

Uninterruptible Power Systems (UPS) —

Part 3: Performance requirements and test methods

ICS 29.200

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National foreword

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This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because of the need to gain experience of its application and assess its suitability for conversion into a European Standard. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion into a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee PEL/22, Static power converter equipment, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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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 existence 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 1 000 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 business equipment
+ A1	1993	(IEC 60950:1991, mod., + A1:1992 + A2:1993
+ A2	1993	+ A3:1995, mod.
+ A3	1995	+ A4:1996, mod.)
+ A4	1997	
+ 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 convertors
		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 61000-3-2:1995)
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 or the power interface is operating 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 power interface 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 synchronized in frequency, voltage phase and limits of voltage magnitude

1.4.28

synchronization

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 synchronized

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 specialized 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 stabilized 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**interruption 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**

1.4.58

reference non-linear load

the load as defined in Annex A

1.4.59

tolerance band

range of values of a quantity within specified limits

2 General ambient service conditions

2.1 Normal environmental and climatic service conditions

A UPS which complies with this Prestandard shall be capable of operating according to the conditions defined in this subclause, unless other values are agreed between manufacturer/supplier and purchaser.

2.1.1 Altitude: A UPS according to this Prestandard shall be designed to operate under rated conditions at a height of minimum range up to and including 1 000 m above sea level.

NOTE The manufacturer shall state on request a necessary derating of equipment to be applied at a height exceeding 1 000 m. The following table is provided for guidance.

2.1.2 Ambient service temperature: A UPS according to this Prestandard shall be designed to operate under rated conditions in a minimum temperature range from 0 °C to + 40 °C.

EXCEPTION: Where designed solely for indoor office use, an ambient temperature range of + 10 °C to + 35 °C shall apply.

NOTE Using the UPS at the limit of the above mentioned ranges guarantees operation, but may affect the effective life of certain components, in particular, the life endurance of the energy storage device and its stored energy time. Refer to manufacturer for details on life limitations, or where the energy storage device is purchased separately, the battery manufacturer.

2.1.3 Relative humidity: A UPS according to this Prestandard shall be designed for an ambient relative humidity with a minimum range from 20 % to 80 % (non-condensing).

Table 1 — Derating factors for use at altitudes above 1 000 m

Metres	Derating factor ^a
1 000	1,0
1 500	0,95
2 000	0,91
2 500	0,86
3 000	0,82
3 500	0,78
4 000	0,74
4 500	0,70
5 000	0,67
Based on density of dry air = 1,225 kg/m ³ at sea level, + 15 °C	
^a Since cooling fans lose efficiency with altitude, forced air cooled equipment will have a similar derating factor.	

2.2 Ambient storage and transportation conditions

UPS equipment according to this Prestandard shall be designed to be stored non-operating under the conditions defined in this subclause, if no other storage conditions are stated by the manufacturers instructions.

NOTE Storage duration may be limited due to recharging requirements of an included lead acid battery. The manufacturer shall state these requirements on request.

2.2.1 Altitude: UPS equipment according to this Prestandard shall be designed to be transported by pressurized aircraft up to 15 000 m above sea level in normal shipping containers or packages for a flight duration of maximum 16 h. Normal continuous storage height shall not exceed 1 000 m above sea level.

2.2.2 Transportation and storage temperature: UPS equipment according to this Prestandard shall be transportable in its normal shipping container, e.g. by aircraft or by truck, in a minimum ambient temperature range from – 25 °C to + 55 °C.

For stationary storage within a building, the minimum temperature range shall be from – 25 °C to + 55 °C.

NOTE When a battery is included which contains an electrolyte, the duration of high or low ambient temperature may be limited due to a reduction of the battery life endurance.

The battery manufacturers transportation and storage instructions shall be observed.

2.2.3 Relative humidity: During transportation and storage of a UPS in its normal shipping container, the relative humidity can range between 20 % up to 95 %. The shipping container shall be designed adequately, unless dry ambient conditions are guaranteed. Containers not designed for wet ambient conditions shall be marked by adequate warning labels.

3 Electrical service conditions and performance

3.1 UPS input specifications

3.1.1 Usual service conditions

Compatibility with public low voltage supplies: UPS conforming to this Prestandard shall as a minimum be capable of operating in *normal mode* of operation when connected to an input supply having the following conditions in accordance with ENV 61000-2-2 of a), b), c), d) below, if not otherwise specified.

- Input voltage variation (± 10 % of nominal rated voltage).
- Input frequency tolerance (± 2 % of nominal rated frequency).
- For three phase inputs, the ratio of negative to positive sequence components shall not exceed 5 % (see EN 60146-1-1, subclause 2.5).
- Input voltage total distortion factor $D \leq 0,08$ with the following maximum level of individual harmonic voltages according to the table below (extract ENV 61000-2-2 for public low voltage supplies) up to the 40th harmonic.

NOTE The limit to order 40 is conventional.

Table 2 — Extract from ENV 61000-2-2 (Table 1) Compatibility levels for individual harmonic voltages in low voltage networks

Odd harmonics non-multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Harmonic order n	Harmonic voltage %	Harmonic order n	Harmonic voltage %	Harmonic order n	Harmonic voltage %
5	6	3	5	2	2
7	5	9	1,5	4	1
11	3,5	15	0,3	6	0,5
13	3	21	0,2	8	0,5
17	2	> 21	0,2	10	0,5
19	1,5			12	0,2
23	1,5			> 12	0,2
25	1,5				
> 25	$0,2 + 0,5 \times 25/n$				

All the above harmonic levels are assumed not to occur simultaneously.

NOTE 1 A decrease in frequency is assumed not to coincide with an increase in a.c. line voltage and vice versa.

NOTE 2 If a bypass is used its input should be within tolerances acceptable for the load.

NOTE 3 The above limits apply to Public Low Voltage Supplies. UPS designed for industrial applications or separately generated supplies may be required to meet more severe conditions. For these situations the purchaser must specify the parameters or in the absence of such information, the manufacturer/supplier may apply his experience as to the compatibility of the design for the intended installation.

NOTE 4 Compliance for immunity to input voltage distortion is tested separately as part of the tests in EN 50091-2: EMC Requirements.

3.1.2 The following rated values and characteristics shall be specified by the manufacturer/supplier.

The values shall be recorded in accordance with the requirements of clause 4 and declared as in 6.2.

- Rated a.c. input voltage;
- a.c. input voltage tolerance;
- Rated input frequency;
- Input frequency tolerance;
- Number of phases (if more than single phase);
- UPS rated input current;
- UPS maximum continuous input current in accordance with 1.4.40 (worst-case condition, i.e. including battery charging, mains tolerance and permitted overload).
- Input current total harmonic distortion (calculated from [i] below);
- Input current individual harmonic current levels ($n < 40$) measured or calculated at rated input current when supplied with a voltage source of negligible distortion, in accordance with EN 61000-3-2 or appropriate standard relating to UPS rating;
- Input power factor;
- Input neutral requirements and rating (if applicable);
- Inrush current requirements worst case (curve of current versus time);
- UPS earth leakage current (where in excess of 3,5 mA).
- In case of three-phase inputs, the maximum allowable mains voltage unbalance.
- Power system configurations designed for e.g. TN, TN-C, TN-S, TN-C-S, TT, IT in accordance with HD 384-4.

3.2 UPS output specifications

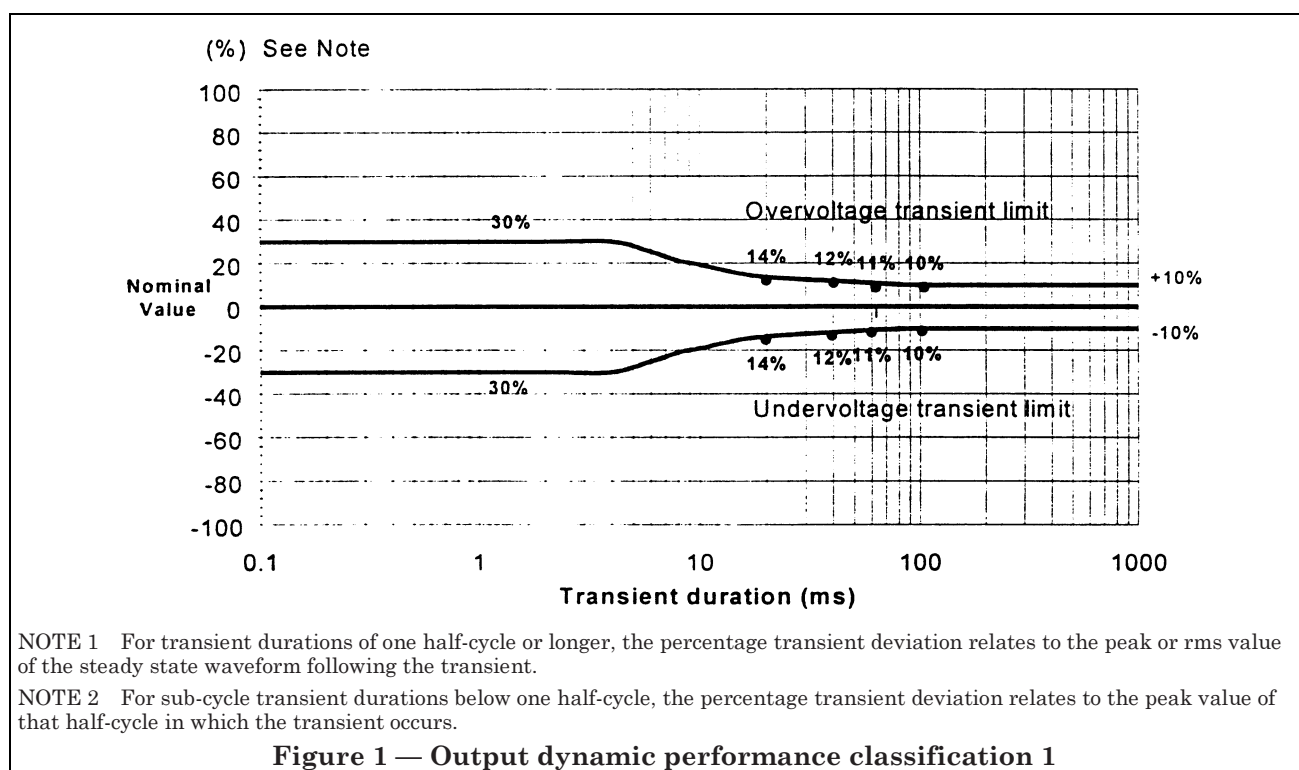
3.2.1 Dynamic output voltage characteristic

UPS conforming to this Prestandard shall have output voltage dynamic performance characteristics (see clause 6 and Annex C), not exceeding the limits of either Figure 1, Figure 2 or Figure 3 of this subclause under each of the following conditions:

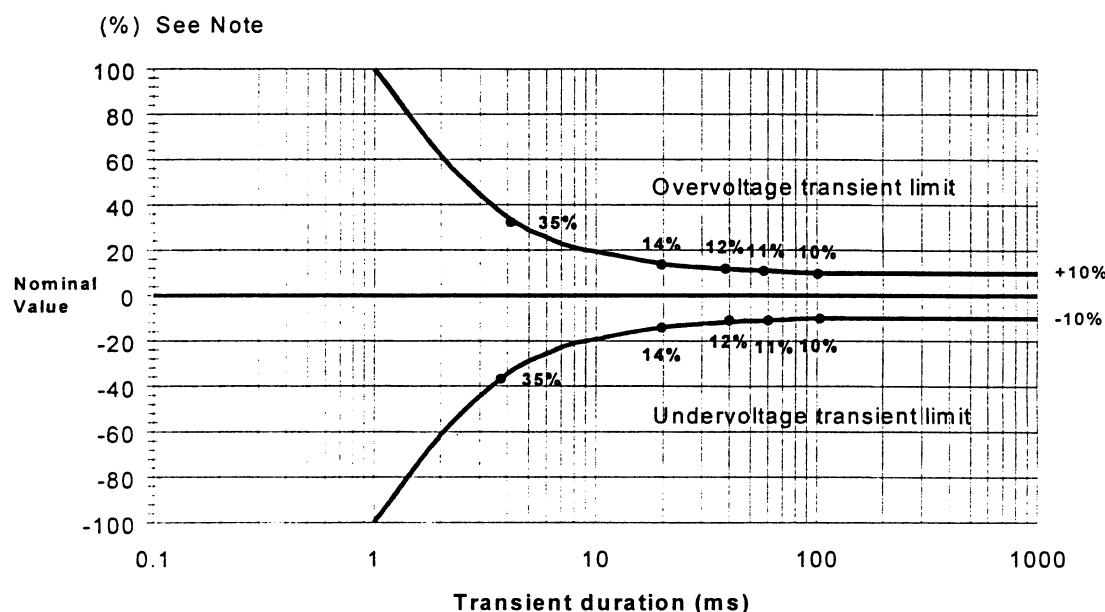
- Change of operating mode (e.g. normal/stored energy/bypass, etc).
- Application of increasing/decreasing load steps under linear and reference non-linear load under the test conditions in 4.3 and its subclauses.

Step reference non-linear loading is defined as application of the test circuit in Annex A set for dissipating the required steady state active power for the percentage load step relative to the rated steady state active power output of the UPS. The load circuit is then de-energized before application, so that its capacitor voltage starts from zero voltage when applied to the UPS output. Where it is known that the actual installed load has input current limiting for initial start-up, it shall be permitted to modify the test circuit to simulate actual conditions in determining output voltage dynamic performance characteristics of the UPS to the purchaser.

Single cord connected UPS designed to be operator installable for use in office environment, either desk or floor-mounted, and intended to be marketed by a third party without reference to the manufacturer, shall be capable of accepting all loads both linear and non-linear, within its rating unless any limitations are stated by the manufacturer within the user instructions.



NOTE 1 UPS complying with Figure 1 will be suitable for all types of loads.



NOTE 1 For transient durations of one half-cycle or longer, the percentage transient deviation relates to the peak or rms value of the steady state waveform following the transient.

NOTE 2 For sub-cycle transient durations below one half-cycle, the percentage transient deviation relates to the peak value of that half-cycle in which the transient occurs.

Figure 2 — Output dynamic performance classification 2

NOTE 2 UPS complying with Figure 2 will be suitable for most types of loads.

NOTE 3 Deviation from the output dynamic performance classifications of Figure 1 and Figure 2 for load steps is permitted where load tolerances permit and in agreement with purchaser.

Where the output dynamic performance classification 2 is exceeded, subject to suitability of load characteristics, the maximum recommended dynamic characteristic is shown in Figure 3.

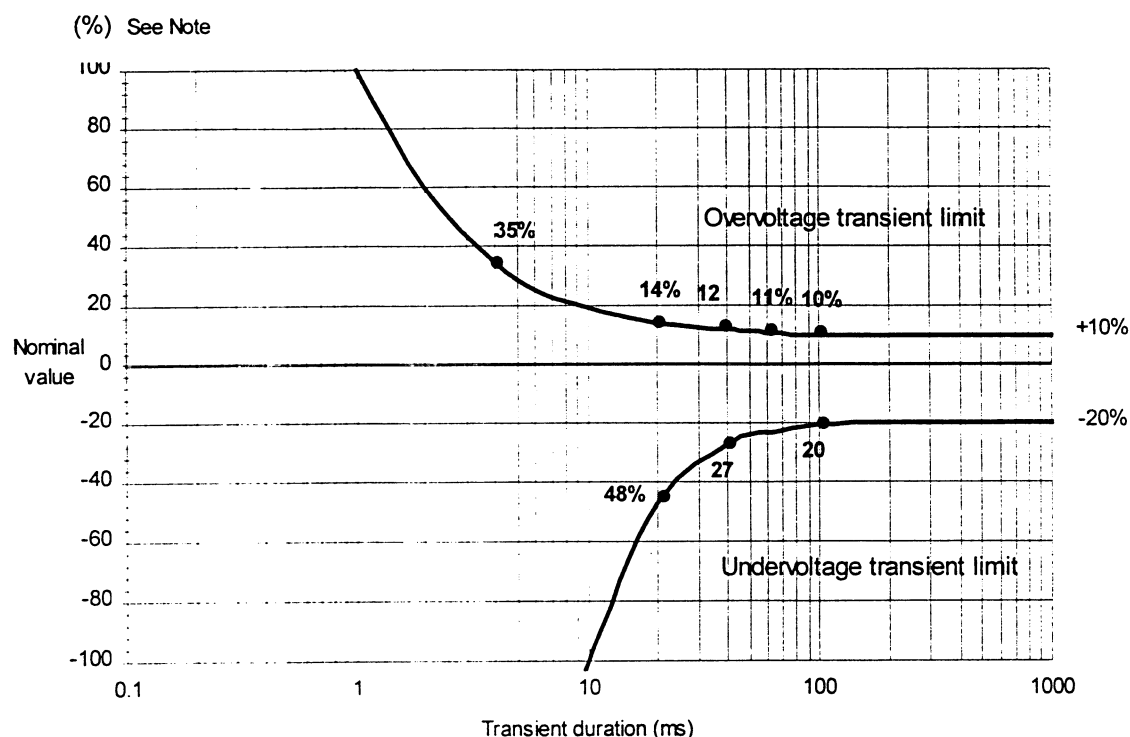
NOTE 4 UPS complying with Figure 3 are suitable only for loads capable of withstanding a wide input voltage tolerance and a period of zero voltage for up to 10 ms duration (e.g. switch-mode power supplies) with name plate voltage rating 186 V a.c. to 265 V a.c..

3.2.1.1 Output characteristic — sinusoidal output voltage: Sinusoidal output waveform in both normal and stored energy mode of operation with total distortion factor D and individual harmonics in accordance with Table 2 Limits (subclause 3.1.1) apply.

EXCEPTION: Under reference non-linear loading, any limitations in output rating shall be stated by the manufacturer so as to remain within the limits of Table 2 (subclause 3.1.1).

3.2.1.2 Output characteristic — non-sinusoidal output voltage: Where the output voltage waveform exceeds the limits of ENV 61000-2-2 (subclause 3.1.1, Table 2) and where the load equipment will tolerate such waveforms, the following limits apply:

- rise time dV/dt , measured between 0,1 Up and 0,9 Up (see Figure 4);
- fall time dV/dt , measured between 0,9 Up and 0,1 Up;
- peak voltage Up.



NOTE 1 For transient durations of one half-cycle or longer, the percentage transient deviation relates to the peak or rms value of the steady state waveform following the transient.

NOTE 2 For sub-cycle transient durations below one half-cycle, the percentage transient deviation relates to the peak value of that half-cycle in which the transient occurs.

Figure 3 — Output dynamic performance classification 3

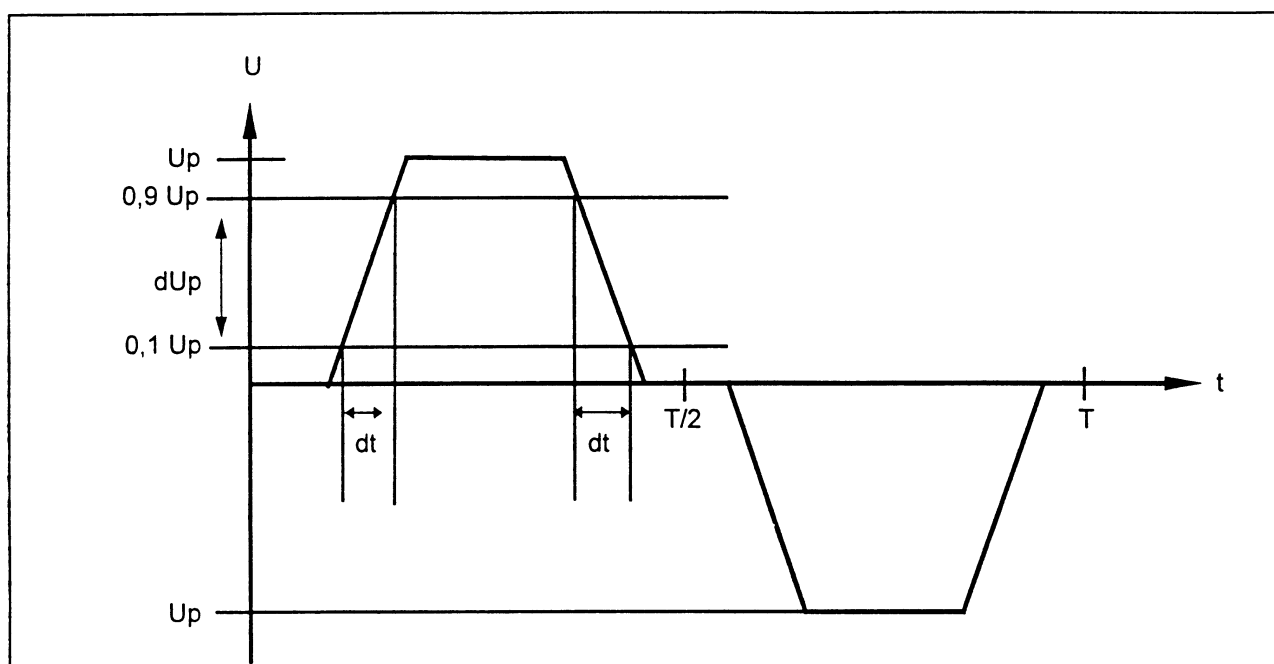


Figure 4 — Example of non-sinusoidal output voltage waveform