loosened and then tightened, with a torque according to table PS-D20:

– 5 times in the case of screws operating in a thread of metal;
– 10 times in the case of screws operating in wood, wood-based material or in a thread in insulating material.

In the latter case, the screws are to be completely removed and reinserted each time.

The screws shall not be tightened in jerks.

After the test, there shall be no deterioration impairing safety in the sense of this standard.

The material in which the screws are inserted is verified by inspection.

Table PS-D20 – Torque to be applied to screws

Nominal diameter of screw mm	Torque Nm		
	I	II	III
Up to and including 2,8	0,2	0,4	0,4
Over 2,8 up to and including 3,0	0,25	0,5	0,5
Over 3,0 up to and including 3,2	0,3	0,6	0,6
Over 3,2 up to and including 3,6	0,4	0,8	0,6
Over 3,6 up to and including 4,1	0,7	1,2	0,6
Over 4,1 up to and including 4,7	0,8	1,8	0,9
Over 4,7 up to and including 5,3	0,8	2,0	1,0
Over 5,3 up to and including 6,0	–	2,5	1,25

The test is made by means of a suitable test screwdriver, spanner or key, applying a torque as shown in table PS-D20, the appropriate column being

– for metal screws without heads, if the screw, when tightened, does not protrude from the hole: I
– for other metal screws and for nuts: II
– for screws of insulating material:
  - having a hexagonal head with the dimension across flats exceeding the overall thread diameter, or
  - with a cylindrical head and a socket for a key, the socket having a dimension across flats not less than 0,83 times the overall thread diameter, or
  - with a head having a slot or cross slots, the length of which exceeds 1,5 times the overall thread diameter: II
– for other screws of insulating material: III

PS-D.17.3 Captive screws

Screws or other fixing devices intended to fix covers, legs, stands or the like, shall be captive in order to prevent replacement during servicing by screws or other fixing devices, which might cause a reduction of clearances or creepage distances between accessible conductive parts or parts connected to them and hazardous live parts below the values given in 2.10.1/RD, 2.10.2/RD, 2.10.3/RD, 2.10.4/RD, 2.10.7/RD, 2.10.8/RD and PS-D.13.5.

Such screws need not be captive if, when replaced by screws having the same nominal diameter, pitch and sharpness with a length of 10 times their nominal diameter, using the torque of table PS-D20, the distances are not less than those stated in 2.10.1/RD, 2.10.2/RD, 2.10.3/RD, 2.10.4/RD, 2.10.7/RD, 2.10.8/RD and PS-D.13.5.

Compliance is checked by inspection and measurement.

PS-D.17.7 Cover fixing devices

Cover-fixing devices, which may be operated during the life of the power supply, shall have adequate mechanical strength, if the failure of such devices would impair safety in the sense of this standard.

The locked and unlocked positions of these devices shall not be ambiguous, and it shall not be possible to unlock the devices inadvertently.

Compliance is checked by inspection, by operating the device and by one of the following tests:

– In the case of devices the operation of which is effected by a combination of rotary and linear movements, the device is locked and unlocked and the torques or forces necessary for this operation are measured. While the device is in the locked position, a torque or force of twice the value necessary to lock the device, with a minimum of 1 Nm or 10 N is applied in the locking direction, unless it is unlocked by a smaller torque or force in the same direction.

  This operation is performed 10 times.

  The torque or force necessary to unlock the device shall be at least 0,1 Nm or 1 N.

– In the case of covers fixed by means of snap fasteners, the cover is removed and replaced 10 times in the intended way.

  After this test the cover shall still comply with the tests by means of the rigid test finger and the test hook described in PS-D.9.1.7 a) and b).

PS-D.17.9 Internal pluggable connections

Internal pluggable connections shall be so designed that unintended loosening is unlikely, if the loosening can impair the safety in the sense of this standard.

Compliance is checked by inspection and in case of doubt by applying a pull of 2 N in any direction to the connection.

NOTE For other internal connections, see 3.1.9/RD.

PS-D.20 Resistance to fire

The apparatus shall be so designed that the start and spread of fire is prevented as far as possible, and shall not give rise to danger of fire to the surroundings of the apparatus.

This is achieved as follows:

– by using good engineering practice in design and production of the apparatus to avoid potential ignition sources,

and

– by using materials of low flammability for internal parts in the vicinity of potential ignition sources,

and

– by using fire enclosures to limit the spread of fire.

The requirements are considered to be fulfilled, if the apparatus complies with the requirements of PS-D.20.1 and PS-D.20.2.

NOTE 1 It is recommended that the quantity of environmentally unfriendly flame retardant materials should be kept as low as possible in order to minimise environmental pollution.

NOTE 2 In Australia and New Zealand special national conditions apply which include tests based on reconciliation with the philosophy of IEC 60695 [9] with respect to glow-wire testing, needle-flame testing, consequential testing and end-product consequential testing.

PS-D.20.1 Electrical components and mechanical parts

Electrical components and mechanical parts with the exception of those in a) and b), shall comply with the requirements of 4.7.3.4/RD, PS-D.20.1.3 and PS-D.20.1.4.

a) Components that are contained in an enclosure having a flammability category of V-0 according to IEC 60707 and having openings only for the connecting wires filling the openings completely, and for ventilation not exceeding 1 mm in width regardless of length.

b) The following parts which would contribute negligible fuel to a fire:

   – small mechanical parts, the mass of each of which does not exceed 4 g, such as mounting parts, gears, cams, belts and bearings;

   – small electrical components, such as integrated circuits, transistors, optocoupler packages and capacitors with a volume not exceeding 1 750 mm3, if these components are mounted on material of flammability category V-1 or better according to IEC 60707.

NOTE In considering how to minimise propagation of fire and what "small parts" are, account should be taken of the cumulative effect of small parts adjacent to each other for the possible effect of propagating fire from one part to another.

PS-D.20.1.3 Printed boards

Base material of printed boards, on which the available power at a connection exceeds 15 W operating at a voltage exceeding 50 V up to and including 400 V (peak) a.c. or d.c. under normal operating conditions, shall be of flammability category V-1 or better according to IEC 60707, unless the printed boards are protected by an enclosure meeting the flammability category V-0 according to IEC 60707, or be made of metal, having openings only for connecting wires which fill the openings completely.

Base material of printed boards, on which the available power at a connection exceeds 15 W operating at a voltage exceeding 400 V (peak) a.c. or d.c. under normal operating conditions, and base material of printed boards supporting spark gaps which provide protection against overvoltages, shall be of flammability category V-0 according to IEC 60707, unless the printed boards are contained in a metal enclosure, having openings only for connecting wires which fill the openings completely.

Compliance is checked for the smallest thickness of printed board used, in accordance with IEC 60707, after a preconditioning of 24 h at a temperature of (125 ± 2) oC in an air-circulating oven and a subsequent cooling period of 4 h at room temperature in a desiccator over anhydrous calcium chloride.

PS-D.20.1.4 Components and parts not covered by 4.7.3.3/RD, 4.7.3.4/RD and PS-D.20.1.3

This clause does not apply to fire enclosures.

When the distance between potential ignition sources and components or parts mentioned in the heading does not exceed the values specified in table PS-D21, then these components and parts shall comply with the relevant flammability category according to IEC 60707 as specified in table PS-D21, unless shielded from potential ignition sources by a barrier made of

metal or meeting the flammability category as specified in table PS-DPS-D21. The barrier shall be solid and rigid and shall have dimensions covering at least the areas specified in table PS-D21 and shown in figure PS-D13. The dimensions of a non-metallic barrier shall be sufficient to prevent ignition of its edges and of the edges of openings in the barrier.

NOTE Requirements for barriers consisting of composite material or a combination of layers are under consideration.

Compliance is checked by inspection, measurement and by the test of clause PS-D.G.3, annex PS-D.G.

Printed boards carrying potential ignition sources are not considered to be a barrier for the purpose of this subclause.

Potential ignition sources inside electrical components are not included in this subclause.

Table PS-D21 – Distances from potential ignition sources and consequential flammability categories

	For apparatus containing voltages not exceeding 4 kV				For apparatus containing voltages exceeding 4 kV			
Open-circuit voltage of the Potential ignition source	Minimum distance from potential ignition sources to the components or parts (see figure PS-D13)		Flammability category of components and parts according to IEC 60707, if the distance is less than the minimum distance required in the previous column	Minimum distance from potential ignition source to non-metallic barrier Barrier flammability category, if other than metal	Minimum distance from potential ignition sources to the components or parts (see figure PS-D13)		Flam-mability category of components and parts according to IEC 60707, if the distance is less than the minimum distance required in the previous column	Minimum distance from potential ignition source to non-metallic barrier. Barrier flamma-bility category, if other than metal
V (peak) a.c. or d.c.	Down-wards or side-ways	Up-wards			Down-wards or side-ways	Up-wards		
>50 up to and including 400	13 mm	50 mm	HB75	No requirement	13 mm	50 mm	V-1	5 mm V-1
>400 up to and including 4 000	13 mm	50 mm	V-1	5 mm V-1	20 mm	50 mm	V-1	5 mm V-0
>4 000					See PS-D.20.2			

Wood and wood-based material with a thickness of at least 6 mm is considered to fulfil the V-1 requirement of this subclause.

For apparatus containing voltages exceeding 4 kV under normal operating conditions and where protection is based on distances exceeding those as specified in table PS-D21, the material of the outer enclosure shall comply with the flammability category HB40 or better according to IEC 60707. However, no flammability requirements apply to those parts or areas of the outer enclosure of the apparatus which are protected by barriers or internal fire enclosures.

Compliance is checked for the smallest thickness used in accordance with IEC 60707.

PS-D.20.2 Fire enclosure

PS-D.20.2.1 Potential ignition sources

Potential ignition sources with open-circuit voltages exceeding 4 kV (peak) a.c. or d.c. under normal operating conditions shall be contained in a fire enclosure which shall comply with the flammability category V-1 or better according to IEC 60707.

A fire enclosure is not required if

– the open-circuit voltage of the potential ignition source is limited to a value < 4 kV by means of an electronic protective circuit, or
– the open-circuit voltage of the potential ignition source does not exceed 4 kV at the moment the faulty connection or interruption occurs.

The voltage is measured with the smallest distance across a faulty connection or interruption by which arcing could start.

Wood and wood-based material with a thickness of at least 6 mm is considered to fulfil the V-1 requirement of this subclause.

Compliance is checked for the smallest thickness used in accordance with IEC 60707.

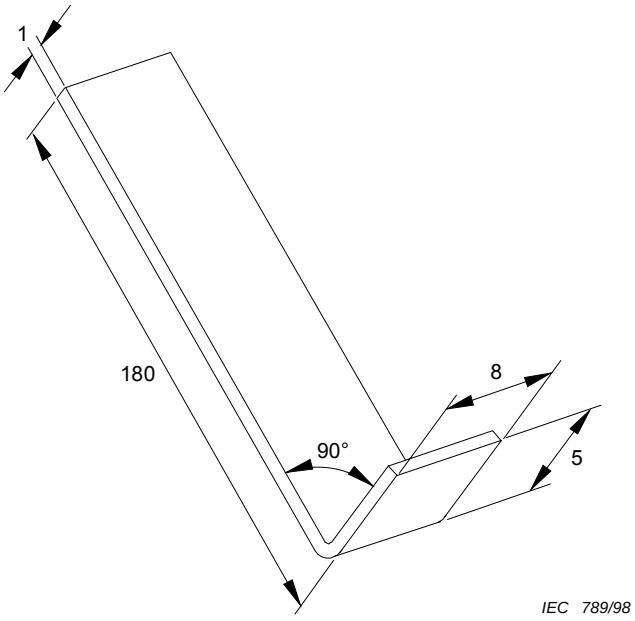
PS-D.20.2.2 Openings in internal fire enclosures

Internal fire enclosures shall not have openings for ventilation exceeding 1 mm in width regardless of length.

Openings for connecting wires shall be filled completely by the wires.

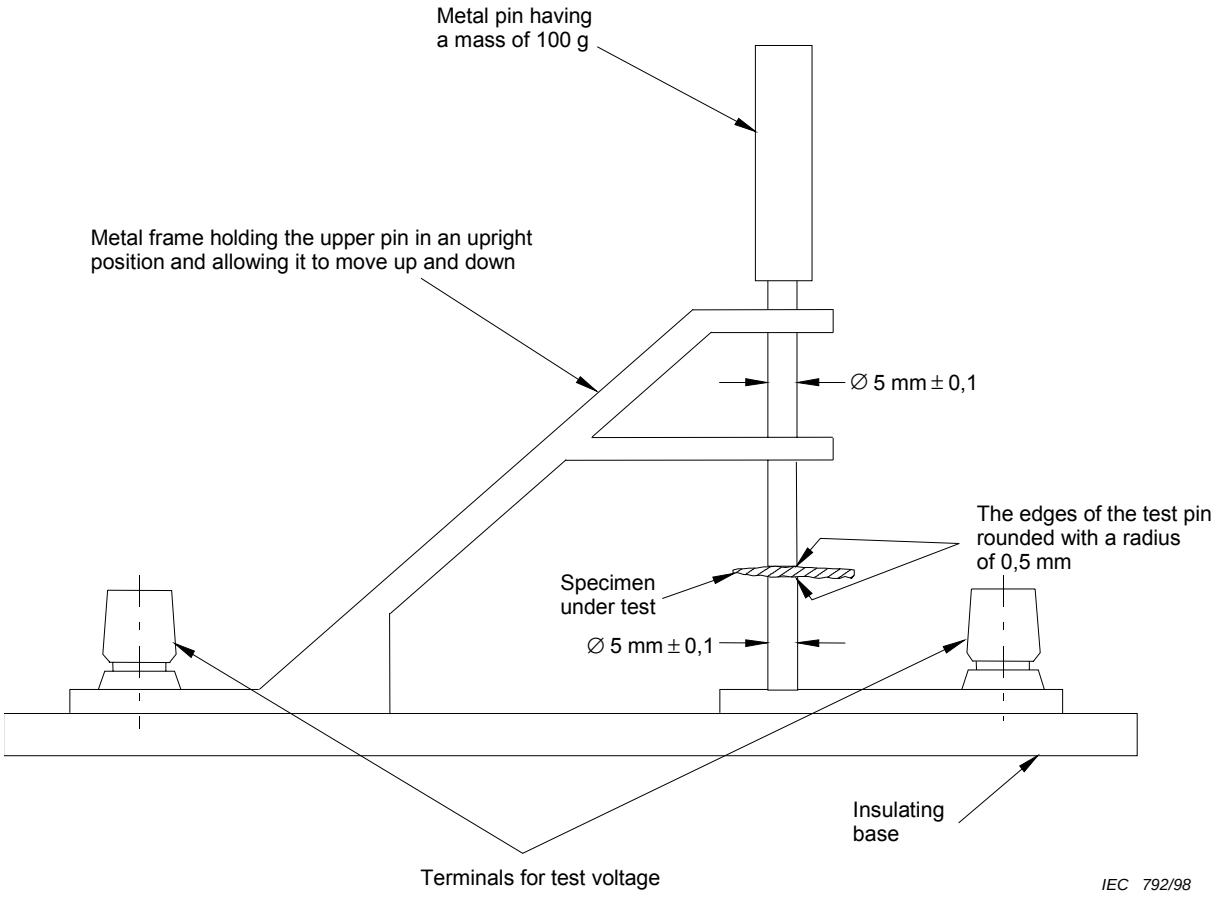
Compliance is checked by inspection and measurement.

Figures PS-D4, PS-D6, PS-D7, PS-D10, PS-D13 are applicable



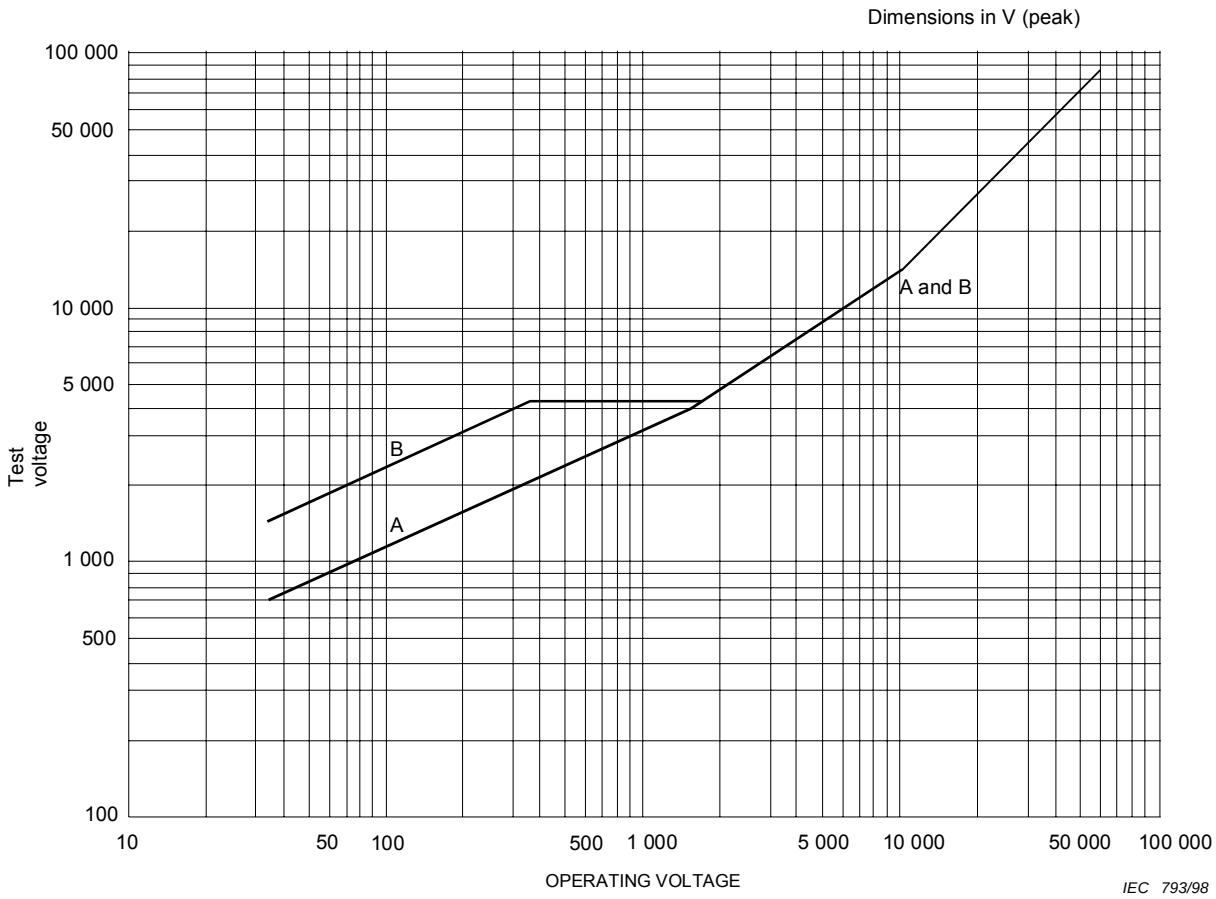
NOTE See PS-D.9.1.7. Dimensions in millimetres

Figure PS-D4 – Test hook



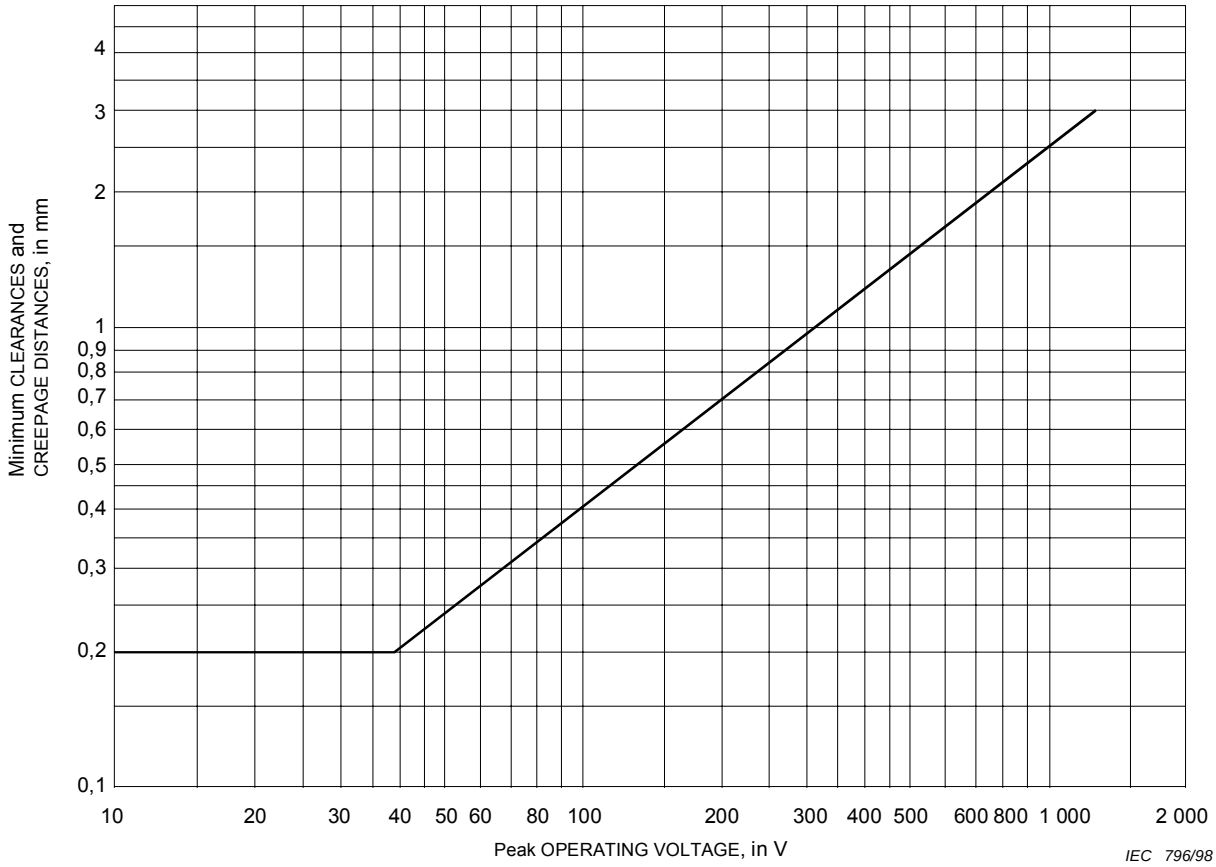
NOTE See PS-D.10.3.2.

Figure PS-D6 – Dielectric strength test instrument



NOTE See PS-D.10.3.2 and table PS-D5.

Figure PS-D7 – Test voltages



The curve is defined by the formula:

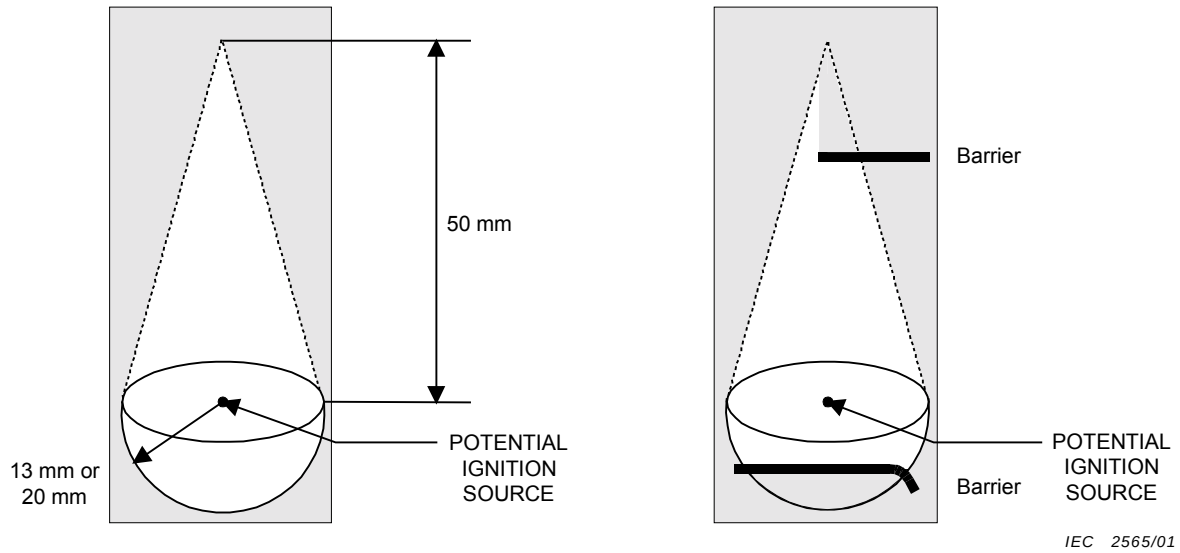
$$\log d = 0{,}78 \log (U/300)$$

with a minimum of 0,2 mm
where

d is the distance;
U is the peak voltage (V).

NOTE See PS-D.13.5.1.

Figure 10 – Minimum clearances and creepage distances on printed boards



NOTE In the shaded areas, the requirements of PS-D.20.1.4 but not covered by table PS-D21, apply.

NOTE See PS-D.20.1.4

Figure PS-D13 – Distances from a potential ignition source and an example for the design of barriers

Annexes of Annex PS-D

Annex PS-D.A (normative)

Additional requirements for apparatus with protection against splashing water

The requirements of this standard, supplemented or replaced by those contained in this annex, apply to power supplies provided with protection against splashing water.

PS-D.A.5 Marking and instructions 1)

1.7/RD applies with the addition of the following:

PS-D.A.5.1 j) Protection against splashing water

Apparatus provided with protection against splashing water shall be marked at least with the designation IPX4 in accordance with IEC 60529.

Compliance is checked by inspection.

PS-D.A.10 Insulation requirements

Modify PS-D.10.2 as follows:

PS-D.A.10.2 Splash and humidity treatment

PS-D.A.10.2.1 Splash treatment

The enclosure shall provide adequate protection against splashing water.

Compliance is checked by the treatment specified below, which is made on the apparatus fitted with external flexible cords in accordance with the requirements of 3.2.5/RD.

The apparatus is subjected to the test described in 14.2.4a), of IEC 60529.

Immediately after this treatment, the apparatus shall comply with the tests of PS-D.10.3 and inspection shall show that water, which may have entered the apparatus, does not cause any damage in the sense of this standard; in particular, there shall be no trace of water on insulations for which creepage distances are specified.

PS-D.A.10.2.2 Humidity treatment

Subclause PS-D.10.2 applies, except that the duration of the test is seven days (168 h).

———————

1) The clause numbering of this annex refers to the clauses of this standard.

Annex PS-D.B
(normative)

Apparatus to be connected to the telecommunication networks

The requirements of this standard supplemented by the requirements of IEC 62151 as referenced in this annex apply to apparatus within the scope of this standard intended to be connected to telecommunication networks.

NOTE 1 In countries listed in IEC 62151, special national conditions apply.

NOTE 2 Attention is drawn to the fact that the telecommunication authorities may impose additional requirements on apparatus to be connected to telecommunication networks. Those requirements generally concern the protection of the networks as well as the users of the apparatus.

IEC 62151 clauses 1 and 2 apply.

IEC 62151 clause 3 applies, with the following modification:

Replace 3.5.4 by the definition 1.2.8.6 of IEC 60950 and 1.2.8.7 of IEC 60950-1.

IEC 62151 clause 4 applies, with the exception of 4.1.2, 4.1.3 and 4.2.1.2.

The requirements of 4.1.2 shall be replaced by the following requirements:

In a single tnv-0 circuit or in interconnected tnv-0 circuits, the voltage between any two conductors of the tnv-0 circuit or circuits and, between any one such conductor and earth shall not exceed the values given in clause PS-D.9.1.1.1 a) of this standard.

NOTE 3 A circuit that meets the above requirements, but that is subject to overvoltages from a telecommunication network, is a tnv-1 circuit.

The requirements of 4.1.3 shall be replaced by the following requirements:

In the event of a single failure of basic insulation or supplementary insulation, or of a component (excluding components with double or reinforced insulation), the voltages between any two conductors of the tnv-0 circuit or circuits and between any one such conductor and earth shall not exceed the values given in PS-D.9.1.1.1 a) of this standard for more than 0,2 s. Moreover, the limit values as given in 2.3.3/RD and 2.4/RD shall not be exceeded.

Except as permitted in 4.1.4, one of the methods specified in 4.1.3.1, 4.1.3.2, or 4.1.3.3 shall be used.

Parts of the interface circuit that do not comply with the requirements for tnv-0 circuits under normal operating conditions shall therefore not be user accessible.

The requirements of 4.2.1.2 shall be replaced by the following requirements:

NOTE 4 See alsno clauses 5 and 6.

Separation of tnv-0 circuits, tnv-1 circuits and accessible conductive parts from tnv-2 circuits and tnv-3 circuits shall be such that

– under normal operating conditions, the limits specified in 4.2.1.1 a) for tnv-1 circuits (35 V peak, or 60 V d.c.) are not exceeded on the tnv-0 circuits, tnv-1 circuits and accessible conductive parts.
– in the event of a single insulation fault, the limits specified in 4.2.1.1 b) for tnv-2 circuits and tnv-3 circuits under normal operating conditions (70 V peak, or 120 V d.c.) are not exceeded on the tnv-0 circuits, tnv-1 circuits and accessible conductive parts. However, after 0,2 s the voltage limits of 4.1.2 (35 V peak, or 60 V d.c.) shall apply.

  The separation requirements will be met if basic insulation is provided as indicated in table PS-D.B.1, which also shows where 6.1 applies; other solutions are not excluded.

Table PS-D.B.1 – Separation of TNV circuits

Parts being separated		Separation
tnv-0 circuit or accessible conductive parts	tnv-1 circuit	6.1
	tnv-2 circuit	basic insulation
	tnv-3 circuit	basic insulation and 6.1
tnv-1 circuit	tnv-2 circuit	basic insulation and 6.1
tnv-2 circuit	tnv-3 circuit	6.1
tnv-1 circuit	tnv-3 circuit	basic insulation
tnv-1 circuit	tnv-1 circuit	functional insulation
tnv-2 circuit	tnv-2 circuit	functional insulation
tnv-3 circuit	tnv-3 circuit	functional insulation

basic insulation is not required provided that all of the following are met:

– the tnv-0 circuit, tnv-1 circuit or accessible conductive part shall be connected to a protective earthing terminal in accordance with this standard; and

– the installation instructions specify that the protective earthing terminal shall be permanently connected to earth; and

– the test of 4.2.1.5 shall be carried out if the tnv-2 or tnv-3 circuit is intended to receive signals or power that are generated externally during normal operation (for example in a telecommunication network).

At the choice of the manufacturer, it is permitted to treat a tnv-1 circuit or a tnv-2 circuit as a tnv-3 circuit. In this case, the tnv-1 circuit or tnv-2 circuit shall meet all the separation requirements for a tnv-3 circuit.

Compliance is checked by inspection and measurement and, where necessary, by simulation of failures of components and insulations such as are likely to occur in the apparatus. Prior to the tests, insulation that does not meet the requirements for basic insulation is short-circuited.

NOTE 5 Where basic insulation is provided and 6.1 also applies to this insulation, the test voltage prescribed in 6.2 is in most cases higher than that for basic insulation.

Clause 5 of IEC 62151 applies, with the following modification in 5.3.1:

The value 1,6 shall be replaced by the value 1,8.

Clauses 6 and 7 of IEC 62151 apply.

Annex A up to and including annex C of IEC 62151 apply.

Annex PS-D.G
(normative)

Flammability test methods

NOTE In Australia and New Zealand special national conditions apply which include tests based on reconciliation with the philosophy of IEC 60695 [9] with respect to glow-wire testing, needle-flame testing, consequential testing and end product consequential testing.

PS-D.G.1 If no test specimens in accordance with IEC 60707, clause 4 are available, the following test methods may be applied.

The test is made according to IEC 60695-2-2 on three specimens of end products as used in the apparatus.

For the purpose of this standard, the following applies with regard to IEC 60695-2-2:

Clause 7 – Initial measurements; not applicable

Clause 8 – Test procedure

– Subclause 8.2

  The first sentence is replaced by the following:

  The test specimens are mounted in such a way as to simulate the conditions obtained when installed in the apparatus.

– Subclause 8.4

  Replace the third paragraph by the following:

  The test flame is applied to several points of the specimen, so that all critical areas are tested.

Clause 9 – Observations and measurements.

– Subclause 9.2

  The second paragraph is replaced by the following:

  Duration of the burning denotes the time interval from the moment the test flame is removed until any flame has been extinguished.

PS-D.G.1.1 If flammability category V-0 according to IEC 60707 is required, in addition, the following applies with regard to IEC 60695-2-2.

Clause 5 – Severities

The values of duration of application of the test flame are as follows:

The test flame is applied for 10 s. If a self-sustaining flame does not last longer than 15 s, the test flame is applied again for 1 min at the same point or at any other point. If again a self-sustaining flame does not last longer than 15 s, the test flame is then applied for 2 min at the same point or at any other point.

Clause 10 – Evaluation of test results

The existing text is replaced by the following:

After the first application of the test flame, the test specimens shall not be consumed completely. After any application of the test flame, the duration of the burning of any specimen shall not exceed 15 s, while the average burning time shall not exceed 10 s. The tissue paper shall not ignite and the board shall not scorch.

PS-D.G.1.2 If flammability category V-1 according to IEC 60707 is required, in addition, the following applies with regard to IEC 60695-2-2.

Clause 5 – Severities

The values of duration of application of the test flame are as follows:

The test flame is applied for 10 s. If a self-sustaining flame does not last longer than 30 s, the test flame is applied again for 1 min at the same point or at any other point. If again a self-sustaining flame does not last longer than 30 s, the test flame is then applied for 2 min at the same point or at any other point.

Clause 6 – Preconditioning (only applicable to components of 14.4.1)

The existing text is replaced by:

The specimens are stored for 2 h in an oven at a temperature of (100 ± 2) °C.

Clause 10 – Evaluation of test results

The existing text is replaced by the following:

After the first application of the test flame, the test specimen shall not be consumed completely. After any application of the test flame, any self-sustaining flame shall extinguish within 30 s. No burning of the tissue paper shall occur and the board shall not scorch.

PS-D.G.1.3 If flammability category V-2 according to IEC 60707 is required, in addition, the following applies with regard to IEC 60695-2-2.

Clause 5 – Severities

The values of duration of application of the test flame are as follows:

The test flame is applied for 10 s. If a self-sustaining flame does not last longer than 30 s, the test flame is applied again for 1 min at the same point or at any other point. If again a self-sustaining flame does not last longer than 30 s, the test flame is then applied for 2 min at the same point or at any other point.

Clause 10 – Evaluation of test results

The existing text is replaced by the following:

After the first application of the test flame, the test specimen shall not be consumed completely.

After any application of the test flame, any self-sustaining flame shall extinguish within 30 s.

PS-D.G.1.4 If flammability category HB75 or HB40 according to IEC 60707 is required, the following applies with regard to IEC 60695-11-10.

Three specimens, 125 mm +/- 5 mm in length by 13 mm +/- 0.5 mm in width, cut from the thinnest part to be tested, are subjected to the burning test as described in IEC 60695-11-10, clause 8, Test method A.

The material shall be classified HB75 or HB40 respectively as described in 8.4 of IEC 60695-11-10.

PS-D.G.2 Compliance of cables and insulation of wires is checked according to IEC 60695-2-2.

For the purpose of this standard, the following applies with regard to IEC 60695-2-2.

Clause 5 – Severities

The values of duration of the application of the test flame are as follows:

– first specimen: 10 s

– second specimen: 60 s
– third specimen: 120 s

Clause 7 – Initial measurements: not applicable

Clause 8 – Test procedure

– Add the following to 8.4:

  The burner is supported so that its axis is in an angle of 45° to the vertical. The cable or wire is held in an angle of 45° to the vertical, its axis being in a vertical plane perpendicular to the vertical plane containing the axis of the burner.

– Subclause 8.5 is replaced by the following:

  The test is made on three specimens taken from each type of cable or wire as used in the apparatus, for example with additional screening and sleeves.

Clause 9 – Observations and measurements

– Subclause 9.1 does not apply.
– Subclause 9.2

  The second paragraph is replaced by the following:

  Duration of the burning denotes the time interval from the moment the test flame is removed until any flame has extinguished.

Clause 10 – Evaluation of the results

  The existing text is replaced by the following:

  During the test, any burning of the insulating materials shall be steady and shall not spread appreciably. Any flame shall self-extinguish in 30 s from the removal of the test flame.

PS-D.G.3 A barrier shall comply with the following requirements.

Three specimens are subjected to the following tests:

1) In case of a non-metallic barrier, each test specimen is fixed horizontally and a needle flame as specified in IEC 60695-2-2 is applied from below with an angle of 45°.

   The top of the flame shall be:

   a) applied to the barrier as used in the appliance, at a location likely to become ignited because of its actual proximity and distance to the potential ignition source

   or

   b) applied to a sample plate with the same thickness and made of the same material, touching the undersurface of this sample plate in the middle.

The flame shall be applied for 60 s in the same position.
The needle flame shall not penetrate the test specimen and after the application there shall be no hole in the test specimen.

No failure is allowed.

2) In case of openings in a barrier regardless of its material, the requirements shown in figure PS-D13 apply, unless it is not possible for the needle flame as specified in IEC 60695-2-2 to penetrate the barrier.

   Compliance is tested according to 1) above. After the test there shall be no change with regard to the openings in the barrier. No failure is allowed.

Annex PS-D.N
(informative)

Routine tests

INTRODUCTION

The tests given in this annex are intended to reveal, as far as safety is concerned, unacceptable variations in material or manufacture. These tests do not impair the properties and the reliability of the apparatus, and should be made by the manufacturer on each apparatus during or at the end of the production.

In general, more tests, such as repetition of type tests and sampling tests, have to be made by the manufacturer to ensure that every apparatus is in conformity with the sample that withstood the type test of this standard, according to experience gained by the apparatus manufacturer.

The manufacturer may use a test procedure which is better suited to his production arrangements and may make the tests at an appropriate stage during production, provided it can be proved that apparatus which withstand the tests carried out by the manufacturer provide at least the same degree of safety as apparatus that withstand the tests specified in this annex.

NOTE Generally, an appropriate quality assurance system should be employed, for example according to the ISO 9000 series [21].

The following rules are given as an example for routine test:

PS-D.N.1 Tests during the production process

PS-D.N.1.1 Correct polarity and connection of components or subassemblies

If incorrect polarity or connection of components or subassemblies might result in a safety hazard, the correct polarity and connection of these components or subassemblies should be checked by measurement or inspection.

PS-D.N.1.2 Correct values of components

If incorrect values of components might result in a safety hazard, the correct value of these components should be checked by measurement or inspection.

PS-D.N.1.3 Protective earthing connection of screens and metal barriers

For class I apparatus with a screen or metal barrier (see 1.5.7/RD, 2.1.1.1/RD, 2.1.7.100 and 2.6/RD) between hazardous live parts and terminals regarded as accessible (see 2.1.1/RD) or accessible conductive parts respectively, the continuity of the protective earthing connection should be checked as late as possible during the production process between the screen or metal barrier and

– the protective earthing contact of the mains plug or appliance inlet, or
– the protective earthing terminal in case of a permanently connected apparatus.

The test current applied for 1 s to 4 s should be in the order of 10 A a.c., derived from a source having a no-load voltage not exceeding 12 V.

The measured resistance should not exceed

– 0,1 Ω for apparatus with a detachable power supply cord,
– 0,2 Ω for apparatus with a non-detachable power supply cord.

NOTE Care should be taken that the contact resistance between the tip of the measuring probe and the metal parts under test does not influence the test results.

PS-D.N.1.4 Correct position of internal wiring

If incorrect position of internal wiring might impair the safety, the correct position of internal wiring should be checked by inspection.

PS-D.N.1.5 Correct fit of internal plug connections

If incorrect fit of internal plug connections might impair the safety, the correct fit of internal plug connections should be checked by inspection or manual test.

PS-D.N.1.6 Safety relevant markings inside the apparatus

The legibility of markings relevant to safety inside the apparatus, for example with regard to fuse-links, should be checked by inspection.

PS-D.N.1.7 Correct mounting of mechanical parts

If incorrect mounting of mechanical parts might impair the safety, the correct mounting should be checked by inspection or manual test.

PS-D.N.2 Tests at the end of the production process

The following tests should be made on the apparatus when completely assembled and just before packing.

PS-D.N.2.1 Dielectric strength test

The insulation of the apparatus should be checked by the following tests. In general, these tests are considered to be sufficient.

An a.c. test voltage of substantially sine-wave form, having mains frequency, or a d.c. test voltage or a combination of both with a peak value specified in table PS-D.N.1, is applied between the mains supply terminals connected in parallel and:

– terminals regarded as accessible (see 2.1.1/RD), and

– accessible conductive parts respectively,

which may become hazardous live in the event of an insulation fault as a result of incorrect assembly.

NOTE 1 Terminals regarded as accessible and accessible conductive parts may be connected together during the dielectric strength test.

Table PS-D.N.1 – Test voltage

Application of test voltage	Test voltage V (peak) a.c. or d.c.	
	Rated mains voltage ≤150	Rated mains voltage >150
Basic insulation	1 130 (800 r.m.s.)	2 120 (1 500 r.m.s.)
Double or reinforced insulation	2 120 (1 500 r.m.s.)	3 540 (2 500 r.m.s.)

Before the test voltage is applied, intimate contact should be made with the specimen.

Initially, not more than half of the prescribed test voltage is applied, then it is raised with a steepness not exceeding 1 560 V/ms to the full value which is held for 1 s to 4 s.

NOTE 2 A steepness of 1 560 V/ms corresponds to the steepness of a sine-wave with a mains frequency of 60 Hz.

During the test, mains switches and functional switches, if any, conductively connected to the mains, should be in the on-position and it should be secured by suitable means so that the test voltage is completely effective.

No flash-over or breakdown should occur during the test. The test voltage source should be provided with a current sensing (over-current) device which, when activated, gives an indication that the test has been failed. The test voltage source should still deliver the prescribed voltage until current tripping occurs.

NOTE 3 The tripping current should not exceed 100 mA.

NOTE 4 Tripping of the current sensing device is regarded as a flashover or breakdown.

PS-D.N.2.2 Protective earthing connection

For class I apparatus, the continuity of the protective earthing connection should be checked between the protective earthing contact of the mains plug or appliance inlet, or the protective earthing terminal in case of a permanently connected apparatus, and

– the accessible conductive parts, including terminals regarded as accessible (see 2.1.1/RD), which should be connected to the protective earthing terminal, and
– the protective earthing contact of socket-outlets respectively, if provided to deliver power to other apparatus.

The test current applied for 1 s to 4 s should be in the order of 10 A a.c., derived from a source having a no-load voltage not exceeding 12 V.

The measured resistance should not exceed

– 0,1 Ω for apparatus with a detachable power supply cord,
– 0,2 Ω for apparatus with a non-detachable power supply cord.

NOTE Care should be taken that the contact resistance between the tip of the measuring probe and the conductive parts under test does not influence the test results.

PS-D.N.2.3 Safety relevant markings on the outside of the apparatus

The legibility of safety relevant markings on the outside of the apparatus, for example with regard to the supply voltage, should be checked by inspection.

Annex PS-E
(Normative)

DC Power and Distribution Equipment

PS-E.1 General

DC POWER AND DISTRIBUTION EQUIPMENT shall comply with the additional requirements of this annex.

PS-E.1.1 Scope

PS-E.1.1.1.101

DC POWER AND DISTRIBUTION EQUIPMENT which provides, distributes, monitors, and controls isolated secondary circuit power to other equipment typically used in communication applications.

Equipment which is within the scope of this annex consists of some or all of the following:

- Distribution panelboards, powerboards, disconnects, and overcurrent protective devices.
- Control and monitoring equipment.
- Assemblies consisting of: racks, shelves, and enclosures which could contain any of the above components, interconnecting hardware, power supplies (such as rectifiers, converters, and inverters), batteries, and any other related peripheral devices.

PS-E.1.1.2.101 Additional requirements

Requirements additional to those specified in this standard may be necessary for equipment located in earthquake zones.

PS-E.1.1.3.101 Exclusions

This annex does not apply to

- AC mains supply distribution equipment which is part of the building wiring system and not an integral part of the equipment used in dc power and distribution equipment,
- batteries,
- the design or installation of DC power branch distribution conductors and other building installation wiring.

PS-E.1.2 Definitions

Definitions in alphabetical order of nouns

Distribution, DC power branch	PS-E.1.2.8.100
Rating, interrupt	PS-E.1.2.1.110
Low voltage load disconnect (LVLD) and low voltage battery disconnect (LVBD)	PS-E.1.2.11.100
DC disconnect switch	PS-E.1.2.11.101
String, Battery	PS-E.1.2.11.102
Supply, DC Battery	PS-E.1.2.11.103
Battery	PS-E.1.2.11.104
Storage Cell	PS-E.1.2.11.105

Temperature excursions	PS-E.1.2.2.100
Withstand, DC short circuit	PS-E.1.2.1.109

PS-E.1.2.1 Equipment electrical ratings

PS-E.1.2.1.109
withstand, DC short circuit
the maximum output short circuit current from a DC source that can be delivered at the input to the equipment being rated in order to not exceed the capability of the circuit within the equipment, including the interrupting capability of any overcurrent protectors, when a fault is applied to the output load circuit after the overcurrent protector.

PS-E.1.2.1.110
interrupt rating
the maximum short circuit current that an overcurrent protection device is capable of interrupting at a given voltage.

PS-E.1.2.2 Operating conditions

PS-E.1.2.2.100
temperature excursions
conditions that the equipment is expected to operate in that are not continuous occurrences, but may cause a higher ambient or higher temperatures internal to the equipment. The higher temperature could be experienced due to outside extreme climates, a failure (e.g. in the air system for indoor installations), or battery discharge conditions. These are conditions that occur infrequently and are corrected or discontinued.

PS-E.1.2.8 Circuits and Circuit characteristics

PS-E.1.2.8.100
D.C. power branch distribution
the circuit conductors, external to the equipment, between an overcurrent protective device and the downstream equipment

PS-E.1.2.11 Components

PS-E.1.2.11.100
low voltage load disconnect (LVLD) and low voltage battery disconnect (LVBD)
used to disconnect the load or battery when the battery condition such as temperature or voltage reaches a defined cut-off limit

PS-E.1.2.11.101
DC disconnect switch
mechanical device which is used to disconnect a DC circuit. The removable part of this device may contain a fuse which protects the circuit

PS-E.1.2.11.102
battery string
a series connection of batteries that produces the desired voltage for the DC power and distribution equipment

PS-E.1.2.11.103
battery supply
a string or a parallel connection of strings specified for use with the DC power and distribution equipment

PS-E.1.2.11.104.
battery
a single cell or multiple cells connected in series, parallel or series-parallel to form an assembly with the desired voltage and current capability.

PS-E.1.2.11.105.
storage cell

the basic electrochemical unit, consisting of an anode and a cathode within a common electrolyte, used to receive, store and deliver electrical energy.

PS-E.1.4 General conditions for tests

PS-E.1.4.5.102
DC rated voltage range
for equipment covered by this standard that is powered from DC power and distribuition equipment, the rated voltage range provided by the manufacturer is used for testing. No tolerance is applied

PS-E.1.4.100 Battery resistance

PS-E.1.4.100.1 The DC battery supply resistance calculation shall be based on the minimum battery resistance specified by the battery manufacturer. The resistance for multi-cell modules supplied by the battery manufacturer as an assembly shall include all cells and internal connecting hardware.

PS-E.1.5.101 Components in the DC distribution circuit

PS-E.1.5.101.1 Contactors and relays used for LVLD or LVBD shall be evaluated for the application using the test of PS-E.5.100.

PS-E.1.5.101.2 DC disconnect switch shall be evaluated for the application using the test of PS-E.5.101.

PS-E.1.6.100.1 Battery supply

The resistance of the battery supply and the output short circuit current shall be calculated to determine the necessary dc short circuit withstand rating of the equipment and the interrupt rating of the overcurrent protective devices, and used for testing in accordance with PS-E.5.3.6.101.

NOTE - Method of calculating output short circuit current for battery assemblies (from a to j)

a) When calculating potential short circuit currents available at the output of the dc power and distribution equipment, the circuit resistance includes published resistance for conductors at 25 °C in series with the components being evaluated, battery supply total resistance, resistance of the maximum size load cable at shortest length that produces a fault path (based on the application). Contact resistance, bolted connections, and the resistance of overcurrent protective devices shall not be included in the calculation.

b) The short circuit current through the dc power and distribution equipment with a fault applied to the output may be less than the dc short circuit withstand rating of the equipment. Therefore, overcurrent protectors may have interrupt ratings less than the withstand rating of the equipment if evaluated for the application.

c) For the purpose of calculating the DC short circuit current, the nominal storage cell voltage shall be used. For lead acid cells, this is assumed to be at 2 V. This will be the voltage used to determine the battery supply voltage (example: 24 V or 48 V). Some batteries may be made up of more than one cell.

d) The internal resistance (R_b) of the battery is is the resistance between the terminals.

e) The figure PS-E.1.100A is provided as a guide for performing the resistance and the short circuit calculations.

f) Resistance of each string (R_{str1}, R_{str2}, $R_{str...}$) equals the minimum internal resistance of each battery (R_b) multiplied by the number of batteries in the string, added to the resistance of the battery cables or straps (R_{bc}) multiplied by the number of cables or straps in each string, added to the resistance of the negative string cable (R_{sc-}) and the positive string cable (Rsc+) that is used to tie the string to a common point with the other strings in the system, cabinet, or rack.

Example: $R_{str1} = (4 \times R_b) + (3 \times R_{bc}) + R_{sc-} + R_{sc+}$

g) The total resistance of all the strings connected in the system/cabinet/rack (R_{tstr}) is the parallel resistance of all the strings together.

Example: $R_{tstr} = \frac{1}{(1/R_{str1}) + (1/R_{str2}) + (1/R_{str...})}$

h). The resistance of the total battery supply (R_{tbs}) includes the cables/busbars (R_{bsc-} and R_{bsc+}) up to the distribution equipment plus the total parallel resistance of all the strings (Rtstr).

Example: $R_{tbs} = R_{tstr} + R_{bsc-} + R_{bsc+}$

i). When more than one battery supply is terminated into the dc power and distribution equipment, the total equivalent resistance of all the supplies (R_{teqbs}) is calculated as the parallel resistance of all the strings (R_{tbs1}, R_{tbs2}, $R_{tbs...}$).

$$R_{teqbs} = \frac{1}{(1/R_{tbs}1) + (1/R_{tbs}2) + (1/R_{tbs}\ldots)}$$

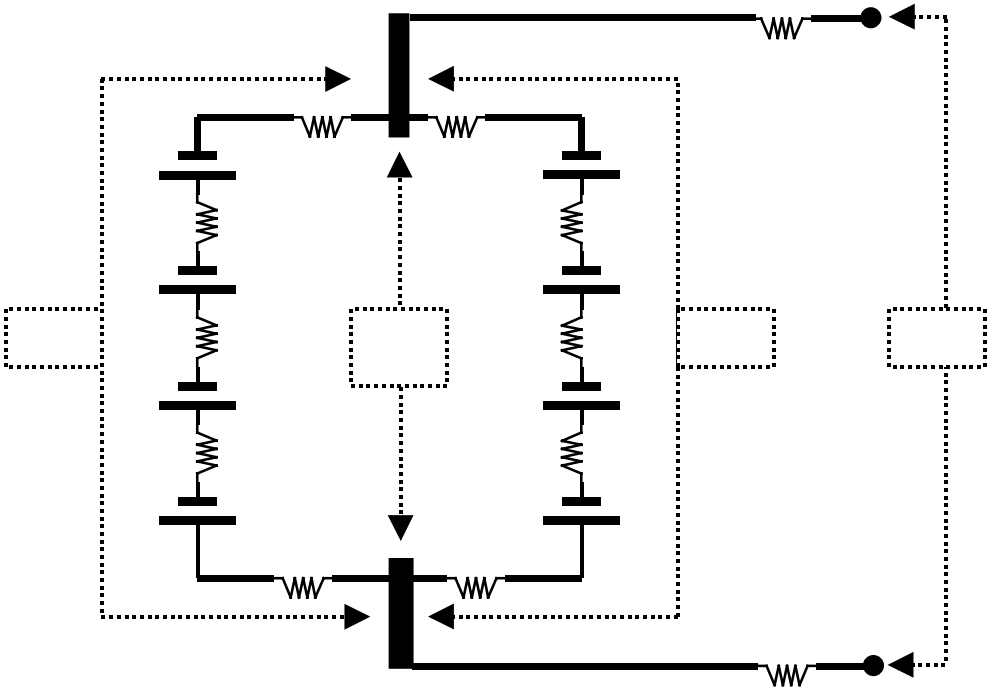


Figure PS-E.1.100A: Resistance and Short Circuit Calculations

j). The short circuit current is determined at various points in the system by dividing the battery supply voltage, based on 2 V per cell, by the resistance up to that point.**To determine the short circuit current at termination point of the battery strings: divide by R_{tstr}.To determine the short circuit current at the input of the dc power and distribution equipment: divide by R_{tbs} or R_{teqbs} depending on how the batteries are connected.**

- To determine the short circuit current through the dc power and distribution equipment with a fault applied at the output after the overcurrent protection device add the resistance of the circuit (excluding the resistance of overcurrent protectors and contacts) and a resistance representative of the minimum fault on the output, based on maximum size load conductor, then divide by either R_{tbs} or R_{teqbs} .

PS-E.1.7.1 Power rating

PS-E.1.7.1.100 Power ratings for DC power and distribution equipment

PS-E.1.7.1.100.1 DC power and distribution equipment containing power supplies shall be marked with the rated output voltage range.

Equipment that only contains overcurrent protection devices and/or busbars for distribution need only be marked with the maximum rated voltage.

Battery supplies are not required to be marked with the rated output voltage range.

PS-E.1.7.2.100 Instructions for DC power and distribution equipment

PS-E.1.7.2.100.1 For future use.

PS-E.1.7.2.100.2 Battery racks output short circuit current rating

Battery racks and/or cabinets shall be provided with output short circuit current rating information in accordance with PS-E. 1.6.100.

PS-E.1.7.2.100.3 Distribution frames withstand rating

Distribution frames shall be provided with DC short circuit withstand rating information and calculation information in accordance with PS-E.1.6.100.1 and PS-E.1.7.2.100.5 and based on testing in accordance with PS-E.5.3.6.101. All safety related information involving the installation, servicing, or operation of the equipment shall also be included.

NOTE Consideration shall be given to evaluating and specifying the withstand capability of equipment and the interrupt rating of any internal overcurrent protectors when the equipment is rated for connection to the ac mains supply inputs that can deliver more than 10 000 A short circuit current.

PS-E.1.7.2.100.4 Battery voltage and source impedance

Marking or installation instructions provided with a battery rack or cabinet shall include the nominal circuit voltage of the battery system and the source or output impedance in accordance with PS-E.1.6.100.1. Also a statement that this information is to be used to calculate the maximum short circuit current based on the circuit impedance added in the installation instructions.

PS-E.1.7.2.100.5 Additional information

Documentation shall include the following statements and information.

a) This equipment is designed to be connected to a battery source of nominal _____ V d.c. based on 2 V per cell with a minimum resistance of _____ Ω per cell.

b) This resistance calculation includes the minimum battery system equivalent parallel resistance and the interconnecting conductors to the input termination point of this equipment.

c) These values are used to verify that the dc short circuit withstand rating of the equipment is not exceeded and that overcurrent protection devices have the required interrupting capability.

d) An illustration and formulas for calculating resistance and short circuit currents from battery systems as given in PS-E.1.6.100.1.

PS-E.1.7.2.100.6 Interrupt rating

Field installed or replaceable components which are intended to interrupt output short circuit current shall have a specified interrupt rating - unless certain components are specified to be used and are tested with the system. This information can be indicated in the installation instructions or marked on the product.

PS-E.1.7.2.100.7 Installation instructions

Equipment shall be provided with installation instructions. The equipment shall be marked in a readily visible location with the following or equivalent: "Refer to (enter document reference) for installation and safety instructions". The marking information in the instructions shall accurately reflect the ratings and use of the equipment.

PS-E.1.7.2.100.8 Restricted access locations

Markings and/or instructions shall be provided in accordance with PS-E.2.1.3.101.

PS-E.1.7.2.101 Markings on DC power and distribution equipment

PS-E.1.7.2.101.1 Symbol for reference to documents

The symbol  (ISO 7000-0434) with reference to product documentation for important information before making any connections to the equipment.

PS-E.1.7.7 Wiring terminals

PS-E.1.7.7.101 Terminals for connection in the field

PS-E.1.7.7.101.1 Terminals for connection in the field shall include identification of the connections, so that the connections are capable of being properly cross-referenced to the wiring instructions.

PS-E.1.7.7.101.2 The wiring information shall be in instructions made available with the equipment.

PS-E.1.7.7.101.3 At least the following wiring instructions, or equivalent, shall be included:

- tightening torque or crimping information;
- conductor material if other than copper;
- conductor size or range;
- the appropriate insulation temperature rating of any field wiring based on temperatures measured on terminals and areas containing field wiring.

PS-E.1.7.7.1.100 DC earth marking

The DC earthing/bonding shall be marked using the earthing symbol  (IEC 60417-1, 5017) and by placing “DC” or the DC symbol next to the earth symbol.

PS-E.1.7.15.100 Battery replacement markings/instructions

The battery type and information for replacement batteries shall be specified on battery racks and cabinets or provided in the documentation.

PS-E.2.1.3 Protection in restricted access locations

PS-E.2.1.3.100 For equipment identified for use in a restricted access location, functional insulation may be used from a hazardous voltage secondary circuit to a non-current carrying bare conductive part when all of the following conditions are met:

a) The non-current carrying bare conductive part shall be earthed according to 2.6.1/RD or required marking shall indicate to service personnel that such parts are not earthed and are to be checked for hazardous voltages before being touched.

b) Documentation must state the need to provide protective earthing where required.

PS-E.2.1.3.101 If the enclosure requirements of IEC 60950 are not met, this equipment shall be identified for installation in a restricted access location (RAL). The instructions shall identify that the equipment must be installed, operated and serviced by qualified technical personnel only. Equipment in these locations will contain parts at hazardous energy levels that can be directly accessed and are only protected by guarding and/or warning. HAZARDOUS VOLTAGE circuits shall be protected by guarding and warning.

PS-E.2.6 Provisions for earthing and bonding

PS-E.2.6.1.100 Earthing of enclosures (and frames) containing earthed DC circuits Equipment supplied by or containing DC power with one side of the DC power connected to the DC earthing terminal shall also have the enclosure connected or provided with a means for connection to the DC earthing terminal with a conductor sized to carry the fault current. AC earth shall not be used for the DC fault path unless sized accordingly.

PS-E.2.7 Overcurrent and earth protection in primary circuits

PS-E.2.7.101 Overcurrent protection in secondary circuits. Equipment containing overcurrent protectors for dc power branch distribution shall be provided with a place on the equipment for the installer to identify the circuit information.

PS-E.2.7.101.1 An overcurrent protective device provided for dc power branch distribution shall have the voltage rating and interrupt rating specified by the manufacturer of the overcurrent protective device. This rating shall not be less than the maximum voltage and dc short circuit withstand rating of the equipment.

PS-E.2.7.101.2 If, at the point of overcurrent protection, the equipment has been evaluated and found to have a reduced level of available fault current, the overcurrent protective device at that point may have an interrupt rating less than that specified above. However, it shall be at least equal to the available fault current of the equipment as determined by analysis or the following test:

The short circuit shall be applied after the location of the overcurrent protective device. The overcurrent protective device shall be replaced by a conductor of negligible impedance.

a) The short shall consist of the largest size conductor that can be attached with the minimal length necessary to make the attachment, a suitable current shunt, a switching device rated sufficiently to apply the short, and a device to measure and record the maximum current through the shunt. The total resistance of the test set-up shall not exceed 0,015 Ω.
b) If the equipment is specified to be used only with certain battery supplies, then these batteries shall be used for the test. If an output short circuit current rating or DC short circuit withstand rating is specified, then a battery source capable of delivering this current shall be used.
c) The current measured through the shunt shall be less than the interrupt rating of the overcurrent protector.

PS-E.2.7.101.3 Overcurrent protection devices rated 30 A or less and used in DC power and distribution equipment with an output short circuit current rating or dc short circuit withstand rating of 10 000 A or less, are capable of being tested in the circuit and do not require an interrupt rating specified by the manufacturer. The following test shall be performed: The test setup shall be as described in PS-E.2.7.101.2 above.A minimum of three samples shall be evaluated.After each test there shall be no mechanical or fire hazard.

PS-E.2.7.102 Alarm indicating fuses

PS-E.2.7.102.1 An alarm indicating fuse is capable of being connected in parallel with an overcurrent protective device under either of the following conditions:

a) the parallel fuse combination has been evaluated and complies with PS-E.2.7.101; or

b) the rated current of the alarm fuse is less than 1/6 the rated current of the overcurrent protective device, and the impedance of the alarm circuit will limit the fault current in the alarm circuit to a value equal to or less than the interrupt rating of the alarm fuse (if the alarm fuse has no specified interrupt rating, then the testing in PS-E.2.7.101.3 can be used).

PS-E.2.7.102.2 When an "open type" alarm indicating fuse is used, a cover shall be provided unless the likelihood of a hazard has been reduced to a safe level.

PS-E.2.7.103 Electronic overcurrent protection

PS-E.2.7.103.1 Electronic overcurrent protection shall limit the output current to a value defined by the manufacturer under any of the following conditions in accordance with 5.3/RD. The value of the current shall be measured minimum 5 s after initiation of the fault condition.

a) Any condition of output loading including short circuit. Under this condition, no overcurrent protective device shall open and the unit shall be functional after the overload condition is removed.

b) Any condition of output loading including short circuit under any single fault condition in the electronic protection circuit. Electronic protection is identified as capable of being used as an overcurrent protective device when during the tests, the unit complies with 5.3.8/RD and neither protective device in the equipment nor the mains circuit overcurrent protection shall open.

PS-E.2.10 Clearances, creepage distances and distances through insulation

PS-E.2.10.1.100 General

clearances and creepage distances at wiring terminals used for field connections shall be dimensioned in accordance with table PS-E.2.100.

clearances and creepage distances for uninsulated bus bars containing hazardous energy levels shall be dimensioned in accordance with table PS-E.2.101.

PS-E.2.10.1.100.1 Circuit breaker arc vents

The effect of possible contaminants from arc vents of devices such as circuit breakers shall be evaluated when determining creepage distances and clearances within the DC power and distribution equipment containing circuits connected to the AC mains supply.

Table PS-E.2.100: AC and DC field wiring spacings [1), 2), 3)]

(mm)

Insulation working voltage up to and including		Between field wiring terminals of the same polarity [4), 5)]	Between field wiring terminals of opposite polarity or to earthed conductive parts	
$V_{r.m.s.}$ (Sinusoidal)	V_{peak} or d.c.	Creepage distance and clearance	Creepage distance	Clearance
50	71	3,2	6,4	6,4
250	354	6,4	6,4	6,4
600	848	12,7	12,7	9,5

Conditions:

1) Creepage distance values in table 2L/RD must be met at a minimum.

2) Connections must be with the most unfavorable conductor size and position.

3) Includes spacings on the load side of switches, fuses, or circuit breakers that have a common input. Consideration shall be given to the way the connection is made. If it can be demonstrated that spacings can be maintained in the field, then the creepage distance and clearance values can be based on tables 2L/RD and either 2H/RD or 2K/RD for the circuit involved (after the appropriate connections are made). Examples: the use of lugs that are prevented from rotating, mating connectors on provided cable sets, or terminal blocks with recessed openings that meet the field wiring spacings without the conductor and comply with tables 2L/RD and either 2H/RD or 2K/RD with the largest conductors installed.

4) Battery terminations before the overcurrent protection shall meet the same spacing requirements for busbars, table PS-E.2.101.

5)Field wiring terminals of limited energy, limited current, limited power or circuits where abnormal testing verifies no hazard exists, can be dimensioned according to 2.10.3/RD, 2.10.4/RD, and 2.10.5/RD as operational insulation.

NOTE - When evaluating spacings, consideration shall be given to tolerances of parts and to the method of assembly.

Table PS-E.2.101: Minimum acceptable spacings for uninsulated bus bars [1), 3), 4)]
(mm)

Insulation working voltage — up to and including		Minimum spacing between live parts of opposite polarity and between live parts and earthed conductive parts	
V r.m.s. (sinusoidal)	V peak or d.c.	clearance	creepage distance 2)
600	848	12.7	Table 2L

Conditions applicable to the table

1) These spacings may be reduced for sections of bus bars that are provided with physical barriers to maintain spacings or secured in such a way to prevent the reduction of spacings as follows:

- when the specified torque is applied to any required field connection;
- when subjected to any abuse likely to be encountered during operation or servicing;
- when the unit is subjected to the enclosure impact and deflection testing.

Insulation between bus bars or sections of bus bars that meet the above conditions, can be evaluated as basic insulation using tables 2K/RD and 2L/RD.

2) Creepage values in table 2L/RD must be met as a minimum.

3) The clearances specified for ac mains supply only apply to field wiring compartments containing busbars that contain voltages above 250 Vr.m.s.

4) If a fault analysis (short circuit and overload) is capable of being performed on the circuit containing hazardous energy levels without creating a safety hazard, the conditions of 5.3.4/RD apply.

NOTE - When evaluating spacings, consideration shall be given to tolerances of parts and to the method of assembly.

PS-E.3 Wiring, connections and supply

PS-E.3.100 Protection of secondary circuits in the DC power and distribution equipment

PS-E.3.100.1 DC POWER BRANCH DISTRIBUTION shall be protected against overcurrent and short circuits.

PS-E.3.100.2 Protection for wiring shall be provided by one or more of the following methods:

– conductor size;
– insulation;
– spacings;
– support design;
– rated protective devices such as circuit breakers or fuses, electronic regulation, or inherently limited power sources.

Circuits between batteries and the first overcurrent protection shall also be provided with increased spacings in accordance with Table PS-E.2.100.

NOTE - As the wiring between batteries and the first overcurrent protection complies with PS-E.2.10.3.101.2, the required protection against faults is determined to exist.

PS-E.3.100.3 No protection is required for wiring that is not directly in the path of the power distribution conductors if it can be shown that there is no safety hazard.

Compliance is checked by inspection and, as appropriate, by the tests of 5.3/RD.

PS-E.4.3.8.100 Electrolyte containment

When a flooded battery is included with the product, the electrolyte containment shall be evaluated. The design shall include either the required containment system, or a reference in the documentation for the need to include a containment system in the installation.

PS-E.4.5 Thermal requirements

The temperature rises under normal operating conditions, shall not exceed the limits given in table 4B/RD and the table PS-E.4B.101.

Table PS-E.4B.101: Temperature limits

Parts	Maximum temperature K
Contact parts in air	
Copper [2)]	70
Silver or Silver-faced [3)]	-
All other metals [4)]	-
Busbars: [8)]	
Unplated bus bar or unplated joint [7)]	70
Plated bus bar joint, point of connection to a circuit breaker [1), 5), and 6)]	90
Terminals for field-installed conductors:	
Intended for use with 60°C wire	75
Intended for use with 75°C wire	90
Wire insulation or any part that can be contacted by field wiring	Temperature marking of the wire

Conditions:

[1)] Both surfaces of a joint shall be plated, but not necessarily the entire length of the bus bar.

[2)] Temperature limits on the contacts of contactors or relays may be exceeded when the contactor only carries load current during battery discharge conditions, as long as condition 3) is met.

[3)] Limited solely by the necessity of not causing any damage to adjacent parts.

[4)] To be specified according to the properties of the metals used and limited by the necessity of not causing any damage to adjacent parts.

[5)] Conditions for allowing bus bar connections to exceed 90 °C are being evaluated.

[6)] Bus bar joints with mixed platings shall meet Appendix J/RD or the acceptability of the combination proven.

[7)] Unplated connections treated with an anti-oxidation compound will be limited by the compound rating or the limits for unplated connections, whichever is higher, but not greater than that allowed for plated connections.

[8)] These limits may be exceeded under conditions identified as temperature excursions, but shall not exceed 105°C total measured temperature for connections, and shall not exceed the recommended temperature limitations specified by the circuit breaker manufacturer to avoid internal damage to the circuit breaker.

PS-E.5.100 Contactors and relays used for load or battery disconnect

PS-E.5.100.1 Contactors or relays used as LOW VOLTAGE LOAD DISCONNECT (LVLD) and LOW VOLTAGE BATTERY DISCONNECT (LVBD) need only be subjected to the following test:

– Test one sample of a contactor design on an overload circuit of 150% of RATED CURRENT at maximum contact voltage for 50 operations. One operation consists of closing and opening of the contacts. The rated coil voltage shall be used.

– Following the overload test, the same contactor is cycled for 1 000 operations at 100% rated contact current at maximum contact voltage. Rated coil voltage is used.

– For both tests, the frame of the contactor is to be connected through a 30 A non-time delay cartridge fuse to the electrical test circuit pole considered least likely to strike to earth.
– The maximum cycling rate for these tests is 1 s on, and 9 s off (6 cycles/min). Cycle times may be reduced as follows:
  a) When the device operation will not permit these cycle times, times as close as possible to these are to be used.
  b) If it is determined that for a duration less than 1 s, the device conducts the test current without interrupting the circuit or being adversely affected by heat and the device contacts are properly seated before the break is initiated as confirmed by oscilloscopic or oscillographic measurements, the on time may be reduced to that duration.
  c) The off time may be less if agreeable to all concerned.

PS-E.5.100.2 The test circuits for both the overload and endurance tests are allowed to be purely resistive such that the circuit time constant is essentially zero. Realistically, there will be some inductive component to the test circuit, and this will only make the test more severe.

PS-E.5.100.3 During the testing, there shall be no electrical or mechanical breakdown. There shall be no permanent arcing, no flash over between poles, no opening of the fuseable elements in the earth circuit, and no welding of the contacts.

PS-E.5.100.4 At the conclusion of test, the sample shall be subject to a dielectric strength test based on table 5B/RD from live parts to earth with contacts closed, across open contacts, between different sets of contacts, from contact to coil, and from coil to earth.

PS-E.5.100.5 The contacts shall be rated for the full load current expected at the end of the battery discharge when the circuit is opened.

PS-E.5.100.6 In addition to temperature testing under normal operating conditions of the equipment, when the equipment contains components affected by a battery discharge condition, the equipment shall also be tested in this condition. The maximum load current at the battery disconnect voltage shall be used until temperatures stabilize on parts in the path of the power distribution conductors. All fans and equipment normally off in this condition shall not be operating during the test. Components, including the busbar clamped connections and circuit breakers, are capable of exceeding the normal temperature limits with the limits for TEMPERATURE EXCURSIONS being applied. See condition 8 of table PS-E.4B.101.

PS-E.5.100.7 The DC SHORT CIRCUIT WITHSTAND capability of the LVLD or LVBD is evaluated using test method in PS-E.5.3.6.100 in its application. For equipment rated less than or equal to 10 000 A, additional evaluation is not required. If used in equipment rated over 10 000 A, the LVLD or LVBD shall not create a hazard and spacings shall not be permanently reduced. Acceptability of contacts welding shall be determined based on the application (for example, alarming of circuit that indicates contactor status; no safety hazard created if contacts do not open).

PS-E.5.101 DC disconnect switches

PS-E.5.101.1 DC DISCONNECT SWITCHES shall comply with the relevant component standard or the following tests based on the application. Contact separation is based on the working voltage and passing the electric strength test per table 5B/RD after the required cycle testing.

PS-E.5.101.2 For DC DISCONNECT SWITCHES, samples of each switch design and rating to be tested shall be subjected to the tests as shown in table PS-E.5.101. The letter in the "Test Sequence" column indicates the test sequences that are to be performed on an individual sample. All tests identified with the same letter shall be performed on a single previously untested sample, except that a sample that was subjected to previous tests may be reconditioned and used if agreeable to those concerned.

Table PS-E.5.101: Switch test sequences

Test sequence[1)]	Order of tests in each test sequence	Clause reference for test	Fuse used
A	1st. Thermal requirements	PS-E.5.101.11	Live fuse
B	1st. Overload	PS-E.5.101.12	Dummy fuse
	2nd. Endurance	PS-E.5.101.12	Dummy fuse
	3rd. Electric strength	PS-E.5.101.16	None
C	1st. Close-open	PS-E.5.101.13	Dummy fuse
	2nd Short-circuit withstand	PS-E.5.101.14	Test limiter
	3rd. Electric strength	PS-E.5.101.16	None
D	1st. Closing	PS-E.5.101.15	Test limiter
	2nd. Electric strength	PS-E.5.101.16	None
E	1st. Strength of insulating base and support	PS-E.5.101.17	None

Conditions:

1) A separate sample is to be used for each lettered test sequence.

NOTE - If the same sample is used for test sequences C and D, the electric strength test is not required for test sequence C.

PS-E.5.101.3 A DC DISCONNECT SWITCH shall be mounted in a manner representing the most severe condition of intended use in regard to the following:

a) enclosure size;

b) spacings between live parts and earthed metal; and

c) mounting position.

PS-E.3.101.4 A door or cover may be open as necessary to operate the switch, but any other openings shall be closed. The line terminals shall be connected to the supply circuit, and the load terminals shall be connected to the necessary resistance or impedance, when needed.

PS-E.5.101.5 A dummy fuse shall be a copper bus or tube, having a size equivalent to the blade (or ferrule) of the fuse that the fuseholder is intended to accommodate. Each of these bars or tubes may be individually reinforced to enable it to withstand the test forces.

PS-E.5.101.6 For test sequences B, C, and D, a switch shall be tested with the enclosure or dead metal parts connected through a 30 A cartridge fuse, without any time delay, to the earthed conductor. This connection is to be made to the load side of the limiting impedance by a 4 mm^2 cross-sectional area (No. 10 AWG) copper wire having a length of 1,83 m or less.

PS-E.5.101.7 If a machine is used as the means of test operation, the closure speed and opening speed shall not exceed 75 mm/s. The construction of the operating mechanism is to be such as to provide positive insertion and withdrawals of DC DISCONNECT SWITCHES.

PS-E.5.101.8 A switch having two or more short-circuit withstand ratings shall be tested at each rating unless a test at one rating is representative of performance at the other ratings.

PS-E.5.101.9 For the overload, close-open, short-circuit withstand, and closing tests, the tests shall be made on circuits adjusted so that the open-circuit voltage is 100 - 110% of the rated voltage of the switch. The open-circuit voltage may be more than 110% of the rated voltage if agreeable to those concerned. The circuits shall have a recovery voltage equal or greater than the rated voltage of the device. No time constant is specified, however, an inductive time constant may be used if agreeable to those concerned.

PS-E.5.101.10 During the overload, endurance, close-open, short-circuit withstand, and closing tests:

– the fuse connected to the enclosure or dead metal parts shall not open;
– there shall not be breakage to the extent that the integrity of the mounting of live parts is impaired;
– there shall not be electrical nor mechanical malfunction;
– there shall be no welding of the contacts;
– the door shall be kept from blowing open by its latch, without any bolts or locks installed thereon (deformation of the case alone is not considered an unacceptable result);
– live end of a fuse shall not be exposed. Neither end of a fuse (live or dummy) shall be completely ejected from the fuse clips and the live end of a fuse shall not bridge from a fuse clip to dead metal;
– the switch shall be capable of being opened manually with the operating handle; and
– the switch head shall not be ejected from its housing and no live metal parts shall be exposed.

PS-E.5.101.11 Thermal requirements

PS-E.5.101.11.1 With the switch carrying rated current continuously until constant temperatures are attained, no part shall exceed the temperature values specified in table 4B/RD and table PS-E.4B.101. Thermal tests are conducted in accordance with 4.5/RD. When fuses are used, no fuse shall open.

PS-E.5.101.11.2 The test may be conducted at any voltage resulting in rated current flow.

PS-E.5.101.12 Overload and endurance tests

PS-E.5.101.12.1 The overload test consists of 50 cycles at 150% of rated current. The endurance test consists of 1 000 cycles at 100% of the rated current. The test voltage shall be within 5% of maximum rated voltage.

PS-E.5.101.12.2 The rate of operation shall be 5 operations per minute or faster if agreeable to the manufacturer.

During the endurance test, the switch blades may be lubricated as needed to resume intended operation.

PS-E.5.101.13 Close-open test

PS-E.5.101.13.1 A switch shall make and break 600% of its RATED CURRENT for five operations.

PS-E.5.101.13.2 The switch shall remain closed for approximately 0,5 s. The rate of operation is not specified. The blades and jaws may be serviced before each operation. The switch may be serviced prior to the short circuit withstand test.

PS-E.5.101.13.3 Servicing is considered to be filing, lubricating, deburring, and the like. There is to be no disassembly of the device to accomplish the servicing. Servicing is not to include replacement of any part.

PS-E.5.101.14 DC Short circuit withstand test

PS-E.5.101.14.1 A circuit capable of providing the maximum DC short circuit withstand current for which the switch is rated shall be connected to the switch. The switch shall withstand the designated current until the overcurrent protective device(s) open. The overcurrent protection device(s) shall be on the load side of the switch and shall be one of the following:

– for fused switches, test limiters as described in PS-E.5.101.14.4 installed in the switch or externally connected.

– for unfused switches, externally connected test limiters or circuit breakers as marked on the switch.

NOTE An equivalent AC source can also be used.

PS-E.5.101.14.2 This test may be performed without overcurrent protection devices if it can be shown that the test current was maintained for a period of time at least equal to the opening time of the specified overcurrent protective devices at the level of current involved.

PS-E.5.101.14.3 The line and load terminals of the switch are to be connected to the corresponding test circuit terminals by short copper wire leads, maximum of 1,22 m per terminal, each of which has an ampacity not less than the current rating of the switch.

PS-E.5.101.14.4 Test limiters used shall have characteristics that are equal to or greater than the maximum peak let-through current (I_p) and clearing I^2t values associated with the maximum rated fuses the device either accepts or by which it is to be externally protected. For an unfused switch it is assumed that protection will be provided by the maximum fuse in the case size of the indicated fuse. Test limiters, of the appropriate size, are capable of being installed in the switch, or dummy fuses are capable of being installed in the switch with the test limiters external to the switch.

NOTE: - Test limiters used for tests are to be selected from a lot from which two samples have been tested and comply with the necessary values.

PS-E.5.101.14.5 The available current and other circuit characteristics shall be determined by suitable methods.

PS-E.5.101.15 Closing test

PS-E.5.101.15.1 A switch shall be closed on a circuit capable of providing the maximum short circuit current for which the switch is rated.

PS-E.5.101.15.2 The conditions of the closing test are to be the same as for the short circuit withstand test. Complete physical closure of the switch contacts need not be established.

PS-E.5.101.16 Electric strength test

PS-E.5.101.16.1 After the tests of PS-E.5.104, PS-E.5.105, and PS-E.5.106, an electric strength test is made on reinforced insulation, or on basic or supplementary insulation forming part of double insulation, if any of the following applies:

a) the creepage distance or clearance has been reduced below the value specified in 2.10/RD; or

b) the insulation shows visible signs of damage; or

c) the insulation cannot be inspected.

PS-E.5.101.16.2 The test is made as specified in 5.3.2/RD after the insulation has cooled to room temperature.

PS-E.5.101.17 Strength of insulating base and support.PS-E.5.101.17.1

The insulating base of a DC DISCONNECT SWITCH shall not be damaged when wire connectors securing short lengths of conductors of rated ampacity are tightened to 110% of the highest torque value specified for the switch.

PS-E.5.101.17.2 Damage is considered to have occurred when the base insulating material cracks or rotates; bosses, recesses, or other means to prevent turning do not perform their intended function; straps or bus bars bend or twist; or members move at electrical joints. Minor chipping or flaking of brittle insulating material is acceptable if the performance is not otherwise impaired. Momentary flexing of metallic members without permanent deformation is acceptable.

PS-E.5.3.6 Tests

PS-E.5.3.6.101 Equipment rated with a 10 000 A or less DC SHORT CIRCUIT WITHSTAND RATING is not required to be tested for withstand capability except for the interrupt ratings of overcurrent protection devices. Test and construction requirements for equipment rated over 10 000 A D.C. SHORT CIRCUIT WITHSTAND rating are under consideration. Until requirements for further evaluations are identified for equipment rated over 10 000 A, components in the circuit shall be evaluated to ensure that no hazard exists under a single fault condition applied to the output of the distribution (or each distribution type). This can be done with a BATTERY SUPPLY where the calculated output short circuit current capability of the BATTERY SUPPLY is greater than or equal to the DC SHORT CIRCUIT WITHSTAND rating of the equipment being evaluated. The fault shall be applied using the maximum size wire that is specified to be connected at the shortest length possible to connect the test setup, and the specified overcurrent protector(s). The test setup shall include a sufficiently rated contactor/relay (or other suitable device) to apply the short and shunt with a measuring device capable of capturing the peak current. There shall be no permanent reduction in spacings or hazards created within the equipment.

ANNEX PS-F
(Informative)

Guidance on marking and installation instructions for proper selection of power supplies for use in information technology equipment.

PS-F.1 In addition to the markings specified in 1.7.1/RD, the following information may either be marked on the power supply or may be provided as part of the installation instructions.

a) Rated output voltage(s); and

b) Rated output current(s); and

c) rated output frequency or frequency range or symbol for dc voltage; and

d) Total maximum output power if it is less than the sum of the powers of the individual outputs; and

e) Required rating and type of the overcurrent protection to be provided in the end product, if not provided as an integral part of the power supply; and

f) Output short circuit current(s).

PS-F.2 One of the following classification levels may either be marked on the power supply or may be provided as part of the installation instructions.

a) LEVEL 0: Classification Level 0 (L0) for power supplies that require special additional features or that depend on the host equipment to meet the applicable requirements; or

b) LEVEL 1: Classification Level 1 (L1) for power supplies with output circuits that are either not suitable for, or have not been investigated for selv or tnv circuits; or

c) LEVEL 2: Reserved for future use; or

d) LEVEL 3S: Classification Level 3 (L3S) for power supplies with output circuits that all meet the requirements for selv circuits and that, under any condition of output overloading do not exceed 240 VA (i.e. the outputs are selv circuits and are at non-hazardous energy levels); or

e) LEVEL 3T1: Classification Level 3 (L3T1) for power supplies with output circuits that all meet the requirements for tnv-1 circuits and that, under any condition of output overloading do not exceed 240 VA (i.e. the outputs are tnv-1 circuits and are at non-hazardous energy levels); or

f) LEVEL 4S: Classification Level 4 (L4S) for power supplies with outputs that all meet the requirements for selv circuits suitable for direct connection to the telecommunication network; or

NOTE 1 Output is suitable for direct connection to the telecommunication network if the output current is limited to 1,3 A by inherent impedance or by an overcurrent protective device rated no more than 1 A (see 6.5/RD).

g) LEVEL 4T1: Classification Level 4 (L4T1) for power supplies with outputs that all meet the requirements for tnv-1 circuits suitable for direct connection to the telecommunication network; or

h) LEVEL 4T2: Classification Level 4 (L4T2) for power supplies with outputs that all meet the requirements for tnv-2 circuits suitable for direct connection to the telecommunication network; or

i) LEVEL 4T3: Classification Level 4 (L4T3) for power supplies with outputs that all meet the requirements for tnv-3 circuits suitable for direct connection to the telecommunication network; or

j) LEVEL 5S: Classification Level 5 (L5S) for power supplies having output circuits that meet the requirements for selv circuits (No limits on the output VA);

k) LEVEL 5T1: Classification Level 5 (L5T1) for power supplies having output circuits that meet the requirements for tnv-1 circuits (No limits on the output VA);

l) LEVEL 5T2: Classification Level 5 (L5T2) for power supplies having output circuits that meet the requirements for tnv-2 circuits (No limits on the output VA);

m) LEVEL 5T3: Classification Level 5 (L5T3) for power supplies having output circuits that meet the requirements for tnv-3 circuits (No limits on the output VA);

n) LEVEL 6: Classification Level 6 (L6) to indicate a multiple output power supply having output circuits in any combination of Levels 1, 3, 4 and 5.

NOTE 2 Additional markings are allowed, provided they do not give rise to misunderstanding.

NOTE 3 Conditions of acceptability, if any, must be provided in the installation instructions.

PS-F.3 One of the following classifications may either be marked on the power supply or may be provided as part of the installation instructions (see 2.3.3/RD and 6.2.1.4/RD).

a) Method 1: Classification M1 for power supplies using method 1 for isolation of selv or tnv circuits from the primary circuit or hazardous voltage circuits; or

b) Method 2: Classification M2 for power supplies using method 2 for isolation of selv or tnv circuits from the primary circuit or hazardous voltage circuits; or

c) Method 3: Classification M3 for power supplies using method 3 for isolation of selv circuits from the primary circuit or hazardous voltage circuits; or

d) Method 4: Classification M4 to indicate a multiple output power supply having selv or tnv circuits isolated from the primary circuit or hazardous voltage circuits in any combination of methods 1, 2 and 3.

NOTE As an example, an output (of a power supply) designated as "L3M1" will mean that the particular output:

a) is an selv circuit;b)is isolated from the primary circuit by double or reinforced insulation; and

c) does not exceed 240 VA, under any condition of overloading.