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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Uninterruptible power systems (UPS) –
Part 1: General and safety requirements for UPS

Alimentations sans interruption (ASI) –
Partie 1: Exigences générales et règles de sécurité pour les ASI

IEC 62040-1:2008

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: General and safety requirements for UPS

FOREWORD

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

This standard cancels and replaces the first edition of IEC 62040-1-1, published in 2004 and IEC 62040-1-2, published in 2004 and constitutes a technical revision. This standard merges all requirements of previous IEC 62040-1-1 and IEC 62040-1-2, with the addition of the following:

– update of normative references including IEC 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.

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

FDIS	Report on voting
22H/104/FDIS	22H/106/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 2.

It is to be used with IEC 60950-1, Edition 2.0, which is referred to in this standard as "RD".

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**.

A list of all parts of the IEC 62040 series, under the general title: *Uninterruptible power systems (UPS)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn;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

The contents of the corrigendum of September 2008 have been included in this copy.

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*

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:

$$P = \frac{1}{T}\int_0^T p\,\mathrm{d}t$$

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.

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.