SLOVENSKI STANDARD
SIST ENV 50091-3:2001

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Uninterruptible power systems (UPS) - Part 3: Performance requirements and test methods

Uninterruptible Power Systems (UPS) -- Part 3: Performance requirements and test methods

Alimentations sans interruption (ASI) -- Partie 3: Conditions de performances et méthodes de test

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ICS:

29.020	Elektrotehnika na splošno	Electrical engineering in general
29.200	Usmerniki. Pretvorniki. Stabilizirano elektriļ no napajanje	Rectifiers. Convertors. Stabilized power supply

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English version

Uninterruptible Power Systems (UPS)
Part 3: Performance requirements and test methods

Alimentations sans interruption (ASI)
Partie 3: Conditions de performances et méthodes de test

This European Prestandard (ENV) was approved by CENELEC on 1998-02-01 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CENELEC will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CENELEC members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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CENELEC

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

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Foreword

This European Prestandard was prepared by the Technical Committee CENELEC TC 22X, Power electronics. The text of the draft was submitted to the CENELEC questionnaire and vote and was approved as ENV 50091-3 on 1998-02-01.

The following date was fixed:

- latest date by which the xistence of the ENV has to be announced at national level (doa) 1998-05-01

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1 General

1.1 *Scope*

This European Prestandard applies to electronic uninterruptible power systems (UPS) with electrical energy storage means on the d.c. link. The primary function of the UPS covered by this Prestandard is to ensure continuity of an alternating power source; it may also serve to improve the quality of the power source by keeping it within defined limits.

The performance requirements of this Prestandard are for UPS within the scope of EN 50091-1-1 or EN 50091-1-2.

UPS switches and for parallel/redundant operation are referenced in IEC 60146-4 and IEC 60146-5.

This Prestandard applies to UPS:

- delivering single or three phase fixed frequency 50 Hz or 60 Hz a.c. output voltage;
- supplied by single or three phase a.c. input voltage;
- with electrical energy storage device in the d.c. link, if not otherwise specified;
- with rated voltage not exceeding 1000 V a.c.
- movable, stationary or fixed equipment.

NOTE 1: This Prestandard recognises that, for UPS ratings within its scope, the major market usage is in conjunction with information technology equipment.

Under current technology, the majority of these equipments employs a power supply which presents a load to the UPS of a non-linear voltage/current characteristic and is tolerant on non-sinusoidal voltage waveforms for a limited time duration.

To meet this requirement, UPS output ratings are specified to be compatible with non-linear loading. Units can be used on linear loads subject to manufacturers additional declaration where desired.

References within this Prestandard to linear loading are retained for test method reasons or validation of manufacturers additional declaration (as in IEC 60146-4).

NOTE 2: For use of UPS with a non-sinusoidal output voltage waveform, beyond the stored energy time recommended in this Prestandard, the agreement of the load equipment manufacturer shall be sought.

NOTE 3: For UPS with output frequencies other than 50 Hz or 60 Hz, performance specifications are subject to agreement between manufacturer and purchaser.

1.2 *Object*

This European Prestandard covers single and three phase UPS and specifies:

- characteristics of the equipment;
- test methods;
- minimum performance levels.

For any safety related characteristic, refer to EN 50091-1-1:1997 "UPS - General and Safety Requirements for use in Operator Access Areas" or EN 50091-1-2: 1998 "UPS - General and Safety Requirements for use in Restricted Access Locations".

Harmful smoke, dust, vapour, oil emanation, salt air, rain or drip water, high electromagnetic fields, radioactive levels greater than the natural level, explosive mixtures of dust or gas, ventilation problems, heat radiated or conducted by other sources, exposure to earthquakes, strong vibrations, are excluded from the nominal environmental conditions covered by this Prestandard.

1.3 *Normative references*

This European Prestandard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed thereafter.
For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision.
For undated references, the latest edition of the publication referred to applies.

1.3.1 *European standards*

EN 27779	1991	Acoustics: Measurement of airborne noise emitted by computer and business equipment (ISO 7779:1988)
EN 50091-1-1	1997	Uninterruptible power systems (UPS) Part 1-1: General and safety requirements for use in operator access areas
EN 50091-1-2	1998	Uninterruptible power systems (UPS) Part 1-2: General and safety requirements for use in restricted access locations
EN 50091-2	1995	Uninterruptible power systems (UPS) Part 2: EMC requirements
EN 60529	1991	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)

EN 60950	1992	Safety of information technology equipment, including electrical
+ A1	1993	business equipment
+ A2	1993	(IEC 60950:1991, mod., + A1:1992 + A2:1993
+ A3	1995	+ A3:1995, mod.
+ A4	1997	+ A4:1996, mod.)
+ A11	1997	
EN 60068-2-1	1993	Environmental testing procedures
+ A1	1993	Part 2: Tests - Tests A: Cold
+ A2	1994	(IEC 60068-2-1:1990 + A1:1993 + A2:1994)
EN 60068-2-2	1993	Basic environmental testing procedures
+ A1	1993	Part 2: Tests - Test B: Dry heat
+ A2	1994	(IEC 60068-2-2:1974 + IEC 60068-2-2A:1976 + A1:1993 + A2:1994)
EN 60068-2-27	1993	Basic environmental testing procedures Part 2: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:1987)
EN 60068-2-32	1993	Basic environmental testing procedures Part 2: Tests - Test Ed: Free fall (IEC 60068-2-32:1975 + A2:1990)
EN 60146-1-1	1993	Semiconductor convertors General requirements and line commutated converters Part 1-1: Specification of basic requirements (IEC 60146-1-1:1991)
ENV 61000-2-2	1993	Electromagnetic compatibility (EMC) Part 2: Environment -- Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems (IEC 61000-2-2:1990, mod.)
EN 61000-3-2	1995	Electromagnetic compatibility (EMC) Part 3: Limits -- Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase) (IEC 61000-2-2:1995)
HD 323.2.48 S1	1988	Basic environmental testing procedures Part 2: Tests - Guidance on the application of the tests of IEC Publication 60068 to simulate the effects of storage (IEC 60068-2-48:1982)
HD 323.2.56 S1	1990	Basic environmental testing procedures Part 2: Tests - Test Cb: Damp heat, steady state (IEC 60068-2-56:1988)
HD 384.4.x	series	Electrical installations of buildings Part 4: Protection for safety (IEC 60364-4-x series, mod.)

1.3.2 *International standards*

IEC 60146-2	1974	Semiconductor converters Part 2: Semiconductor self commutated converters
IEC 60146-4	1986	Semiconductor converters Part 4: Method of specifying the performance and test requirements of UPS
IEC 60146-5	1988	Semiconductor converters Part 5: Switches for uninterruptible power systems (UPS switches)

1.4 *General terms and definitions*

1.4.1 *converter*

An operative unit which can be used for electronic power conversion comprising one or more electronic valve devices (IEV 551-04-01), transformers and filters if necessary, and auxiliaries, if any.

1.4.2 *UPS rectifier*

Electronic converter for rectification.

1.4.3 *UPS inverter*

Electronic converter for inversion.

1.4.4 *energy storage means*

A system consisting of single or multiple devices (typically batteries) designed to provide the required stored energy time.

1.4.5 *valve regulated sealed (secondary) cell*

A secondary cell which is closed under normal conditions but which has an arrangement which allows escape of gas if the internal pressure exceeds a predetermined value. The battery cannot normally receive addition to the electrolyte.

1.4.6 *vented (secondary) cell*

A secondary cell having a cover provided with an opening through which gaseous products may escape.

NOTE: The opening may be fitted with a venting system.

1.4.7 *end of discharge voltage*

Voltage at which stored energy mode of operation is terminated.

1.4.8 *UPS switch*

Switch (quenched, line or self-commutated, electronic or mechanical, depending on required continuity of load power) used to connect/isolate UPS or bypass to/from load.

1.4.9 *transfer switch*

UPS switch consisting of one or more switches used to transfer power from one source to another.

1.4.10 *electronic (power) switch*

An operative unit which can be used for electronic power switching comprising at least one controllable electronic valve device (IEV 551-04-01).

1.4.11 *UPS maintenance bypass switch*

Switch designed to isolate a section or sections of a UPS for safety during maintenance and to maintain continuity of load power via an alternative path.

1.4.12 *a.c. input*

Power supplied to UPS and bypass, if any, which can be either prime power or standby power.

1.4.13 *bypass*

Power path alternative to the indirect a.c. convertor.

1.4.14 *maintenance bypass*

Power path designed to allow isolation of a section or sections of a UPS for safety during maintenance and/or to maintain continuity of load power. This path may be supplied with primary or standby power.

1.4.15 *static bypass (electronic)*

A power path (primary or standby) alternative to the a.c. convertor/inverter where control is via an electronic power switch, for example: transistors, thyristors, triacs or other semiconductor device or devices.

1.4.16 *primary power*

Power normally continuously available which is usually supplied by an electrical utility company but sometimes by the user's own generation.

1.4.17 *standby power*

Power intended to replace primary power in the event of primary power failure.

1.4.18 *bypass power*

Power supplied via the bypass.

1.4.19 *normal mode of UPS operation*

The stable mode of operation that the UPS finally attains when supplied by the following conditions:

- primary power is present and within its given tolerance;
- the battery is charged or under recharge within its given restored energy time;
- the operation is or may be continuous;
- the phase lock is active, if present;
- the load is within its given range;
- the output voltage is within its given tolerance.

Where a UPS switch is used:

- the bypass is available and within specified tolerances.

1.4.20 *stored energy mode of operation*

The 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.

1.4.21 *bypass mode of operation*

The state the UPS attains when operating the load supplied via the bypass supply.

1.4.22 *UPS double conversion operation*

Any UPS operation, where in normal mode of operation, the load is continuously supplied by the converter/ inverter combination in a double conversion technique, i.e. a.c.-d.c.-d.c.-a.c.

When the a.c. input supply is out of UPS preset tolerances, the UPS enters stored energy mode of operation where the battery/inverter combination continues to support the load for the duration of the stored energy time or until the a.c. input returns within UPS design tolerances, whichever is the sooner.

This method/technique permits the output voltage and frequency to be independent of the input voltage and frequency conditions.

1.4.23 ***UPS double conversion operation with bypass***

Operation as in 1.4.22 with the following operational addition.
The continuity of load power can be improved by activation of a bypass by means of a transfer switch in case of:

i. UPS failure;
ii. load current transients (inrush currents or fault clearing currents);
iii. peak load.

1.4.24 ***UPS line interactive operation***

Any UPS operation where in normal mode of operation, the load is supplied with conditioned power via a parallel connection of the a.c. input and the UPS inverter. The inverter is operational to provide output voltage conditioning and/or battery charging. The output frequency is dependent upon the a.c. input frequency.

When the a.c. input supply voltage is out of UPS preset tolerances, the inverter and battery maintain continuity of load power in stored energy mode of operation and the switch disconnects the a.c. input supply to prevent backfeed from the inverter.

The unit runs in stored energy mode for the duration of the stored energy time or until the a.c. input supply returns within UPS design tolerances, whichever is the sooner.

1.4.25 ***UPS line interactive operation with bypass***

Operation as in 1.4.24 with the following operational addition:
In the event of a UPS functional unit failure, the load may be transferred to an alternative bypass fed from primary of stand-by power.

1.4.26 ***UPS passive stand-by operation***

Any UPS operation where in normal mode of operation, the load is supplied by the a.c. input primary power via the UPS switch.

Additional devices may be incorporated to provide power conditioning, e.g. ferro-resonant transformer or automatic tap changing transformers. The output frequency is dependent upon the a.c. input frequency.

When the a.c. input supply voltage is out of UPS preset tolerances, the UPS enters stored energy mode of operation, when the inverter is activated and the load transferred to the inverter directly or via the UPS switch (which may be electronic or electro-mechanical).

The battery/inverter combination maintains continuity of load power for the duration of the stored energy time or until the a.c. input supply voltage returns within UPS preset tolerances and the load is transferred back, whichever is the sooner.

1.4.27 *synchronous transfer*

Transfer of load power between two sources which are synchronised in frequency, voltage phase and limits of voltage magnitude.

1.4.28 *synchronisation*

The adjustment of an a.c. power source to match another a.c. source in frequency and phase.

1.4.29 *asynchronous transfer*

Transfer of load power between two sources which are not synchronised.

1.4.30 *type test*

Testing of a representative sample of the UPS with the objective of determining if the equipment, as designed and manufactured, can meet the requirements of this Prestandard.

NOTE: Purchasers should note that for physically large units and/or power ratings adequate test facilities to demonstrate some of the type tests may not exist, or not be economically viable.

This situation also applies to some electrical tests for which no commercially available test simulation equipment is available or require specialised test facilities beyond the scope of a manufacturers premises.

Where these situations exist, the manufacturer may elect to either:

1. Use a certified test house to carry out testing for compliance on his behalf. Evidence of third party certification shall be deemed sufficient to prove compliance with the relevant clauses.

2. Demonstrate that the design is compliant by calculation or by experience and/or testing of similar designs or sub-assemblies in similar conditions.

For testing of parameters other than those listed as routine, it shall be a matter of agreement between the manufacturer and the purchaser (see also clause 4.1.3) as a contract condition.

1.4.31 *routine test*

Tests made for quality control by the manufacturer on every device or representative samples, or on parts or materials or complete equipments as required to verify during production that the product meets the design specification.

1.4.32 *UPS efficiency*

Ratio of output power to input power under specified conditions with no significant energy transfer to and from the energy storage means.

1.4.33 *transient*

The behaviour of a variable during transition between two steady states.

1.4.34 *recovery time*

Time interval between a step change in one of the control quantities and the instant when the stabilised output quantity returns to and stays within the steady state tolerance band.

1.4.35 ***input voltage tolerance***

The maximum continuous input voltage variation with the UPS operating in normal mode.

1.4.36 ***input voltage distortion***

The input voltage harmonic distortion in normal mode.

1.4.37 ***input frequency tolerance***

The maximum continuous input frequency variation with the UPS operating in normal mode.

1.4.38 ***input power factor***

Ratio of the input active power to the input apparent power with the UPS operating in normal mode at rated input voltages at rated output apparent power, and fully charged battery.

1.4.39 ***UPS rated input current***

Input current with UPS operating in normal mode, at rated input voltage, rated output apparent power and fully restored d.c. energy storage system.

1.4.40 ***UPS maximum input current***

Input current with the UPS operating under worst case conditions of permitted overload, input voltage tolerance and with a depleted d.c. energy storage system.

1.4.41 ***UPS inrush current***

Maximum instantaneous value of the input current when the UPS is switched on for normal mode.

1.4.42 ***input current distortion***

The maximum input current harmonic distortion, in normal mode.

1.4.43 ***supply impedance***

Impedance at the input lines to the UPS with the UPS disconnected.

1.4.44 ***high impedance mains failure***

A mains failure where the supply impedance as presented to the UPS input terminals is infinite.

1.4.45 ***low impedance mains failure***

A mains failure where the supply impedance as presented to the UPS input terminals is negligible.

1.4.46 ***output voltage***

RMS value (unless otherwise specified for a particular load) of the voltage between the output terminals.

1.4.47 ***output voltage tolerance***

The maximum output voltage variation with the UPS operating in normal mode or in stored energy mode.

1.4.48 ***output frequency tolerance***

The maximum output frequency variation with the UPS operating in normal mode or in stored energy mode.

1.4.49 ***UPS short-circuit output current***

The maximum output current capability from the UPS into a short circuit across its output terminals in each mode of operation.

1.4.50 ***overload capability***

Output current capability of the UPS over a given time, with the output voltage remaining within its rated range, in normal or in stored energy mode.

1.4.51 ***iInterruption time***

Time interval during which the output voltage is below the lower limit of the tolerance band.

1.4.52 ***transfer time***

Time interval between initiation of transfer and the instant when the output quantities have been transferred.

1.4.53 ***total UPS transfer time***

Time interval between the occurrence of an abnormality or out of tolerance condition and the instant when the output quantities have been transferred.

1.4.54 ***unbalanced load***

A three-phase load with a different current or power factor between at least two of the phases.

1.4.55 ***step load***

The instantaneous addition or removal of electrical loads to a power source.

1.4.56 ***sinusoidal output voltage***

The output voltage waveform complying with the minimum requirements given in ENV 61000-2-2 clause 2, Harmonics.

1.4.57 ***non-sinusoidal output voltage***

The output voltage waveform outside the tolerances given in 1.4.56.