

BS EN 62040-1:2008+A1:2013



BSI Standards Publication

Uninterruptible power systems (UPS)

Part 1: General and safety requirements for UPS

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

raising standards worldwide™

Full document details: BS EN 62040-1:2008+A1:2013



National foreword

This British Standard is the UK implementation of EN 62040-1:2008+A1:2013. It is identical to IEC 62040-1:2008, incorporating amendment 1:2013 and IEC corrigendum September 2008. It supersedes BS EN 62040-1:2008, which will be withdrawn on 14 February 2016.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power electronics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

© The British Standards Institution 2013.
Published by BSI Standards Limited 2013

ISBN 978 0 580 75103 5

ICS 29.200

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2009

Amendments/corrigenda issued since publication

Date	Text affected
30 June 2013	Implementation of IEC amendment 1:2013 with CENELEC endorsement A1:2013

**Uninterruptible power systems (UPS) -
Part 1: General and safety requirements for UPS
(IEC 62040-1:2008 + corrigendum August 2008)**

Alimentations sans interruption (ASI) -
Partie 1: Exigences générales
et règles de sécurité pour les ASI
(CEI 62040-1:2008 +
corrigendum août 2008)

Unterbrechungsfreie
Stromversorgungssysteme (USV) -
Teil 1: Allgemeine Anforderungen
und Sicherheitsanforderungen
(IEC 62040-1:2008 +
Corrigendum August 2008)

This European Standard was approved by CENELEC on 2008-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

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

CENELEC

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

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

Foreword

The text of document 22H/104/FDIS, future edition 1 of IEC 62040-1, prepared by SC 22H, Uninterruptible power systems (UPS), of IEC TC 22, Power electronic systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62040-1 on 2008-09-01.

This European Standard supersedes EN 62040-1-1:2003 + corrigendum August 2004 and EN 62040-1-2:2003 + corrigendum August 2004.

EN 62040-1:2008 merges all requirements of EN 62040-1-1:2003 and EN 62040-1-2:2003, with the addition of the following:

- update of normative references including EN 60950-1 as Reference Document (RD);
- harmonization and alignment with current world recognized best practices;
- enhancement of backfeed protection, definition of ground-fault, revision of temperature rise tables and of hydrogen concentration in battery compartments.
- Amendment 1 introduces short-time withstand current requirements when a short-circuit is applied at the output of the **UPS** (5.5.4).

This standard is to be used in conjunction with EN 60950-1:2006 which is referred to in this standard as "RD".

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2009-06-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2011-09-01 |

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 Clause 3: **bold**.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62040-1:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60439-1	NOTE	Harmonized as EN 60439-1:1999 (not modified).
IEC 60925	NOTE	Harmonized as EN 60925:1991 (not modified).
IEC 60990	NOTE	Harmonized as EN 60990:1999 (not modified).
IEC 61347	NOTE	Harmonized in EN 61347 series (partially modified).

Foreword to amendment A1

The text of document 22H/151/FDIS, future edition 1 of IEC 62040-1:2008/A1, prepared by SC 22H, "Uninterruptible power systems (UPS)", of IEC TC 22, "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62040-1:2008/A1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-11-17
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-02-14

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

Endorsement notice

The text of the International Standard IEC 62040-1:2008/A1:2013 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60364-4-42	- ¹⁾	Electrical installations of buildings - Part 4-42: Protection for safety - Protection against thermal effects	-	-
IEC 60417	Data- base	Graphical symbols for use on equipment	-	-
IEC 60529	- ¹⁾	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 ²⁾ 1993
IEC 60664	Series	Insulation coordination for equipment within low-voltage systems	EN 60664	Series
IEC/TR 60755	- ¹⁾	General requirements for residual current operated protective devices	-	-
IEC 60950-1 (mod)	2005	Information technology equipment - Safety - Part 1: General requirements	EN 60950-1	2006
IEC 61000-2-2	- ¹⁾	Electromagnetic compatibility (EMC) - Part 2-2: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	EN 61000-2-2	2002 ²⁾
IEC 61008-1 (mod)	- ¹⁾	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) - Part 1: General rules	EN 61008-1 + A11	2004 ²⁾ 2007
IEC 61009-1 (mod)	- ¹⁾	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) - Part 1: General rules	EN 61009-1 + corr. July + A11	2004 ²⁾ 2006 2008
 IEC 61439 1	2011	Low-voltage switchgear and controlgear assemblies - Part 1: General rules	EN 61439-1	2011 
IEC 62040-2	2005	Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements	EN 62040-2 + corr. November	2006 2006
IEC 62040-3 (mod)	1999	Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements	EN 62040-3	2001

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

CONTENTS

1	Scope and specific applications	9
1.1	Scope	9
1.2	Specific applications	9
2	Normative references	10
3	Terms and definitions	11
3.1	General definitions	11
3.2	UPS electrical ratings	12
3.3	Load types	13
3.4	Connection to the supply	14
3.5	Circuits and circuit characteristics	14
3.6	Insulation	14
3.7	Equipment mobility	14
3.8	Insulation classes of UPS	14
3.9	Earth fault	14
3.10	Enclosures	14
3.11	Accessibility	14
3.12	Components	14
3.13	Power distribution	14
3.14	Flammability	14
3.15	Miscellaneous	14
3.16	Clearances and creepage distances	14
3.17	Telecommunication networks	15
4	General conditions for tests	15
4.1	Introduction	15
4.2	Type test	15
4.3	Operating parameters for tests	15
4.4	UPS loading during tests	16
4.5	Components	16
4.6	Power interfaces	16
4.7	Markings and instructions	17
4.7.1	General	17
4.7.2	Power rating	17
4.7.3	Safety instructions	17
4.7.4	Main voltage adjustment	19
4.7.5	Power outlets	19
4.7.6	Fuses	19
4.7.7	Wiring terminals	19
4.7.8	Battery terminals	20
4.7.9	Controls and indicators	20
4.7.10	Isolation of multiple power sources	20
4.7.11	IT power systems	20
4.7.12	Protection in building installation	21
4.7.13	High leakage current	21
4.7.14	Thermostats and other regulating devices	21
4.7.15	Language	21

4.7.16	Durability of markings	21
4.7.17	Removable parts	21
4.7.18	Replaceable batteries	21
4.7.19	Operator access with a tool	21
4.7.20	Battery	22
4.7.21	Installation instructions	23
5	Fundamental design requirements	23
5.1	Protection against electric shock and energy hazards	23
5.1.1	Protection for UPS intended to be used in operator access areas	23
5.1.2	Protection for UPS intended to be used in service access areas	24
5.1.3	Protection for UPS intended to be used in restricted access areas	24
5.1.4	Backfeed protection	24
5.1.5	Emergency switching (disconnect) device	25
5.2	Requirements for auxiliary circuits	25
5.2.1	Safety extra low voltage circuits – SELV	25
5.2.2	Telephone network voltage circuits – TNV	25
5.2.3	Limited current circuits	25
5.2.4	External signalling circuits	25
5.2.5	Limited power source	25
5.3	Protective earthing and bonding	25
5.3.1	General	25
5.3.2	Protective earthing	26
5.3.3	Protective bonding	27
5.4	AC and d.c. power isolation	27
5.4.1	General	27
5.4.2	Disconnect devices	27
5.5	Overcurrent and earth fault protection	27
5.5.1	General	27
5.5.2	Basic requirements	27
5.5.3	Battery circuit protection	28
5.5.4	Short time withstand current	29
5.6	Protection of personnel – Safety interlocks	31
5.6.1	Operator protection	31
5.6.2	Service person protection	31
5.7	Clearances, creepage distances and distances through insulation	33
6	Wiring, connections and supply	33
6.1	General	33
6.1.1	Introduction	33
6.1.2	Dimensions and ratings of busbars and insulated conductors	33
6.2	Connection to power	34
6.2.1	General provisions for connection to power	34
6.2.2	Means of connection	34
6.3	Wiring terminals for external power conductors	34
7	Physical requirements	35
7.1	Enclosure	35
7.2	Stability	35
7.3	Mechanical strength	35
7.4	Construction details	35
7.4.1	Introduction	35
7.4.2	Openings	36

7.4.3	Gas concentration	36
7.4.4	Equipment movement	36
7.5	Resistance to fire	36
7.6	Battery location	36
7.6.1	Battery location and installation	36
7.6.2	Accessibility and maintainability	37
7.6.3	Distance	37
7.6.4	Case insulation	37
7.6.5	Wiring	37
7.6.6	Electrolyte spillage	37
7.6.7	Ventilation	37
7.6.8	Charging voltages	38
7.7	Temperature rise	38
8	Electrical requirements and simulated abnormal conditions	39
8.1	General provisions for earth leakage	39
8.2	Electric strength	39
8.3	Abnormal operating and fault conditions	39
8.3.1	General	39
8.3.2	Simulation of faults	40
8.3.3	Conditions for tests	40
9	Connection to telecommunication networks	41
Annex A (normative)	Tests for resistance to heat and fire	42
Annex B (normative)	Motor tests under abnormal conditions	43
Annex C (normative)	Transformers	44
Annex D (normative)	Measuring instruments for touch current tests	45
Annex E (normative)	Temperature rise of a winding	46
Annex F (normative)	Measurements of clearances and creepage distances	47
Annex G (normative)	Alternative method for determining minimum clearances	48
Annex H (informative)	Guidance on protection against ingress of water and foreign objects	49
Annex I (normative)	Backfeed protection test	51
Annex J (informative)	Table of electrochemical potentials	54
Annex K (normative)	Thermal controls	55
Annex L (normative)	Reference loads	56
Annex M (normative)	Ventilation of battery compartments	60
Annex N (normative)	Minimum and maximum cross-sections of copper conductors suitable for connection (see 6.3)	63
Annex O (informative)	Guidance for disconnection of batteries during shipment	64
A1 Annex P (informative)	Short-time withstand current test procedure – Guidance and typical values	66 A1
	Bibliography	68
	Figure I.1 – Test circuit for load-induced change of reference potential – single-phase output	52
	Figure I.2 – Test circuit for load-induced change of reference potential – three-phase output	52
	Figure O.1 – Precautionary label for products shipped with the battery disconnected	64
	Figure O.2 – Precautionary label for products shipped with the battery connected	65
A1 Figure P.1	– Test circuit for UPS short-time withstand current	66 A1

Table 1 – Temperature limits	38
Table 2 – Permitted temperature limits for magnetic windings at the end of stored energy mode of operation	39
A1 Table 3 – Short time withstand current	30 A1
Table H.1 – Degrees of protection against foreign objects indicated by the first characteristic numeral.....	49
Table H.2 – Degrees of protection against water indicated by the second characteristic numeral	50
Table N.1 – Conductor cross-sections (extract from IEC 60439-1)	63

UNINTERRUPTIBLE POWER SYSTEMS (UPS) ±

Part 1: General and safety requirements for UPS

1 Scope and specific applications

1.1 Scope

This part of IEC 62040 applies to **uninterruptible power systems (UPS)** with an electrical energy storage device in the d.c. link. It is used with IEC 60950-1, which is referred to in this standard as "RD" (reference document).

NOTE **UPS** applications generally make use of a chemical battery as the energy storage device. Alternative devices may be suitable, and as such, where "battery" appears in the text of this standard, where applicable, this may be understood as "energy storage device".

When a clause is referred to by the phrase "The definitions or the provisions of item/RD apply", this phrase is intended to mean that the definitions or provisions in that clause of IEC 60950-1 apply, except any which are clearly inapplicable to **uninterruptible power systems**. National requirements additional to those in IEC 60950-1 apply and are found as notes under relevant clauses of the RD.

The primary function of the **UPS** covered by this standard is to ensure continuity of an alternating power source. The **UPS** may also serve to improve the quality of the power source by keeping it within specified characteristics.

This standard is applicable to **UPS** which are movable, stationary, fixed or for building-in, for use in low-voltage distribution systems and intended to be installed in any **operator** accessible area or in **restricted access locations** as applicable. It specifies requirements to ensure safety for the **operator** and layman who may come into contact with the equipment and, where specifically stated, for the **service person**.

This standard is intended to ensure the safety of installed **UPS**, both as a single **UPS** unit or as a system of interconnected **UPS** units, subject to installing, operating and maintaining the **UPS** in the manner prescribed by the manufacturer.

This standard does not cover **UPS** based on rotating machines.

Electromagnetic compatibility (EMC) requirements and definitions are given in IEC 62040-2.

1.2 Specific applications

Even if this standard does not cover all types of **UPS**, it may be taken as a guide for such equipment. Requirements additional to those specified in this standard may be necessary for specific applications, e.g. related to **UPS** that operate:

- while exposed to extremes of temperature; to excessive dust, moisture, or vibration; to flammable gases; to corrosive or to explosive atmospheres;
- where ingress of water and foreign objects are possible;

NOTE 1 Annex H provides guidance on such requirements and on relevant testing.

- in vehicles, on board ships or aircraft, in tropical countries, or at elevations greater than 1 000 m;

NOTE 2 Guidance for performance of **UPS** operating at elevations greater than 1 000 m is provided in 4.1.1 of IEC 62040-3.

- with trapezoidal output waveforms and long run times (greater than 30 min);

NOTE 3 In addition to complying with 5.3.1.2 of IEC 62040-3, voltage distortion tests for the purpose of load compatibility should also be performed.

- subject to transient overvoltages exceeding those of overvoltage category II according to IEC 60664;

NOTE 4 Subclause G.2.1/RD provides guidance for additional protection against transient overvoltages at the mains supply to the **UPS**. Where such additional protection is an integral part of the equipment insulation requirements, creepage distances and clearance distances from the mains through to the load side of the additional protection may be judged as category III or IV as required. All further downstream insulation requirements, creepage distances, and clearance distances on the load side of the additional protection may be judged as category I or II as required.

- in electromedical applications with the **UPS** located within 1,5 m of the patient contact area;
- in systems classified as emergency power systems by an authority having jurisdiction.

NOTE 5 Additional requirements may also apply in accordance with local regulations.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60364-4-42, *Electrical installations of buildings ± Part 4-42: Protection for safety ± Protection against thermal effects*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60755, *General requirements for residual current operated protective devices*

IEC 60950-1:2005, *Information technology equipment ± Safety ± Part 1: General requirements*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) ± Part 2-2: Environment ± Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) ± Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) ± Part 1: General rules*

A1 IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules* **A1**

IEC 62040-2:2005, *Uninterruptible power systems (UPS) ± Part 2: Electromagnetic compatibility (EMC) requirements*

IEC 62040-3:1999, *Uninterruptible power systems (UPS) ± Part 3: Method of specifying the performance and test requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General definitions

NOTE 1 Where the terms "voltage" and "current" are used, they imply the r.m.s. values, unless otherwise specified.

NOTE 2 Care should be taken that measuring instruments give a true r.m.s. reading in the presence of non-sinusoidal signals.

3.1.1

uninterruptible power system

UPS

combination of convertors, switches and energy storage devices (such as batteries), constituting a power system for maintaining continuity of load power in case of input power failure

NOTE Continuity of load power occurs when voltage and frequency are within rated steady-state and transient tolerance bands and with distortion and interruptions within the limits specified for the load. Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or with distortion or interruptions outside the limits specified for the **UPS**.

3.1.2

bypass

alternative power path, either internal or external to the **UPS**

3.1.3

primary power

power supplied by an electrical utility company or by a **user's** generator

3.1.4

active power

under periodic conditions, mean value, taken over one period T , of the instantaneous power p :

$$P = \frac{1}{T} \int_0^T p \, dt$$

NOTE 1 Under sinusoidal conditions, the **active power** is the real part of the complex power.

NOTE 2 The SI unit for **active power** is the watt.

[IEV 131-11-42]

NOTE 3 DC, fundamental and harmonic voltages contribute directly to the magnitude of the **active power**. Where applicable, instruments used to measure **active power** should therefore present sufficient bandwidth and be capable of measuring any significant non-symmetrical and harmonic power components.

3.1.5

apparent power

product of the r.m.s. voltage and r.m.s. current

3.1.6

backfeed

condition in which a voltage or energy available within the **UPS** is fed back to any of the input terminals, either directly or by a leakage path while operating in the **stored energy mode** and with **primary power** not available

3.1.7

backfeed protection

control scheme that reduces the risk of electric shock due to **backfeed**

3.1.8

stored energy mode

operation of the **UPS** when supplied by the following conditions:

- **primary power** is disconnected or is out of a given tolerance;
- battery is being discharged;
- load is within the given range;
- output voltage is within the given tolerance

3.2 UPS electrical ratings

3.2.1

rated voltage

input or output voltage (for three-phase supply, the phase-to-phase voltage) as declared by the manufacturer

3.2.2

rated voltage range

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

3.2.3

rated current

input or output current of the **UPS** as declared by the manufacturer

NOTE See 4.7.2.

A1 3.2.4

rated peak withstand current

I_{pk}

value of peak short-circuit current, declared by the **UPS** manufacturer, that can be withstood under specified conditions

NOTE For the purpose of this standard, I_{pk} refers to the initial asymmetric peak value of the prospective test current listed in Table 3

3.2.5

rated short-time withstand current

I_{cw}

r.m.s. value of short-time current, declared by the **UPS** manufacturer, that can be carried without damage under specified conditions, defined in terms of current and time

3.2.6

rated conditional short-circuit current

I_{cc}

r.m.s. value of **prospective short-circuit current**, declared by the **UPS** manufacturer, that can be withstood for the total operating time (clearing time) of the short-circuit protective device (SCPD) under specified conditions

NOTE The short-circuit protective device may form an integral part of the **UPS** or may be a separate unit. **A1**

A1 3.2.7

low impedance path

path containing devices that for **UPS** load purposes present negligible impedance such as cabling, switching devices, protecting devices and filtering devices

NOTE The devices in a **low impedance path** may under short-circuit conditions present current limiting characteristics. Examples include current limiting fuses, current limiting circuit-breakers, transformers and inductors.

3.2.8

prospective short-circuit current

I_{cp}

r.m.s. value of the current which would flow if the supply conductors to the circuit are short-circuited by a conductor of negligible impedance located as near as practicable to the supply terminals of the **UPS** **A1**

3.3 Load types

3.3.1

normal load

mode of operation which approximates as closely as possible the most severe conditions of normal use in accordance with the manufacturer's operating instructions

NOTE 1 However, when the conditions of actual use can obviously be more severe than the maximum load conditions recommended by the manufacturer, a load should be used that is representative of the maximum that can be applied

NOTE 2 For examples of reference **normal load** conditions for **UPS**, see Annex L.

3.3.2

linear load

load where the current drawn from the supply is defined by the relationship:

$$I = U/Z$$

where

I is the load current;

U is the supply voltage;

Z is the load impedance

3.3.3

non-linear load

load where the parameter Z (load impedance) is no longer a constant but is a variable dependent on other parameters, such as voltage or time (see Annex L)

3.4 Connection to the supply

The definitions of 1.2.5/RD apply together with the following.

3.4.1

power cord

flexible cord or cable for interconnection purposes

3.5 Circuits and circuit characteristics

The definitions of 1.2.8/RD (e.g. hazardous voltage 1.2.8.6/RD) apply.

3.6 Insulation

The definitions of 1.2.9/RD apply.

3.7 Equipment mobility

The definitions of 1.2.3/RD apply.

3.8 Insulation classes of UPS

The definitions of 1.2.4/RD apply.

3.9 Earth fault

Occurrence of an accidental conductive path between a live conductor and the earth

[IEV 195-04-14]

3.10 Enclosures

The definitions of 1.2.6/RD apply.

3.11 Accessibility

The definitions of 1.2.7/RD apply.

3.12 Components

The definitions of 1.2.11/RD apply.

3.13 Power distribution

The definitions of 1.2.8.1/RD and 1.2.8.2/RD apply.

3.14 Flammability

The definitions of 1.2.12/RD apply.

3.15 Miscellaneous

The definitions of 1.2.13/RD (e.g. type test definition 1.2.13.1/RD) apply.

3.16 Clearances and creepage distances

The definitions of 1.2.10/RD apply.

3.17 Telecommunication networks

The following definitions apply: 1.2.8.11/RD, 1.2.8.12/RD, 1.2.8.13/RD, 1.2.8.14/RD.

4 General conditions for tests

4.1 Introduction

The provisions of 1.4.1/RD, 1.4.3/RD, 1.4.6/RD, 1.4.7/RD, 1.4.8/RD, 1.4.10/RD, 1.4.11/RD, 1.4.12/RD, 1.4.13/RD, 1.4.14/RD apply together with the following.

Only the leakage current and heating tests shall be performed at input voltage tolerances (see 1.4.5/RD). All tests shall be run at nominal input voltages, unless specifically prescribed otherwise.

4.2 Type test

The provisions of 1.4.2/RD apply together with the following addition.

Where in this standard compliance of materials, components or subassemblies is checked by inspection or by testing of properties, it is permitted to confirm compliance by reviewing any relevant data or previous test results that are available instead of carrying out the specified **type tests**.

NOTE For physically large units and/or power ratings, adequate test facilities to demonstrate some of the **type tests** may not exist.

This situation also applies to some electrical tests for which no commercial test simulation equipment is available or requires specialized test facilities beyond the scope of the manufacturer's premises.

4.3 Operating parameters for tests

Except where specific test conditions are stated elsewhere in the standard, and where it is clear that there is a significant impact on the results of the test, the tests shall be carried out at **rated voltage** and under the most unfavorable combination of the following parameters, within the manufacturer's operating specifications:

- absence of supply voltage;
- supply frequency;
- charge condition of the battery;
- physical location of **UPS** and position of movable parts;
- operating mode.

The following does not apply to **UPS** installed in **restricted access locations**:

- adjustments of **thermostats**, regulating devices or similar controls in **operator access areas**, which are
 - a) adjustable without the use of a **tool**, or
 - b) adjustable using a means, such as a key or a **tool**, deliberately provided for the **operator**.

4.4 UPS loading during tests

Where test results could reasonably be expected to vary upon **UPS** loading, adjustments shall be made to provide the most unfavorable results. This is achieved by considering loading

- that could be connected to any standard supply outlet or terminal on the equipment, up to the value indicated in the marking required by 4.7.2;
- due to recharge of the stored energy source (batteries or similar);
- due to optional features, offered or provided for by the manufacturer for inclusion in or with the equipment under test;
- due to other units of equipment intended by the manufacturer to draw power from the equipment under test.

NOTE 1 Artificial loads may be used to simulate such loading while testing.

NOTE 2 See also 4.6.

4.5 Components

Where safety is involved, components shall comply either with the requirements of this standard or with the safety aspects of the relevant IEC component standards.

NOTE 1 An IEC component standard is considered relevant only if the component in question clearly falls within its scope.

Further, the provisions of 1.5.2/RD, 1.5.3/RD, 1.5.4/RD, 1.5.5/RD, 1.5.6/RD, 1.5.7/RD and 1.5.8/RD apply.

NOTE 2 The requirements of this standard include abnormal tests to ensure safe failure mode of components; see 8.3.

4.6 Power interfaces

The provisions of 1.6.1/RD, 1.6.2/RD, 1.6.4/RD apply together with the following.

NOTE While supplying rated output under each of the conditions described in a) to d) below, the relevant a.c. or d.c. steady state input current should not exceed 110 % of the **rated current**.

- a) **Recharging mode** – Applicable to the **primary power** received by the **UPS** while also charging the battery.
- b) **Stored energy mode** – Applicable to the d.c. current from, for example, a remote battery while simulating **primary power** outage. The inverter portion of the **UPS** should receive power from either a fully charged battery bank or an external d.c. source of supply.
- c) **Bypass mode** – The transfer switch should be positioned to allow the **primary power** for the output load to bypass the rectifier/charger and inverter sections of the **UPS** and be delivered directly to the load.
- d) **Normal mode** – With a fully charged battery, the **UPS** should receive power from the **primary power** source.

The neutral conductors, if any, shall be insulated from earth and the body throughout the equipment, as if they were phase conductors. Components connected between neutral and earth shall be rated for a **working voltage** equal to the phase-to-neutral voltage. In the case of the output neutral conductor being isolated from the input neutral conductor, the **service person** responsible for the installation shall connect this output neutral conductor as required by local wiring rules and as detailed in the installation instructions.

Compliance is checked by inspection.

4.7 Markings and instructions

4.7.1 General

Where a marking is required as detailed below, provision shall be allowed for equivalent wording. The marking shall be readily visible either in an **operator access area** or shall be located on an outside surface of the equipment. If located on an outside surface of fixed equipment, the marking shall be visible after the equipment has been installed as in normal use.

For equipment intended to be installed by a **service person** or located in a **restricted access location**, the marking may be located behind a door or cover that it is not operator accessible. In this case, a readily visible marker shall be attached to the equipment to clearly indicate the location of such marking. It is allowed to use a temporary marker.

4.7.2 Power rating

Equipment shall be provided with adequate markings in order to specify

- input supply requirements;
- output supply ratings.
- ▣^{A1} – **rated short-time withstand current** (I_{cw}) or **rated conditional short-circuit current** (I_{cc}) in accordance with 5.5.4. ▣^{A1}

For equipment with multiple **rated voltages**, the corresponding **rated currents** shall be marked such that the different current ratings are separated by a solidus (/) and the relation between **rated voltage** and associated **rated current** appears distinctly.

Equipment with a **rated voltage range** shall be marked with either the maximum **rated current** or with the current range.

The markings of input and output shall include those in the RD, in addition to the following:

- output **rated voltage**;
- output rated power factor, if less than unity, or **active power** and **rated current**;
- number of output phases and neutral (refer to 1.7.1/RD);
- output rated **active power**, in watts or kilowatts according to Annex L/RD;
- output rated **apparent power** in volt-amperes or kilovoltamperes according to Annex L/RD;
- ambient operating temperature range (if other than 0 °C to 40 °C).

▣^{A1} NOTE 1 ▣^{A1} For example for indoor office ambient, the temperature range specified by the manufacturer may be 10 °C to 35 °C.

▣^{A1} NOTE 2 Table 3 values may be exceeded and so marked. ▣^{A1}

For units designed with additional separate automatic **bypass/maintenance bypass**, additional input a.c. supply, or external batteries, it shall be allowed for relevant supply ratings to be specified in the accompanying installation instructions. Where this is done, the following instruction shall appear on or near the point of connection:

**SEE INSTALLATION INSTRUCTIONS BEFORE
CONNECTING TO THE SUPPLY**

4.7.3 Safety instructions

4.7.3.1 General

The manufacturer shall make safety instructions available as required to avoid introduction of hazards when operating, installing, maintaining, transporting or storing the **UPS**.

For example, special precaution for the protective earth conductor may be required when installing a pluggable **UPS** comprising separate enclosures. The protective conductor should remain interconnected between enclosures also when the mains plug of the **UPS** is disconnected. Such enclosures may house power electronics, battery strings, **bypass** switch, terminals and/or outlets.

4.7.3.2 Installation

The manufacturer shall provide guidance on the level of competence necessary for installation. Where appropriate, installation instructions should include reference to national wiring rules. Distinct instructions apply for:

- **UPS** designed for location in a **restricted access location** only
The installation instructions shall clearly state that the **UPS** may only be installed in accordance with the requirements of IEC 60364-4-42. Such **UPS** may not meet the requirements for a fire enclosure as specified in 1.2.6.2/RD.
- **UPS** designed for permanent connection by fixed wiring to the a.c. supply or to the load or to a separate energy storage device, e.g. batteries that are not installed when delivered to the **user**. The installation instructions shall clearly state that only a qualified professional (e.g. **service person**) may install the **UPS** and that, when the disconnect device for isolation of mains power is not incorporated in the equipment (see 3.4.2/RD), an appropriate and readily accessible disconnect device shall be incorporated in the fixed wiring.
- **Pluggable type A** or **pluggable type B UPS** with energy storage device, e.g. a battery, already installed by the supplier. The installation instructions for **UPS** intended for **user** installation shall be made available to the **user**, e.g. in the **user** manual. When the disconnect device for isolation of mains power is not incorporated in the equipment (see 3.4.2/RD) or when the plug on the power supply cord is intended to serve as the disconnect device, the installation instructions shall state that the mains socket outlet that supplies the **UPS** shall be installed near the **UPS** and shall be easily accessible. When the **UPS power cord** must be connected to an earthed mains socket outlet for safety reasons, the **UPS** marking or installation instructions shall so state. The same requirement for marking applies to any special equipotential earth bonding to other connected **UPS** equipment or to Class I loads.

NOTE Pluggable **power cords** are normally 2 m in length or less.

4.7.3.3 Operation

The manufacturer shall, except when the **UPS** is intended for operation by a layperson, provide guidance on the level of competence necessary to operate the equipment. This may include reference for operators to undergo training or to be qualified and authorized to enter **restricted access locations**.

4.7.3.4 Maintenance

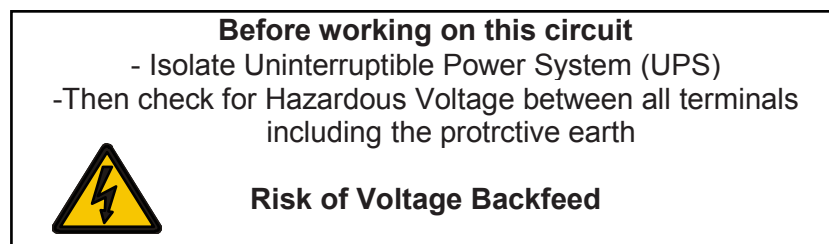
Except for minor routine maintenance that may be performed by the operator, safety instructions to be used during maintenance of the **UPS** are normally made available only to **service persons**.

4.7.3.5 Distribution related backfeed

For the purpose of warning the electrical **service person** against backfeed situations not caused by the **UPS** but that may arise when a particular load fault is present while the **UPS** operates in **stored energy mode** or while unbalanced loads are supplied through a particular power distribution system, e.g. an impedance grounded IT system, the installation instructions for permanently connected **UPS** shall require the fitting of a warning label

- by the **UPS** supplier, at the **UPS** input terminals
- and
- by the **user**, on all **primary power** isolators installed remote from the **UPS** area and on external access points, if any, between such isolators and the **UPS**
- when
- a) the automatic **backfeed** isolation (see 5.1.4) is provided external to the equipment
- or
- b) the **UPS** input is connected through external isolators that, when opened, isolate the neutral
- or
- c) the **UPS** is connected to an IT power distribution system (see 1.6.1/RD).

The warning label shall carry the following wording or equivalent.



NOTE **Backfeed protection** against faults occurring in the **UPS** is described in 5.1.4.

4.7.4 Main voltage adjustment

The provisions of 1.7.4/RD apply.

4.7.5 Power outlets

The provisions of 1.7.5/RD apply.

4.7.6 Fuses

The provisions of 1.7.6/RD apply.

4.7.7 Wiring terminals

The provisions of 1.7.7/RD apply.

4.7.8 Battery terminals

Terminals intended for connection to batteries shall indicate the polarity according to IEC 60417 or be so constructed as to reduce the likelihood of improper connection.

4.7.9 Controls and indicators

The provisions of 1.7.8/RD apply.

4.7.10 Isolation of multiple power sources

The provisions of 1.7.9/RD apply.

4.7.11 IT power systems

The provisions of 1.7.2.4/RD apply.

4.7.12 Protection in building installation

A1 The **UPS** manufacturer shall state, as applicable, the **rated short-time withstand current**, (I_{CW}) or **rated conditional short circuit current** (I_{CC}). This current shall be equal to or higher than the I_{CP} value stated in 5.5.4.3.1 (column 2 of Table 3).

If an I_{CP} value higher than that specified in Table 3 is stated, the following applies.

- a) If higher I_{CP} stated ≤ 10 kA:
the values corresponding to the next higher applicable line of Table 3 apply.
- b) If higher I_{CP} stated > 10 kA:
values 16 kA, 20 kA, 25 kA, 35 kA, 50 kA, 65 kA, 85 kA, 100 kA are preferred and the values corresponding to line $500 < I$ of Table 3 apply.

NOTE 1 Examples of Table 3 line values to be used when a higher I_{CW} or I_{CC} is stated.

- a) If a 50 A **UPS** is declared to sustain $I_{CW} = 8$ kA (instead of 6 kA), use the values of line $75 < I < 400$ in Table 3.
- b) If a 1 000 A **UPS** is declared to sustain $I_{CW} = 85$ kA (instead of $20 \times 1\,000 = 20$ kA), use the values of line $500 < I$ in Table 3.

The installer can then verify that the **prospective short-circuit current** resulting at the a.c. input terminals of the unit is equal to or less than the value declared by the **UPS** manufacturer. Otherwise, subject to an agreement between the manufacturer and the user, a solution shall be procured. Such a solution may consist in employing external current-limiting overcurrent protectors or customizing the **UPS** accordingly.

Irrespective of the **UPS** being a single unit or a unit in a paralleled system, the **prospective short-circuit current** of the a.c. input to be verified is that available at the relevant connection point of each unit. **A1**

If **pluggable equipment type B** or **permanently connected equipment** relies on the building installation for the protection of internal wiring of the equipment, the equipment installation instructions shall so state and shall also specify the necessary requirements for short-circuit protection or overcurrent protection or, where necessary, for both (see 5.5.2).

If the protection against electric shock of the **UPS** (see 5.1) relies on residual current devices in the building installation circuit and the design of the **UPS** is such that in any normal or abnormal operating condition a fault current to earth with d.c. component is possible, the installation instructions shall define the building residual current devices as type B (see IEC 60755) for three-phase **UPS** and as type A (IEC 61008-1 or IEC 61009-1) for single-phase **UPS**.

NOTE 2 ^(A1) Consideration should be given to national wiring rules, if any, regarding requirements for public networks protection.

4.7.13 High leakage current

The provisions of 5.1/RD apply in addition with the following.

For **UPS** systems intended for use as **pluggable equipment type B** or fixed installations, where the earth leakage currents of the **UPS** and connected loads sum in the primary **UPS** protective earth conductor exceeds or is likely to exceed the limits of 5.1/RD under any mode of operation, the unit shall carry a warning label as required by 5.1/RD, and the installation manual shall define the connection method to the **primary power** source.

4.7.14 Thermostats and other regulating devices

The provisions of 1.7.10/RD apply.

4.7.15 Language

Instructions and equipment marking related to safety shall be in a language which is acceptable in the country in which the equipment is to be installed.

The provisions of 1.7.2.1/RD and 1.7.8.1/RD apply.

4.7.16 Durability of markings

The provisions of 1.7.11/RD apply.

4.7.17 Removable parts

The provisions of 1.7.12/RD apply.

4.7.18 Replaceable batteries

The provisions of 1.7.13/RD apply.

4.7.19 Operator access with a tool

The provisions of 1.7.2.5/RD apply.