

# INTERNATIONAL STANDARD

**IEC**  
**62040-1-1**

First edition  
2002-08

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## Uninterruptible power systems (UPS) –

### Part 1-1: General and safety requirements for UPS used in operator access areas

*Alimentations sans interruption (ASI) –*

*Partie 1-1.*

*Prescriptions générales et règles de sécurité  
pour les ASI utilisées dans des locaux  
accessibles aux opérateurs*

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## UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

### Part 1-1: General and safety requirements for UPS used in operator access areas

#### 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 specifications, 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.
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International Standard IEC 62040-1-1 has been prepared by subcommittee 22H: Uninterruptible power systems (UPS), of IEC technical committee 22: Power electronic systems and equipment.

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

FDIS	Report on voting
22H/22/FDIS	22H/24/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.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes L, M and N form an integral part of this standard.

Annexes H and X are for information only.

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**.

The committee has decided that this publication remains valid until 2006. At this date, in accordance with the committee's decision, the publication will be

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- withdrawn;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

The contents of the corrigendum of December 2002 have been included in this copy.

**Withdrawn**

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## UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

### Part 1-1: General and safety requirements for UPS used in operator access areas

#### 1 Scope and specific applications

##### 1.1 Scope

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

When any item 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 item 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 on low-voltage distribution systems and intended to be installed in any **operator** accessible area. 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 d.c. supplied electronic ballasts (IEC 60924 and IEC 60925), **UPS** intended to be installed in separated electrical locations and **UPS** based on rotating machines.

The relevant general and safety requirements for **UPS** installed in restricted access locations are given in IEC 62040-1-2; 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, for example:

- **UPS** intended for operation while exposed, for example, to extremes of temperature; to excessive dust, moisture, or vibration; to flammable gases; to corrosive or explosive atmospheres;
- electromedical applications with the **UPS** located within 1,5 m from the patient contact area;
- for **UPS** subject to transient overvoltages exceeding those for Overvoltage Category II according to IEC 60664, additional protection might be necessary in the mains supply to the **UPS**;

- **UPS** intended for use where ingress of water and foreign objects are possible, additional requirements may be necessary; for guidance on such requirements and for relevant testing, see annex H;
- **UPS** with trapezoidal output waveforms and long run times (greater than 30 min) in addition to complying with 5.3.12 of IEC 62040-3 are subject to voltage distortion tests for the purpose of load compatibility.

NOTE For **UPS** intended to be used in vehicles, on board ships or aircraft, in tropical countries, or on elevations greater than 1 000 m, different requirements may be necessary.

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

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC/TR 60755:1983, *General requirements for residual current operated protective devices*  
Amendment 1 (1988)  
Amendment 2 (1992)

IEC 60950-1:2001, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61008-1:1996, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1:1996, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 62040-1-2, *Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations*<sup>1)</sup>

IEC 62040-2:1999, *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 Definitions

### 3.1 General

For the purposes of this standard, the following definitions apply. Where the terms "voltage" and "current" are used, they imply the r.m.s. values, unless otherwise specified.

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

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<sup>1)</sup> To be published.

**3.1.1****uninterruptible power system (UPS)**

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

**3.1.2****bypass**

power path alternative, 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****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

**3.1.5****backfeed protection**

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

**3.1.6****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**

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

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

NOTE For examples of reference **normal load** conditions for **UPS**, see annex M.

### 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 M)

### 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 apply.

#### 3.5.1

##### **hazardous voltage**

The definitions in 1.2.8.5/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 Enclosures

The definitions of 1.2.6/RD apply.

### 3.10 Accessibility

The definitions of 1.2.7/RD apply.

### 3.11 Components

The definitions of 1.2.11/RD apply.

### 3.12 Power distribution

The definitions of 1.2.8/RD apply.

### 3.13 Flammability

The definitions of 1.2.12/RD apply.

### 3.14 Miscellaneous

The definitions of 1.2.13/RD apply together with the following.

#### 3.14.1 type test

The definition of 1.4.2/RD applies 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.

### 3.15 Telecommunication networks

The following definitions apply:

1.2.8.9/RD, 1.2.8.10/RD, 1.2.8.11/RD, 1.2.8.12/RD, 1.2.13.8/RD

## 4 General conditions for tests

The provisions of 1.4.1/RD, 1.4.2/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. All other tests shall be run at nominal input voltages.

### 4.1 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 under the most unfavourable combination of the following parameters, within the manufacturer's operating specifications:

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

- 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**.

## 4.2 Loads for tests

In determination of input current, and where other test results could be affected, the following variables shall be considered and adjusted to give the most unfavourable results:

- loads due to recharging of batteries;
- loads due to optional features, offered or provided for by the manufacturer for inclusion in or with the equipment under test;
- loads due to other units of equipment intended by the manufacturer to draw power from the equipment under test;
- loads that could be connected to any standard supply outlets in **operator access areas** on the equipment, up to the value indicated in the marking required by 4.5.2.

Artificial loads may be used to simulate such loads during testing.

## 4.3 Components

The provisions of 1.5.1/RD, 1.5.2/RD, 1.5.4/RD, 1.5.5/RD, 1.5.6/RD, 1.5.7/RD, 1.5.8/RD apply.

## 4.4 Power interfaces

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

The neutral conductors, if any, shall be insulated from earth and the body throughout the equipment, as if they were a phase conductor. 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.*

## 4.5 Marking and instructions

### 4.5.1 General

Where a marking is required as detailed below, provision shall be allowed for equivalent wording. For equipment intended to be installed by anyone other than a **service person**, 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.

Markings that are not visible from the outside of the equipment are considered to be in compliance if they are directly visible when opening a door or cover. If the area behind a door or cover is not an **operator access area**, a readily visible marker shall be attached to the equipment to clearly indicate the location of the marking; it is allowed to use a temporary marker.