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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Uninterruptible power systems (UPS) –
Part 3: Method of specifying the performance and test requirements

Alimentations sans interruption (ASI) –
Partie 3: Méthode de spécification des performances et exigences d'essais

IEC 62040-3:2011

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UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 3: Method of specifying the performance and test requirements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62040-3 has been prepared by subcommittee 22H: Uninterruptible power systems (UPS), of IEC technical committee 22: Power electronic systems and equipment.

This second edition cancels and replaces first edition published in 1999 and constitutes a technical revision. The significant technical changes are:

– reference test load – definition and application revised (3.3.5 and 6.1.1.3);
– test schedule – presented as a single table grouped by revised type and routine tests (see 6.1.6, Table 3);
– dynamic output voltage performance characteristics – guidance to measure – addition (Annex H);
– UPS efficiency – requirements and methods of measure – addition (Annexes I and J);
– functional availability – guidance for UPS reliability integrity level classification – addition (Annex K).

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

FDIS	Report on voting
22H/129/FDIS	22H/133A/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.

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 stability 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 2011 have been included in this copy.

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 3: Method of specifying the performance and test requirements

1 Scope

This International Standard applies to movable, stationary and fixed electronic **uninterruptible power systems** (UPS) that deliver single or three-phase fixed frequency a.c. output voltage not exceeding 1 000 V a.c. and that incorporate an **energy storage system**, generally connected through a d.c. link.

This standard is intended to specify performance and test requirements of a complete UPS and not of individual **UPS functional units**. The individual UPS functional units are dealt with in IEC publications referred to in the bibliography that apply so far that they are not in contradiction with this standard.

The primary function of the UPS covered by this standard is to ensure continuity of an a.c. power source. The UPS may also serve to improve the quality of the power source by keeping it within specified characteristics. UPS have been developed over a wide range of power, from less than hundred watts to several megawatts, to meet requirements for availability and quality of power to a variety of loads. Refer to Annexes A and B for information on typical UPS configurations and topologies.

This standard also covers UPS test and performance when power switches form integral part of a UPS and are associated with its output. Included are interrupters, bypass switches, isolating switches, and tie switches. These switches interact with other functional units of the UPS to maintain **continuity of load power**.

This standard does not cover

- conventional a.c. input and output distribution boards or d.c. boards and their associated switches (e.g. switches for batteries, rectifier output or inverter input);
- stand-alone static transfer systems covered by IEC 62310-3;
- systems wherein the output voltage is derived from a rotating machine.

NOTE 1 This standard recognises that power availability to information technology (IT) equipment represents a major UPS application. The UPS output characteristics specified in this standard are therefore also aimed at ensuring compatibility with the requirements of IT equipment. This, subject any limitation stated in the manufacturer's declaration, includes requirements for steady state and transient voltage variation as well as for the supply of both linear and non-linear load characteristics of IT equipment.

NOTE 2 Test loads specified in this standard simulate both linear and non-linear load characteristics. Their use is prescribed with the objective of verifying design and performance, as declared by the manufacturer, and also of minimising any complexity and energy consumption during the tests.

NOTE 3 This standard is aimed at 50 Hz and 60 Hz applications but does not exclude other frequency applications within the domain of IEC 60196. This is subject to an agreement between manufacturer and purchase in respect to any particular requirements arising.

NOTE 4 Single phase and three-phase voltage UPS covered by this standard include without limitation UPS supplying single-phase, two-wire; single-phase, three-wire; two-phase, three-wire, three-phase, three-wire and three-phase, four-wire loads.

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 60038, *IEC standard voltages*

IEC 60068-2-1, *Environmental testing - Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60146-1-1:2009, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

IEC 60146-2:1999, *Semiconductor converters – Part 2: Self-commutated semiconductor converters including direct d.c. converters*

IEC 60196, *IEC standard frequencies*

IEC 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-5-52, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

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

IEC 60947-6-1, *Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment – Transfer switching equipment*

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

IEC 60990, *Methods of measurement of touch current and protective conductor current*

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 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC/TS 61000-3-4, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 61000-4-30, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 2: Pattern evaluation tests*

IEC 62040-1:2008, *Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS*

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

IEC 62310-3:2008, *Static transfer systems (STS) – Part 3: Method for specifying performance and test requirements*

ISO 7779:2010, *Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment*

3 Terms and definitions

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

NOTE In this standard, IEC 60050 definitions are referenced wherever possible, particularly those of IEC 60050(551).

When an existing IEC 60050 definition needs amplification or additional information, this is indicated by adding the word "modified" after the IEC 60050 reference.

3.1 Systems and components

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

3.1.2
(electronic) (power) converter or convertor
an operative unit for electronic power conversion, comprising one or more electronic valve devices, transformers and filters if necessary and auxiliaries if any

NOTE In English, the two spellings "converter" and "convertor" are in use, and both are correct.

[IEC 60050-551:1998, 551-12-01]

3.1.3
UPS functional unit
functional unit, for example, a UPS rectifier, a UPS inverter or a UPS switch

3.1.4
UPS rectifier
electronic converter for rectification

[IEC 60050-551:1998, 551-12-07, modified]

3.1.5
UPS inverter
electronic converter for inversion

[IEC 60050-551:1998, 551-12-10, modified]

3.1.6
energy storage system
system consisting of single or multiple devices and designed to provide power to the UPS inverter for the required stored energy time

NOTE Notwithstanding challenges with respect to recharge, examples of energy storage systems include but are not limited to battery, double-layer capacitor ("super" or "ultra" capacitor), flywheel and fuel-cell systems.

3.1.7
d.c. link
direct current power interconnection between the rectifier or rectifier/charger and the inverter functional unit

NOTE 1 The voltage of the energy storage system may differ from that of the d.c. link.

NOTE 2 The d.c. link may include converters.

3.1.8
battery

set of electrochemical cells of the same type so connected as to act together

[IEC 60050-151:2001, 151-12-11, modified]

3.1.9
secondary battery (of electrochemical cells)
composite system in which electric energy produces chemical reactions or, conversely, in which the energy produced by chemical reactions is mainly delivered as electric energy

[IEC 60050-111:1996, 111-15-10]

NOTE 1 A valve regulated secondary battery consists of cells which are closed but have a valve which allows the escape of gas if the internal pressure exceeds a predetermined value. Valve regulated lead-acid cells are abbreviated as VRLA cells [IEC 60050-482:2004, 482-05-15, modified].

NOTE 2 A vented secondary battery consists of cells having a cover provided with an opening through which products of electrolysis and evaporation are allowed to escape freely, or through a venting system, from the cell to the atmosphere [IEC 60050-482:2004, 482-05-14, modified].

3.1.10
flywheel storage system
mechanical energy storage system wherein stored kinetic energy can be converted to d.c. power during stored energy mode of operation

3.1.11
battery charger
device for changing alternating current power to direct current power for the purpose of charging a battery

3.1.12
UPS switch
controllable switch used in accordance with applicable requirements for load power continuity to interconnect or isolate power ports of UPS units, bypass or load

NOTE 1 Annex C details UPS switch applications.

NOTE 2 Examples of ports include a group of terminals and sockets.

3.1.13
transfer switch
UPS switch used to transfer power from one source to another

NOTE **Transfer** represents the act of switching the supply path to the load from one source to another.

3.1.14
electronic (power) switch
UPS switch comprising at least one controllable valve device

[IEC 60050-551:1998, 551-13-01, modified]

NOTE A static bypass switch is an example of an electronic (power) switch.

3.1.15
mechanical (power) switch
UPS switch with mechanically separable contacts

3.1.16
hybrid (power) switch
UPS switch with mechanically separable contacts in combination with at least one controlled electronic valve device

3.1.17
self-commutated electronic switch
electronic switch where the commutating voltage is supplied by components within the electronic switch

3.1.18
line-commutated electronic switch
electronic switch where the commutating voltage is supplied by the line

3.1.19
interrupter
UPS switch which is capable of making, carrying and breaking currents under normal circuit conditions, making and carrying currents for a specified time and breaking currents under specified unusual circuit conditions

3.1.20
isolation switch
mechanical UPS switch that provides in the open position an isolating distance and that may be capable of making, carrying and breaking currents in accordance with UPS operational requirements

NOTE Resettable circuit-breakers and manual disconnectors are examples of isolation switches.

3.1.21
tie switch
UPS switch which can connect two or more a.c. busbars together

3.1.22
maintenance bypass switch
UPS switch designed to isolate a UPS, or part thereof, from the load and to maintain **continuity of load power** via an alternative path during maintenance activities

3.1.23
a.c. input power
primary or stand-by power supplied to UPS and bypass circuits (maintenance bypass included)

3.1.24
bypass
power path alternative to the a.c. converter

3.1.25
maintenance bypass (path)
alternative power path provided to maintain **continuity of load power** during maintenance activities

3.1.26
static bypass (electronic bypass)
power path (primary or stand-by) alternative to the indirect a.c. converter where control is via an electronic power switch, for example transistors, thyristors, triacs or other semiconductor device or devices

3.1.27
UPS unit
complete UPS consisting of at least one of each of the following functional units: UPS inverter, UPS rectifier and battery or other energy storage means

NOTE A UPS unit may operate with other UPS units to form a parallel or redundant UPS.

3.1.28
single UPS
UPS comprising only one UPS unit

3.1.29
parallel UPS
UPS comprising two or more UPS units operating in parallel

3.1.30
redundant system
addition of functional units or groups of functional units in a system to enhance the **continuity of load power**

3.1.31
stand-by redundant UPS
UPS in which one or more UPS are held in reserve until the operating UPS unit fails

3.1.32
parallel redundant UPS
UPS with a number of paralleled load sharing UPS units which, upon failure of one or more UPS units, can take over full load with the remainders