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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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

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FOREWORD

This amendment has been prepared by subcommittee 22H: Uninterruptible power systems (UPS), of IEC technical committee 22: Power electronic systems and equipment.

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

FDIS	Report on voting
22H/151/FDIS	22H/155/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base 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- withdrawn,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.

INTRODUCTION TO THE AMENDMENT

This amendment determines the short-time withstand current test requirements for the purpose of verifying the safety of the **UPS** when a short circuit is applied across the output terminals under prescribed modes of operation wherein the output power is delivered by the a.c. input through a **low impedance path**.

FOREWORD

Add, at the end of the list beginning " – update of normative references" the following new item:

– Amendment 1 introduces short-time withstand current requirements when a short-circuit is applied at the output of the **UPS** (5.5.4).

2 Normative references

Add the following new reference:

IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

3.2 UPS electrical ratings

Add the following new terms and definitions:

3.2.4
rated peak withstand current
I_{pk}
value of peak short-circuit current, declared by the **UPS** manufacturer, that can be withstood under specified conditions

NOTE For the purpose of this standard, I_{pk} refers to the initial asymmetric peak value of the prospective test current listed in Table 3

3.2.5
rated short-time withstand current
I_{cw}
r.m.s. value of short-time current, declared by the **UPS** manufacturer, that can be carried without damage under specified conditions, defined in terms of current and time

3.2.6
rated conditional short-circuit current
I_{cc}
r.m.s. value of **prospective short-circuit current**, declared by the **UPS** manufacturer, that can be withstood for the total operating time (clearing time) of the short-circuit protective device (SCPD) under specified conditions

NOTE The short-circuit protective device may form an integral part of the **UPS** or may be a separate unit.

3.2.7
low impedance path
path containing devices that for **UPS** load purposes present negligible impedance such as cabling, switching devices, protecting devices and filtering devices

NOTE The devices in a **low impedance path** may under short-circuit conditions present current limiting characteristics. Examples include current limiting fuses, current limiting circuit-breakers, transformers and inductors.

3.2.8
prospective short-circuit current
I_{cp}
r.m.s. value of the current which would flow if the supply conductors to the circuit are short-circuited by a conductor of negligible impedance located as near as practicable to the supply terminals of the **UPS**

4.7.2 Power rating

Add to the end of the list, the following new item:

– **rated short-time withstand current** (I_{cw}) or **rated conditional short-circuit current** (I_{cc}) in accordance with 5.5.4.

Renumber the existing note as Note 1 and add the following new Note 2:

NOTE 2 Table 3 values may be exceeded and so marked.

4.7.12 Protection in building installation

Add the following paragraphs at the beginning of 4.7.12:

The **UPS** manufacturer shall state, as applicable, the **rated short-time withstand current**, (I_{cw}) or **rated conditional short circuit current** (I_{cc}). This current shall be equal to or higher than the I_{cp} value stated in 5.5.4.3.1 (column 2 of Table 3).

If an I_{cp} value higher than that specified in Table 3 is stated, the following applies.

a) If higher I_{cp} stated ≤ 10 kA:

   the values corresponding to the next higher applicable line of Table 3 apply.

b) If higher I_{cp} stated > 10 kA:

   values 16 kA, 20 kA, 25 kA, 35 kA, 50 kA, 65 kA, 85 kA, 100 kA are preferred and the values corresponding to line 500 < I of Table 3 apply.

NOTE 1 Examples of Table 3 line values to be used when a higher I_{cw} or I_{cc} is stated.

a) If a 50 A **UPS** is declared to sustain I_{cw} = 8 kA (instead of 6 kA), use the values of line 75 < I < 400 in Table 3.

b) If a 1 000 A **UPS** is declared to sustain I_{cw} = 85 kA (instead of 20 × 1 000 = 20 kA), use the values of line 500 < I in Table 3.

The installer can then verify that the **prospective short-circuit current** resulting at the a.c. input terminals of the unit is equal to or less than the value declared by the **UPS** manufacturer. Otherwise, subject to an agreement between the manufacturer and the user, a solution shall be procured. Such a solution may consist in employing external current-limiting overcurrent protectors or customizing the **UPS** accordingly.

Irrespective of the **UPS** being a single unit or a unit in a paralleled system, the **prospective short-circuit current** of the a.c. input to be verified is that available at the relevant connection point of each unit.

Renumber the existing note as Note 2.

5.5 Overcurrent and earth fault protection

Add the following subclause:

5.5.4 Short-time withstand current

5.5.4.1 General

The **short-time withstand current** test shall be performed as a type test to verify the safety of the **UPS** when a short circuit is applied across the output terminals under prescribed modes of operation, except where exempted. Refer to Annex P, Figure P.1 for a typical circuit for implementation of the test and to 5.5.4.3.2 for exemptions.

NOTE Internal faults are not considered in this section. The effect of faults originated within the **UPS** are addressed in 8.3.

5.5.4.2 Modes of operation

Testing is performed only in modes of operation wherein the output power is delivered by the a.c. input through a **low impedance path**.

NOTE 1 Examples of such modes of operation include:

– input voltage and frequency dependent (VFD) **UPS** operating in normal and/or bypass modes;

– input voltage independent (VI) **UPS** operating in normal and/or bypass modes;

– input voltage and frequency independent (VFI) **UPS** when operating in bypass mode;

– any **UPS** with built-in maintenance bypass switch when operating in maintenance bypass mode.

NOTE 2 **UPS** performance classifications VFD, VI and VFI are detailed in IEC 62040-3.

5.5.4.3 Test procedure

5.5.4.3.1 General application

The **UPS** a.c. input shall be connected to a supply capable of delivering the prospective test current in accordance with Table 3. The **UPS** shall be in the appropriate mode of operation (see 5.5.4.2) and otherwise operating without load and at rated input voltage and frequency. A short-circuit shall then be applied across the output terminals of the **UPS**. A **UPS** rated for multiple input and output voltages may be tested at any of its rated input voltages provided that applicable interrupting components have been certified or tested to interrupt the prospective test current at the highest rated input voltage.

NOTE 1 The manufacturer can opt to perform additional tests at other rated voltages and currents.

NOTE 2 For consideration in a future edition of this standard, the making capability of the short-circuit current into the **low impedance path** can be verified for safety purposes. Such verification could involve tests or analysis of component documentation. Examples include a **UPS** that in normal mode of operation, does not supply the output terminals through a **low impedance path**, but that upon application of a short-circuit across the output terminals, automatically transfers into a **low impedance path**.

NOTE 3 For consideration in a future edition of this standard it will be evaluated whether tests would be permitted at voltages lower than rated and, subject to the phase current being observed not interrupted throughout the minimum duration listed in Table 3, whether the manufacturer could then declare the I_{cw} to be the phase current recorded during the test.

The test shall be repeated by placing a short circuit across the phase closest to the neutral terminal when the latter is provided. However, the phase-to-neutral test is not required when the neutral construction is at least as robust as that of the phase conductors in terms of cross-sectional area, mechanical support and clearance.

If the manufacturer declares a short-time withstand current higher than shown in Table 3, the declared value applies for test purposes.

The test is considered complete when the prospective test current has been made available for the minimum duration listed in Table 3.

Table 3 – Short time withstand current

Rated UPS output current *I* (r.m.s.) A	Prospective test current [a]		Initial asymmetric peak current ratio [e] (I_{pk} / I_{cw})	Minimum duration of prospective test current [f] (cycles 50/60 Hz)
	(r.m.s.) A [b]	Typical power factor [e]		
$I \leq 16$	1 000 [c d]	0,95	1,42	1,5
	3 000	0,9		
$16 < I \leq 75$	6 000	0,7	1,53	1,5
$75 < I \leq 400$	10 000	0,5	1,70	1,5
$400 < I \leq 500$	10 000	0,5	1,70	3,0
$500 < I$	20 x I or 50 kA whichever is the lower	0,5 – 0,3 × (*I - 500) / 2 000* or 0,2 whichever is the higher	(0,5 I + 3 150) / 2 000 or 2,2 whichever is the lower	3,0

NOTE 1 Depending on the characteristics of the **UPS** the actual values observed during the test may be different from those listed in Table 3.

NOTE 2 Refer to 4.7.12 for conditions applying if the I_{cp} value declared is higher than that specified in Table 3.

NOTE 3 Minimum duration of prospective test current can be increased when required by national deviation.

[a] Prospective test current, in the context of this standard, shall be understood as **prospective short-circuit current** (I_{cp}) – refer to 3.2.8.

[b] Values compatible with Table 4 of IEC 60947-6-1:2005.

[c] Pluggable **UPS** only.

[d] The typical fault current of public supply networks rated 75 A and below and intended to supply equipment with a rated current of 16 A or below can be calculated from the reference impedances in IEC/TR 60725: 2005: phase conductor 0,24 + j0,15 Ω and neutral conductor 0,16 + j0,10 Ω. For 230 V/400 V supplies this results in typical fault currents of 0,5 kA (230 V) and 0,7 kA (400 V).

[e] From Table 16 of IEC 60947-1:2007.

[f] From 5.3.6.1 of IEC 60947-6-1:2005.

Compliance is verified when, at the conclusion of the test, the following criteria are satisfied.

a) *The **UPS** shall not have emitted flames, molten metal or burning particles, other than, for example, metal particles normally emitted from a circuit breaker when it clears a fault.*

NOTE 4 Refer to 7.5 for further guidance as required.

b) *There shall have been no arcing from live parts to the **UPS** chassis or enclosure.*

NOTE 5 An intact enclosure test fuse as described in Annex P indicates compliance. The use of an enclosure test fuse is not applicable for UPS with non conductive chassis or enclosure (e.g. plastic case)

c) *Components, e.g. busbar supports, used for the mounting of live parts shall not break away from their initial position.*

d) *Any enclosure door shall not open rapidly (so as to cause injury) when protected only by its normal latch.*

e) *No conductor shall get pulled out of its terminal connector and there shall be no damage to the conductor or conductor insulation.*

f) *The **UPS** shall successfully pass the electric strength tests as specified in 8.2.*

5.5.4.3.2 Exemption from testing

Exemption from short-time withstand current testing applies to:

a) **UPS** with declared I_{cw} or I_{cc} not exceeding 10 kA;

b) **UPS** protected by current-limiting devices having a cut-off current not exceeding 17 kA with the maximum allowable **prospective short-circuit current** at the terminals of the incoming circuit of the **UPS**;

c) **UPS** intended to be supplied from transformers whose rated power does not exceed 10 kVA per phase for a rated secondary voltage of not less than 110 V, or 1,6 kVA per phase for a rated secondary voltage less than 110 V, and whose short-circuit impedance is not less than 4 %;

d) **UPS** variants of a more onerous **UPS** tested compliant with the test requirements prescribed in 5.5.4.3.1;

For guidance on how to determine when a **UPS** is a variant of a more onerous **UPS**, refer to 10.11.3 and Table 13 (check list) or 10.11.4 (calculation) of IEC 61439-1:2011.

NOTE The exemption conditions above align Amendment 1 of this standard with 10.11.2 of IEC 61439-1:2011 that should be considered.

Compliance is verified by satisfying at least one of the exemption conditions.

Add, after existing Annex O, the following new Annex P:

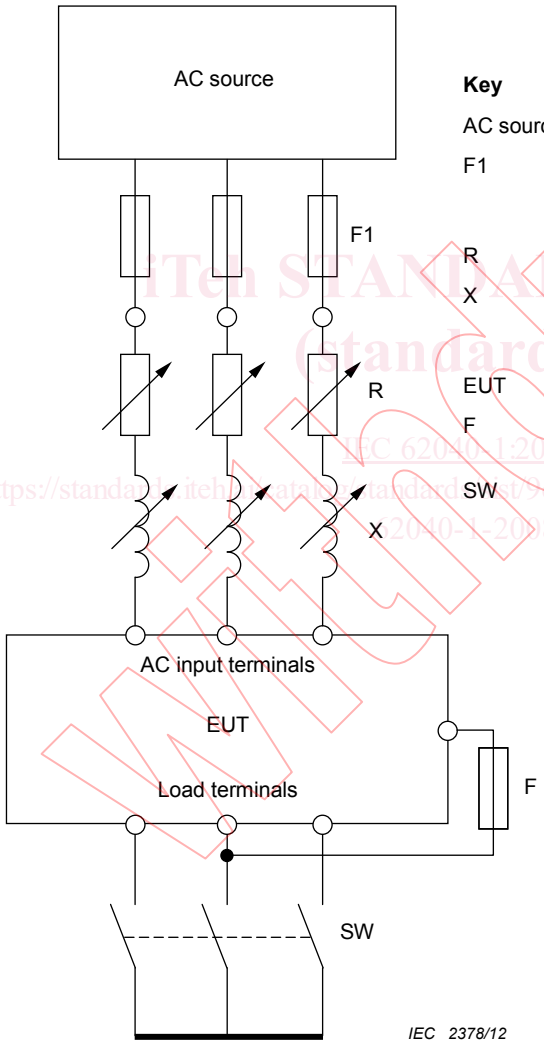
Annex P
(informative)

Short-time withstand current test procedure – Guidance and typical values

P.1 General

This annex presents circuits and methods that are typical for the implementation of the short-time withstand current test prescribed in 5.5.4. The test circuit in Figure P.1 can be used to carry out the test.

NOTE Further guidance can be found in 10.11.5.2 of IEC 61439-1:2011.



Key

AC source	rated voltage, 3-phase as applicable
F1	conditional withstand protection device e.g. fuses or circuit breaker if specified by the manufacturer
R	adjustable resistor
X	source reactance implemented with linear reactors that may be adjustable and of air-core technology
EUT	equipment under test
F	enclosure fuse (for positive verification of arcing to chassis, as applicable)
SW	closing switch – may be located as shown or ahead of limiting impedance

NOTE Since the transient recovery voltage characteristics of test circuits, including large air-core reactors, are not representative of usual service conditions, any air-core reactor in each phase should be shunted by a resistor (not shown in the diagram) taking approximately 0,6 % of the current through the reactor.

Figure P.1 – Test circuit for UPS short-time withstand current

P.2 Test set up

The **UPS** output should be set up as prescribed in 5.5.4.3.

P.3 Calibration of the test circuit

The resistance and reactance of the test circuit, if applied to the rated a.c. input source, should provide the current listed in Table 3 and satisfy the test conditions specified in Table 3. The source reactance is represented by X that should be implemented with linear reactors that may be adjustable and of air-core technology. They should be connected in series with the resistors R. The parallel connecting of reactors is acceptable when these reactors have practically the same time constant. The leads to the unit under test should be included in the calibration.

P.4 Test procedure

The test should be performed as prescribed in 5.5.4.3.

The phase current(s) should be recorded during the test for the purpose of verifying that calibration test conditions were not exceeded.

NOTE The **UPS** manufacturer may declare a conditional withstand rating and specify a protective device (F1) to be used in conjunction with the unit under test that should be placed between the **UPS** input terminals and the a.c. input source. The closing switch SW should be fitted at the load terminals of the **UPS**. When SW is closed the test current should be maintained until it is interrupted by F1 or until the prescribed duration of the test current has elapsed.

P.5 Test verification criteria

Refer to 5.5.4.3.1.

Bibliography

Add the following new entries:

IEC/TR 60725:2005, *Consideration of reference impedances and public supply network impedances for use in determining disturbance characteristics of electrical equipment having a rated current ≤75 A per phase*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-6-1:2005, *Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment – Transfer switching equipment*

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