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Date: 08 February 2023

Origin: International

Latest date for receipt of comments: 1 March 2023

Project No. 2023/00298

Responsible committee: PEL/22 Power electronics

Interested committees:

Title: BS EN IEC 62040-1 Uninterruptible power systems (UPS)

Part 1: Safety requirements

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



22H/307A/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 62040-1 ED3

DATE OF CIRCULATION:

2023-02-10 (2023-02-03)

CLOSING DATE FOR COMMENTS:

2023-03-31

SUPERSEDES DOCUMENTS:

22H/290/RR

IEC SC 22H : UNINTERRUPTIBLE POWER SYSTEMS (UPS)

SECRETARIAT:

France

SECRETARY:

Mr Eric Brun

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 22, SC 22E, SC 22G, SC 121B

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of

- any relevant patent rights of which they are aware and to provide supporting documentation,
- any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "in some countries" clauses. See AC/22/2007.

TITLE:

Uninterruptible power systems (UPS) - Part 1: Safety requirements

NOTE FROM TC/SC OFFICERS:

- To facilitate reading, an "extended version" format is circulated as 22H/308/INF concurrently with this CD. The INF document includes the applicable text of the direct reference standard (IEC 62477-1) in red in the text.
- National Committees are invited to note that comments on the CD should be restricted to those in the CD (22H/307/CD).
- The CD is circulated for 8 weeks commenting to facilitate discussion at the next MT 62040-1 meeting to be held in Arlington, USA from April 17th to 21st, 2023.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –**Part 1: Safety 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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

This third edition cancels and replaces the second edition published in 2017, Amendment 1:2021 and Amendment 2:2022. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) (List to be added by MT62040-1)

b)

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This International Standard is to be read in conjunction with IEC 62477-1:2022.

The provisions of the general rules dealt within IEC 62477-1:2022 are only applicable to this document insofar as they are specifically cited. Clauses and subclauses of IEC 62477-1:2022 that are applicable in this document are identified by reference to IEC 62477-1:2022, for example, "Clause 4 of IEC 62477-1:2022 applies, except as follows".

The exceptions are then listed. The exceptions can take the form of a deletion, a replacement or an addition of subclauses, tables, figures or annexes.

Subclauses, tables and figures that are additional to those in IEC 62477-1:2022 are, in this document, identified by a suffix in the format of X.10x, for example 4.3.101.

Annexes that are additional to those in IEC 62477-1:2022 are, in this document, lettered AA, BB, etc.

In this document, the following print types are used:

- requirements and normative annexes: roman type
- notes and other informative matter: smaller roman type
- normative conditions within tables: smaller roman type
- terms that are defined in Clause 3: *italic type*

A list of all parts in the IEC 62040 series, published under the general title Uninterruptible Power Systems (UPS), can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

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INTRODUCTION

191 IEC technical sub-committee 22H: Uninterruptible power systems (UPS) carefully considered the
192 relevance of each paragraph of IEC 62477-1:2022 in UPS applications. This part of IEC 62040
193 utilizes IEC 62477-1:2022 as a reference document and references, adds, replaces, or modifies
194 requirements as relevant. This is because product-specific topics not covered by the reference
195 document are the responsibility of the technical committee using the reference document.

196 IEC 62477-1:2022 relates to products that include power electronic converters, with a rated system
197 voltage not exceeding 1 000 V AC or 1 500 V DC. It specifies requirements to reduce risks of fire,
198 electric shock, thermal, energy and mechanical hazards, except functional safety as defined in
199 IEC 61508 (all parts). The objectives of this document are to establish a common terminology and
200 basis for the safety requirements of products that contain power electronic converters across
201 several IEC technical committees.

202 IEC 62477-1:2022 was developed as a technical revision of the first edition published in 2012 and
203 Amendment 1:2016 with the intention:

204 to be used as a reference document for product committees inside IEC technical committee 22:
205 Power electronic systems and equipment in the development of product standards for power
206 electronic converter systems and equipment;

207 to be used as a reference document for product committees outside TC 22 in the development of
208 product standards of power electronic converter systems and equipment intended for renewable
209 energy sources. TC 82, TC 88, TC 105 and TC 114, in particular, have been identified as relevant
210 technical committees at the time of publication.

211 The reference document, being a group safety standard, will not take precedence over this
212 product-specific standard according to IEC Guide 104. IEC Guide 104 provides information about
213 the responsibility of product committees to use group safety standards for the development of their
214 own product standards.

215 When reading this document together with the reference document, the term “power electronic
216 converter system” and its abbreviated form “PECS” shall be read as “uninterruptible power system”
217 and “UPS” respectively.

218

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: Safety requirements

1 Scope

This part of IEC 62040 applies to movable, stationary, fixed, or built-in UPS for use in low-voltage distribution systems and that are intended to be installed in an area accessible by an ordinary person or in a restricted access area as applicable, that deliver fixed frequency AC output voltage with port voltages not exceeding 1 000 V AC or 1 500 V DC and that include an *energy storage device*. It applies to pluggable and to permanently connected UPS, whether consisting of a system of interconnected units or of independent units, subject to installing, operating and maintaining the UPS in the manner prescribed by the manufacturer.

NOTE 1 Typical UPS configurations, including voltage and/or frequency converters and other topologies, are described in IEC 62040-3:2021, the test and performance product standard for UPS.

NOTE 2 UPS generally connect to their *energy storage device* through a DC link. A chemical battery is used throughout the standard as an example of an *energy storage device*. Alternative devices exist, and as such, where "battery" appears in the text of this document, this is to be understood as "*energy storage device*".

This document specifies requirements to ensure safety for the ordinary person who comes into contact with the UPS and, where specifically stated, for the skilled person. The objective is to reduce risks of fire, electric shock, thermal, energy and mechanical hazards during use and operation and, where specifically stated, during service and maintenance.

This product standard is harmonized with the applicable parts of group safety publication IEC 62477-1:2022 for power electronic converter systems and contains additional requirements relevant to UPS.

This document does not cover:

- UPS that have a DC output;
- systems for operation on moving platforms including, but not limited to, aircrafts, ships and motor vehicles;
- external AC or DC input and output distribution boards covered by their specific product standard;
- stand-alone static transfer systems (STS) covered by IEC 62310-1;
- to grid-connected power converter systems with multiple DC ports which are covered by IEC 62909-1;
- systems wherein the output voltage is directly derived from a rotating machine covered by IEC 88528-11;
- telecommunications apparatus other than UPS for such apparatus;
- functional safety aspects covered by IEC 61508 (all parts).

NOTE 1 Even if this document does not cover the applications listed above, it is commonly taken as a guide for such applications.

NOTE 2 Specialized UPS applications are generally governed by additional requirements covered elsewhere, for example UPS for medical applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

Clause 2 of IEC 62477-1:2022 applies, except as follows:

Add the following normative references:

ISO 11014:2009, *Safety data sheet for chemical products*.

IEC 60364-4-42, *Low-voltage electrical installations – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-2:2016/AMD1:2019

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

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 62040-2:2016, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements*

IEC 62040-3:2021, *Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements*

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

IEC 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

3 Terms and definitions

Clause 3 of IEC 62477-1:2022 applies, except as follows:

Delete the terms 3.13, 3.38, 3.48 and 3.69.

Add the following new terms and definitions, and new notes:

Note 1 to entry: Where the terms "voltage" and "current" are used, RMS values are implied unless otherwise specified.

Note 2 to entry: Non-sinusoidal signals are measured with appropriate true RMS measuring instruments.

3.101

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 1 to entry: 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 output port. 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*.

3.102**maximum input current**

<UPS> RMS current at the AC input port of the *UPS* while operating in *normal mode*, at worst case input voltage, *rated load* and charging a fully depleted *energy storage device*

[SOURCE: IEC 62040-3:2021, 3.5.24]

3.103**hazardous voltage**

voltage exceeding 42,4 V peak, or 60 V DC, existing in a circuit that does not meet the requirements for either a limited current circuit or a TNV-1 circuit

Note 1 to entry: A limited current circuit is understood in the context of "protection by means of protective impedance" as described in IEC 62477-1:2022, 4.4.5.5.

[SOURCE: IEC 60950-1:2005, 1.2.8.6 modified – TNV has been replaced by TNV-1.]

3.104**hazardous energy**

available power level of 240 VA or more, having a duration of 60 s or more, or a stored energy level of 20 J or more (for example, from one or more capacitors), at a potential of 2 V or more

Note 1 to entry: See IEC 62477-1:2022, 4.5.1.2.

3.105**AC input power**

external electrical power supplied to the *UPS* and, subject to satisfying the *UPS* output specification, to any *bypass* circuits

Note 1 to entry: The *AC input power* is usually the mains or a private low-voltage power supply system.

[SOURCE: IEC 62040-3:2021, 3.2.8]

3.106**bypass**

alternative power path, either internal or external to the *UPS*

3.107**active power**

under periodic conditions, mean value, taken over one period T , of the instantaneous power p

$$P = \frac{1}{T} \int_0^T p dt$$

Note 1 to entry: Under sinusoidal conditions, the *active power* is the real part of the complex power $\underline{S}$, thus $P = \operatorname{Re} \underline{S}$

Note 2 to entry: The coherent SI unit for *active power* is watt, W.

Note 3 to entry: DC, fundamental and harmonic voltages and currents contribute 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.

[SOURCE: IEC 60050-131: 2013, 131-11-42, modified – A third note to entry has been added.]

3.108**apparent power**

product of the RMS voltage and RMS current

3.109**rating**

set of *rated values* and operating conditions of a machine, a device or equipment

[SOURCE: IEC 60050-151:2001, 151-16-11, modified – The words "of a machine, a device or equipment" have been added.]

3.110**rated value**

value of a quantity used for specification purposes, generally established by a manufacturer for a specified set of operating conditions of a component, device, equipment, or system

[SOURCE: IEC 60050-151:2001, 151-16-08, modified – The word "established" has been expanded to read "generally established by a manufacturer".]

3.111**rated load**

value of load used for specification purposes, generally established by a manufacturer for a specified set of operating conditions of a component, device, equipment, or system

Note 1 to entry: The *rated load* is expressed in *apparent power* [VA] and *active power* [W] resulting in a power factor of the *rated load* that includes the effect of any applicable combination of linear and of non-linear load

3.112**rated voltage**

input or output voltage as declared by the manufacturer

Note 1 to entry: For a three-phase supply, the *rated voltage* corresponds to the phase-to-phase voltage.

3.113**rated current**

input or output current of the *UPS* as declared by the manufacturer

3.114**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 1 to entry: The devices in a *low impedance path* generally present current limiting characteristics under short-circuit conditions.

Note 2 to entry: Examples include current limiting fuses, current limiting circuit-breakers, transformers and inductors.

3.115**rated peak withstand current**

I_{pk}

value of peak short-circuit current, declared by the *PECS* manufacturer, which can flow under specified conditions

Note 1 to entry: For the purpose of this document, I_{pk} refers to the initial asymmetric peak value of the prospective test current. See Table 32.

3.116**rated short-time withstand current**

I_{cw}

RMS value of short-time current, declared by the *UPS* manufacturer, that can be carried under specified conditions, defined in terms of current and time

[SOURCE: IEC 61439-1:2020, 3.8.10.3, modified – The word "assembly" has been replaced by "UPS" and the phrase "that can be withstood" has been replaced by "that can be carried".]

3.117
rated conditional short-circuit current

I_{cc}

RMS 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)* specified by the *UPS* manufacturer.

3.118
rated minimum required prospective short-circuit current

$I_{cp, mr}$

RMS value of a minimum prospective short-circuit current, declared by the *UPS* manufacturer, that is available from a source to ensure operation of the *short-circuit protective device (SCPD)* specified by the *UPS* manufacturer.

3.119
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 *AC input power* not available

3.120
backfeed protection

control scheme that reduces the risk of electric shock due to *backfeed*

3.121
stored energy mode

stable mode of operation that the *UPS* attains under the following conditions:

- a) *AC input power* is disconnected or is out of the specified tolerance band;
- b) all power is derived from the *energy storage device*;
- c) the load is within the specified *rating* of the *UPS*

[SOURCE: IEC 62040-3:2021, 3.3.8, modified – The words " <UPS operation>" have been deleted in the definition.]

3.122
earth fault

occurrence of an accidental conductive path between a live conductor and the earth

[SOURCE: IEC 60050-826:2004, 826-04-14, modified – The second preferred term "ground fault" has been deleted, as well as the notes.]

3.123
primary circuit

circuit that is directly connected to the AC mains supply

It includes, for example, the means for connection to the AC mains supply, the primary windings of transformers, motors and other loading devices.

Note 1 to entry: Conductive parts of an interconnecting cable may be part of a *primary circuit*.

[SOURCE: IEC 60950-1:2005, 1.2.8.4, modified – The text "as stated in 1.2.11.6." has been deleted from the Note 1 to entry]

3.124**energy storage device**

system consisting of a single or multiple devices designed to provide power to the *UPS* inverter for the required stored energy time

Note 1 to entry: Examples of *energy storage devices* include, but are not limited to, battery, double-layer capacitor ("super" or "ultra" capacitor) and flywheel energy storage systems

[SOURCE: IEC 62040-3:2021, 3.2.18]

3.125**rated capacity**

capacity value of a cell or battery determined under specified conditions and declared by the manufacturer

Note 1 to entry: The *rated capacity* is the quantity of electricity C_n Ah (ampere-hours) which a single cell or battery can deliver during an n -hour period when charging, storing and discharging under the conditions declared by the manufacturer.

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – Addition of Note 1 to entry.]

3.126**module**

group of cells connected together either in a series and/or parallel configuration with or without protective devices (e.g. fuse or positive temperature coefficient device (PTC) and monitoring circuitry

[SOURCE: IEC 62619:2022, 3.9]

3.127**battery pack**

energy storage device, which comprises one of one or more cells or *modules* electrically connected and has monitoring circuitry which provides information (e.g. cell voltage) to a *battery system* to influence the battery's safety, performance and/or service life

Note 1 to entry: The battery pack may incorporate a protective housing and be provided with terminals or other interconnection arrangements.

[SOURCE: IEC 62619:2022, 3.10]

3.128**battery system**

system which comprises one or more cells, *modules* or *battery packs* and has a *battery management system*

Note 1 to entry: The *battery system* may have a cooling or heating units. More than one *battery system* may constitute a larger *battery system*.

[SOURCE: IEC 62619:2022, 3.11 modified - deleted the text "capable of controlling current in case of overcharge, overcurrent, overdischarge, and overheating" and the first note to entry, and modified the 2nd note to entry to delete the text "The *battery system* is sometimes also referred to as a battery."]

3.129**battery management system****BMS**

electronic system associated with a *battery system* which has functions to control current in case of overcharge, overcurrent, overdischarge and overheating and which monitors and/or manages the *battery system's* state, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life

488 Note 1 to entry: Overdischarge cut-off is not mandatory if there is an agreement between the cell manufacturer and the
489 *UPS* manufacturer.

490 Note 2 to entry: The function of the *BMS* can be assigned to the *battery pack* or to the *UPS*.

491 Note 3 to entry: The *BMS* can be divided and it can be found partially in the *battery pack* and partially on the *UPS* (see
492 figure 10x)

493 Note 4 to entry: The *BMS* is sometimes also referred to as a BMU (battery management unit).

494 [SOURCE: IEC 62619:2022, 3.12 modified – changed the shortened form “battery” to “*battery*
495 *system*”]

496 **3.130**
497 **leakage**
498 visible escape of liquid electrolyte

499 Note 1 to entry *leakage* may also referred to a electrolyte spillage.

500 [SOURCE: IEC 62619:2022, 3.13 modified – added note to entry]

501 **3.131**
502 **venting**
503 release of excessive internal pressure from a cell, *module*, *battery pack*, or *battery*
504 *system* in a manner intended by design to preclude *rupture* or *explosion*

505 [SOURCE: IEC 62619:2022, 3.14]

506 **3.132**
507 **rupture**
508 mechanical failure of a cell container or battery case induced by an internal or external
509 cause, resulting in exposure or spillage but not ejection of materials

510 [SOURCE: IEC 62619:2022, 3.15]

511 **3.133**
512 **explosion**
513 failure that occurs when a cell container or battery case opens violently and solid
514 components are forcibly expelled

515 Note 1 to entry: Liquid, gas, and smoke are excepted.

516 [SOURCE: IEC 62619:2022, 3.16]

517 **3.134**
518 **fire**
519 emission of flames from a cell, *module*, *battery pack* or *battery system* for more than
520 1 s

521 Note 1 to entry: sparks and arcing are not considered flames.

522 [SOURCE: IEC 62619:2022, 3.17]

523 **3.135**
524 **normal mode**
525 <*UPS* operation> stable mode of operation that the *UPS* attains under the following
526 conditions:

527 a) *AC input power* is within the specified tolerance band;

528 b) *energy storage device* is connected and charged or is under recharge;

529 c) load is within the specified *rating*;

530 d) *bypass*, if applicable, is within the specified tolerance band.

531 [SOURCE: IEC 62040-3:2021, 3.3.6]

532 **3.136**

533 **charger**

534 converter that provides DC power to an *energy storage device* for the purpose of
535 increasing or maintaining the amount of stored energy

536 [SOURCE: IEC 62040-3:2021, 3.2.21]

537 **4 Protection against hazards**

538 Clause 4 of IEC 62477-1:2022 applies, except as follows:

539 **4.2 Single fault conditions and abnormal operating conditions**

540 Subclause 4.2 of IEC 62477-1:2022 applies, except as follows:

541 *Replace the fourth paragraph of IEC 62477-1:2022, 4.2 by the following:*

542 Compliance is checked by analysis or by test according to 5.2.4.6 of IEC 62477-1:2022.

543 Compliance through analysis only is permitted when such analysis conclusively shows that
544 no hazard will result from failure of the component.

545 **4.3 Short-circuit and overload protection**

546 Subclause 4.3 of IEC 62477-1:2022 applies, except as follows:

547 **4.3.1 General**

548 Subclause 4.3.1 of IEC 62477-1:2022 applies, except as follows:

549 *In the second paragraph of 4.3.1 IEC 62477-1:2022, replace the first and second bullet points as*
550 *follows:*

- 551 • *rated conditional short-circuit current (I_{cc}) according to 4.3.2.2; or*
552 • *rated short-time withstand current (I_{cw}) according to 4.3.2.3.*

553 *After the third paragraph, add the following text:*

554 A *UPS* with AC input *ports* that may be configured with jumpers or busbars to present a
555 single AC input *port* or multiple AC input *ports* shall be tested as having multiple AC
556 input *ports*. Testing with installed jumpers or busbars that combine multiple AC input
557 *ports* into a single AC input *port* is not required when the construction of the jumpers
558 or busbars is at least as robust as that of the phase conductors in terms of cross-
559 sectional area, mechanical support and clearance.

560 A *UPS* with multiple AC input *ports* and different *ratings* for each *port* shall indicate,
561 when configured as a single AC input *port*, a *rating* equal to the lowest *rating* of
562 any port (see table 101).

563

Table 101 – UPS AC input port configuration

AC input port configuration	AC input port(s)	I_{cc}/I_{cw} rating
Single AC input port	Port 1 e.g. combined rectifier and <i>bypass</i> input	I_{cc}/I_{cw}
Multiple AC input ports	Port 1 e.g. rectifier input	I_{cc1}/I_{cw1}
	Port 2 e.g. <i>bypass</i> input	I_{cc2}/I_{cw2}
	Combined ports 1 and 2	Lesser of I_{cc1}/I_{cw1} or I_{cc2}/I_{cw2}

Add the following subclauses:

4.3.1.101 UPS input port with low impedance path to output port

Except where exempted in 5.2.4.4.101, the *rated conditional short-circuit current* and/or *rated withstand current* shall be verified by application of a short-circuit across the AC output port only in modes of operation wherein the output power is delivered by the AC 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 operating in *bypass* mode;
- 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 62040-3:2021.

The effects of faults that originate within the UPS are addressed in 4.2, except as stated in 4.3.102

4.3.1.102 UPS input port with no low impedance path to output port

Except where exempted in 5.2.4.4.101, the *rated conditional short-circuit current* and/or *rated withstand current* shall be verified by application of a short-circuit immediately before the point where the input path no longer presents negligible impedance. The point of application of the short-circuit may be internal to the UPS.

Subclause 4.3.2 of IEC 62477-1:2022 applies, except as follows:

Replace the existing title by:

4.3.2 Input short-circuit withstand strength

4.3.2.2 Conditional short-circuit current (I_{cc}) on input ports

Subclause 4.3.2.2 of IEC 62477-1:2022 applies, except as follows:

In the first paragraph replace the first and third bullet points as follows:

- *rated conditional short-circuit current* (I_{cc});
- *rated minimum required prospective short-circuit current* ($I_{cp, mr}$).

4.3.2.3 Short-time withstand current (I_{cw}) on input ports

Subclause 4.3.2.3 of IEC 62477-1:2022 applies, except as follows:

In the first paragraph replace the first and third bullet points as follows:

In the second paragraph replace the reference to 5.2.4.4.3 with 5.2.4.4

- *rated short-time withstand current* (I_{cw});

- *rated peak withstand current (I_{pk})*.

4.3.2.4 Output short-circuit current ability

Subclause 4.3.2.4 of IEC 62477-1:2022 applies, except as follows:

Replace the text with the following:

The requirements specified in IEC 62040-3:2021, 6.4.2.9.2 apply.

4.3.4 Protection by several devices

Subclause 4.3.4 of IEC 62477-1:2022 applies, except as follows:

Add the following subclauses:

4.3.101 AC input current

The input current to the *UPS* shall not exceed the *maximum input current* declared by the *UPS* manufacturer.

In determining the steady state input current, the consumption due to all optional features offered or provided by the manufacturer for inclusion in or with the *UPS* that increase the steady state input current shall be considered and adjusted to give the most unfavourable result.

Transient input current arising from dynamic occurrences are not considered.

NOTE Inrush or overload current are examples of transient input current.

Compliance is checked when highest current measured or calculated (as applicable) when performing the test described in 5.2.3.12 does not exceed the maximum input current declared by the manufacturer.

For marking, see 6.2.1.3.

4.3.102 Transformer protection

Transformers shall be protected against overtemperature.

NOTE Means of protection include:

- overcurrent protection,
- internal thermal cut-outs,
- use of current limiting devices.

Compliance is checked by the applicable tests of 5.2.3.104.

4.3.103 Protection of the *energy storage device*

The *energy storage device* whether internal (integral) or external to the *UPS* unit shall be protected against fault current and against overcurrent.

An overcurrent protective device providing the functions of a disconnect device as stated in 4.101.2 shall be located in close proximity to the *energy storage device*, and the following requirements apply:

- a) for the purpose of interrupting a fault current supplied by the *energy storage device*, the overcurrent protective device shall:

- not require a current greater than the fault current available,
- be rated to interrupt the maximum fault current available.

- b) the cables interconnecting the *energy storage device*, the overcurrent protective device and the *UPS* unit shall be rated to support: