

Supplementary Specification to IEC 62040-5-3, Uninterruptible power systems (UPS) – Part 5-3: DC output UPS – Performance and test requirements

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
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Acknowledgements

This IOGP Specification was prepared by a Joint Industry Project 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) “Standardization of Equipment Specifications for Procurement” organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization for projects globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly approved specification, building on recognized industry and/or international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector’s capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP’s Competition Law Guidelines (November 2014).

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Introduction

The purpose of this specification is to define a minimum common set of specification requirements for the procurement of DC UPS in accordance with IEC 62040-5-3, Uninterruptible power systems (UPS) - Part 5-3: DC output UPS - Performance and test requirements, Edition 1.0, 2016-10 for application in the petroleum and natural gas industries.

This JIP33 standardized procurement specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents Supplementary Technical Specification

It is required to use all of these documents in conjunction with each other when applying this specification, as follows:

S-702: Supplementary Specification to IEC 62040-5-3 DC Uninterruptible Power Systems (UPS)

This specification is written as an overlay to IEC 62040-5-3, following the clause structure of the parent standard, to assist in cross-referencing the requirements. Where clauses from the parent standard IEC 62040-5-3 are not covered in this specification, there are no supplementary requirements or modifications to the respective clause. The terminology used within this specification follows that of the parent standard and otherwise is in accordance with ISO/IEC Directives, Part 2.

Modifications to the parent standard defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

S-702D: Data Sheet for DC Uninterruptible Power Systems (UPS)

This document provides project specific requirements where this specification requires the purchaser to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed in the data sheet, to define scope and technical requirements for enquiry and purchase of the equipment.

S-702L: Information Requirements for DC Uninterruptible Power Systems (UPS)

This document defines the information requirements, including format, timing and purpose, for information to be provided by the vendor. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

S-702Q: Quality Requirements for DC Uninterruptible Power Systems (UPS)

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the data sheet.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

Unless defined otherwise in the purchase order, the order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (data sheet, IRS, QRS);
- d) this specification;
- e) the parent standard.

1 Scope

Add to second paragraph

This specification also specifies the DC UPS manufacturing requirements of the various assemblies such as rectifiers, switches and functional requirements related to measurement, protection and alarms. Packing, handling, preservation and storage requirements are also defined.

2 Normative references

Add to clause

IEC 60076-11	Power transformers – 11: Dry-type transformers
IEC 60085	Electrical insulation – Thermal evaluation and designation
IEC 60092 (all parts)	Electrical installations in ships
IEC 60146-1-3	Semiconductor convertors requirements and line commutated convertors Part 1-3: Transformers and reactors
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60947-2	Low-voltage switchgear and controlgear – Part 2: Circuit-breakers
IEC 60947-3	Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC 60947-4-1	Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters
IEC 61000-2-4: 2002	Electromagnetic compatibility (EMC) – 2-4: – Compatibility levels in industrial for low-frequency conducted disturbances
IEC 61892-1	Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions
IEC 61892 (all parts)	Mobile and fixed offshore units – Electrical installations
IEC 62040-1:2017	Uninterruptible power systems (UPS) – Part 1: Safety requirements
IEC 62040-3: 2011	Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements
IEC 62040-5-3: 2016	Uninterruptible power systems (UPS) – Part 5-3: DC output UPS – Performance and test requirements
IEC 62040 (all parts)	Uninterruptible power systems (UPS)
IEEE C57.110	Recommended Practice for Establishing Liquid Immersed and Dry-Type Power and Distribution Transformer Capability when Supplying Nonsinusoidal Load Currents

Replace clause heading with

3 Terms and definitions, acronyms and abbreviations

Add new subclause

3.7 Acronyms and abbreviations

HMI	human machine interface
LAN	local area network
MCB	miniature circuit breaker

MCCB	moulded case circuit breaker
MTTR	mean time to repair
PCB	printed circuit board
THD	total harmonic distortion
VPI	vacuum pressure impregnation

4 Environmental conditions

4.2 Normal conditions

4.2.1 Operation

4.2.1.1 Ambient temperature and relative humidity

Replace first paragraph with

DC UPS equipment conforming to this standard shall perform as rated when operating within the following ambient ranges:

- temperature 0 °C to +50 °C;
- relative humidity of 10 % to 90 %.

5 Electrical conditions, performance and declared values

5.1 General

5.1.2 Markings and instructions

Add to subclause

In addition to the information required on the nameplate in accordance with IEC 62040-1:2017, 6.2, the item serial number and month and year of manufacture shall be included.

Add to subclause

In addition to English as the default language, caution, danger and warning labels shall have information displayed in the local language, as defined in the data sheet.

Add new subclause heading

5.1.3 Safety

Add new subclause

5.1.3.1

DC UPS supplied in accordance with this specification shall comply with the safety requirements for UPS prescribed in IEC 62040-1.

Add new subclause

5.1.3.2

The sound pressure level shall not exceed 70 dBA at any load condition, from no load to the rated load of the DC UPS, when measured at a distance of one metre from the DC UPS, in any direction.

Add new subclause

5.1.4 Electromagnetic compatibility

The DC UPS shall conform to the electromagnetic emission and immunity levels detailed in IEC 62040-2, for the category level specified in the data sheet.

Add new subclause

5.1.5 DC UPS Design basis

The operational life of the DC UPS and its components at the rated load, shall be in accordance with Table 5.

Table 5 – DC UPS operational life

Components	Minimum operation life (years)
Rectifier unit / DC power module	20
Cooling fans	5
DC Capacitors	10

Add new subclause

5.1.6 Availability

Irrespective of its configuration, the DC UPS shall achieve reliability integrity level 4, in accordance with IEC 62040-3, Table K.1.

5.2 DC UPS input specification

5.2.1 Conditions for normal mode operation

Replace item d) with

d) **frequency variation + 5% of rated frequency;**

Add “for public low voltage networks” at the beginning of list item f)

Add new list item h) after NOTE 3

- h) for industrial networks, total harmonic distortion (THD) of voltage $\leq 10\%$ as per class 3 compatibility levels, with a maximum level of individual harmonic voltages in accordance with IEC 61000-2-4, Table 2, Table 3 and Table 4. Refer to IEC 61892-1 for offshore installations.

5.3 DC UPS output specification

5.3.4 Performance classification

Add to subclause

The DC UPS shall comply with the requirement of the performance-based classification code defined in the data sheet.

5.6 Communication circuits

Add to subclause

The DC UPS shall be provided with communication hardware compliant with the interface media and protocol specified in the data sheet.

Add to subclause

Any cable distance limitations for the specified protocol shall be defined.

Add to subclause

A list of mapping addresses of the data communication and signalling circuits intended to be exchanged with the information technology equipment (e.g. SCADA system, local area networks (LAN) or telecommunication networks) shall be provided.

Add new clause

7 Constructional requirements

7.1 General

7.1.1

The DC UPS shall be designed to minimize the mean time to repair (MTTR) by using self-diagnostics, comprehensive alarm descriptions, and easy accessibility to components and circuits.

7.1.2

Components, printed circuit boards (PCBs), connectors and terminals and the associated locations of these items shall be identified with labels in accordance with IEC 62040-1.

7.1.3

The spare parts list shall include limited life components that require periodic replacement, with the required replacement frequency.

7.1.4

An obsolescence management plan in accordance with an industry recognized system (e.g. IEC 62402) shall be provided for all UPS assembly components.

7.1.5

The documentation provided with the equipment shall include an installation manual, maintenance manual, operational manual and manufacturing record book.

7.2 Enclosure

7.2.1

The DC UPS system shall be installed in an enclosure made of one or more floor-mounted, free-standing, self-supporting steel cabinets or wall-mounted cabinets as indicated in the data sheet.

7.2.2

The enclosure shall have a minimum degree of protection of IP31 in accordance with IEC 60529.

7.2.3

The battery bank shall be integrated in the DC UPS cabinets or placed separately, as specified in the data sheet.

7.2.4

Undrilled removable gland plates of the cabinet shall be used for cable entry.

7.2.5

Gland plates used for cable entry shall be non-magnetic for single core cables.

7.3 Accessibility and maintenance safety

7.3.1

The location and grouping of components and auxiliary equipment shall permit easy identification and access for operational, maintenance and repair purposes, without interruption of supply to the load.

7.3.2

Protection devices that cause the DC UPS to trip shall not be mounted on the door.

7.3.3

Live components and parts, which are accessible when the compartment door is opened, shall be protected by enclosures, barriers or shrouds to a degree of protection of at least IP2X.

7.3.4

Document holders shall be provided inside the enclosure doors, if specified in the data sheet.

7.4 Components

7.4.1

Main circuit switches, miniature circuit breakers (MCBs) and moulded case circuit breakers (MCCBs) shall have padlocking facilities.

7.4.2

Mechanical type main circuit switches shall be in accordance with IEC 60947-3.

7.4.3

Main circuit switches shall comply with utilisation category AC22 and DC22 for AC and DC switches respectively, in accordance with IEC 60947-3.

7.4.4

Main circuit switches shall be of independent, manually operated air-break type for continuous duty.

7.4.5

MCBs and MCCBs shall comply with IEC 60947-2.

7.4.6

Contactors shall be rated for uninterrupted duty in accordance with IEC 60947-4-1.

7.4.7

Contactors shall comply with utilization category of AC-1 and DC-1 for AC and DC contactors respectively in accordance with IEC 60947-4-1.

7.4.8

Transformers and reactors used for input isolation shall be air-cooled type in accordance with IEC 60146-1-3.

7.4.9

In accordance with IEC 60076-11, transformers shall be:

- copper wire wound;
- with a high-grade silicon steel core; and
- air-cooled type design.

7.4.10

The transformer design shall use winding insulation material of thermal class H in accordance with IEC 60085.

7.4.11

An epoxy based insulating varnish shall be applied with a vacuum pressure impregnation (VPI) system in accordance with IEC 60076-11.

7.4.12

The transformers shall be rated for minimum of K-4 (K factor) in accordance with IEEE C57.110.

7.4.13

The DC UPS system shall have a mimic diagram showing the topology and status indication, located on the front panel.

7.5 Internal wiring and terminals

7.5.1

Insulation material of internal wires shall be zero halogen, flame retardant, non-toxic, and have a low smoke index.

7.5.2

Wiring shall be labelled with alphanumeric characters on insulated ferrules, located adjacent to the terminals.

7.5.3

Wiring for external connections shall be routed to individual terminals on an accessible terminal block.

7.5.4

Space and termination arrangements shall be provided for cables to be terminated without difficulty.

7.6 Earthing

7.6.1

A main earth rail shall be provided in close proximity to the external cable glands.

7.6.2

The cubicle shall be bonded to the main earth rail in accordance to IEC 62040-1.

7.6.3

All exposed, non-current carrying parts of the DC UPS inclusive of the enclosure, components and doors shall be earthed.

7.6.4

The gland plates shall be earthed to the main earth rail.

7.7 Ventilation

7.7.1

The cooling system design of the DC UPS shall adopt convection cooling or fan assisted forced air cooling.

7.7.2

Cooling fans shall be installed with a redundant (N+1) configuration.

7.7.3

In the event of a cooling fan being out of service, the DC UPS shall continue to deliver the rated load without maximum continuous temperature of components exceeding the designed limits.

7.7.4

Fans shall be equipped with monitoring facilities to provide an alarm in the event of a fan failure.

7.7.5

The DC UPS shall not incorporate cooling air filters that need periodic cleaning or replacement.

7.8 Additional requirements for offshore (fixed and floating) installations

7.8.1

For offshore installations, the DC UPS and associated equipment and components shall be type designed, tested and certified in accordance with general requirements of IEC 62040 (all parts) and:

- specific requirements of IEC 61892 for mobile and fixed units; or
- specific requirements of IEC 60092 for electrical installations in ships.

7.8.2

If requirements mandated by the International Maritime Organization (IMO), International Association of Classification Societies Ltd. (IACS) or any other classification societies, contradicts or conflicts with the requirements of IEC standards, the most stringent shall be applied.

7.9 Battery isolator box

7.9.1

The battery isolator box shall be a lockable enclosure made of sheet steel for wall, frame or pedestal installation.

7.9.2

The battery isolator box design shall depend on its location of installation and in accordance with the environmental conditions specified in the data sheet.

7.9.3

The battery isolator box shall have a minimum degree of protection of IP31 (with closed door) in accordance with IEC 60529.

7.9.4

The choice of enclosure of battery isolator box shall depend on the area classification assigned to its location of installation specified in the data sheet.

7.9.5

The battery isolator box enclosure shall have undrilled, removable gland plates.

7.9.6

The battery isolator shall be either switch fuse unit or MCCB.

7.9.7

The battery isolator shall be selected for rated DC voltage and DC current rating.

7.9.8

The auxiliary supply for the MCCB control element (under voltage coil or shunt trip coil) shall be compatible with the DC UPS control supply.

7.9.9

The battery isolator shall have potential free contacts hard wired to the terminals, if specified in the data sheet.

8 Functional requirements

8.1 Charger

8.1.1 Charger components

8.1.1.1

The charger unit of the DC UPS shall have a mains input transformer to galvanically isolate the AC and DC sections.

8.1.1.2

The charger unit and components on the input side of the DC UPS shall supply the rated output while simultaneously boost charging the battery.

8.1.1.3

If specified in the data sheet, the active front end charger shall carry out an online battery capacity discharge test by feeding the power back to the power source.

8.1.1.4

The DC UPS shall have an automatic or manual feature to perform on-line battery capacity testing by discharging of the battery into the load.

8.1.1.5

If an on-line battery monitoring system is specified, the DC UPS shall integrate with the on-line battery monitoring system to continuously assess individual cell condition of the battery bank.

8.1.1.6

If an on-line battery monitoring system is specified, the DC UPS shall generate an alarm when the battery parameters exceed the set limits.

8.1.1.7

The total AC ripple at the battery terminals shall not exceed the tolerance limits given by battery manufacturer.

8.1.2 Operations

8.1.2.1

The charger unit shall operate according to a constant voltage and current limiting philosophy.

8.1.2.2

The charger unit shall have two modes of operation:

- “boost charge”; and
- “float charge”.

8.1.2.3

It shall be possible to manually initiate Float and Boost mode of operation on the charger.

8.1.2.4

The return from float or boost mode to safe operation mode for the battery shall be automatic.

8.1.2.5

The charger unit shall have a walk-in/ramp-up/soft-start feature to restrict the inrush current on energization.

8.1.2.6

The charger unit shall restrict the battery charging current to a safe value specified by battery supplier, depending on the mode of operation.

8.1.2.7

The charger unit shall restart automatically upon restoration of the mains power supply following a power interruption.

8.1.2.8

Upon restoration of mains power supply following a power interruption, the charger unit shall initiate the boost-charge cycle automatically, depending upon type of battery selected for energy storage.

8.1.2.9

The duration of the boost charging shall be controlled by:

- automatic timer; or
- feedback of the battery current and voltage indicating that adequate battery charge has been achieved.

8.1.2.10

The charger unit shall revert automatically to float charging upon completion of the boost charging.

8.1.2.11

The charger unit shall have provision for terminating the boost charging in case of failure of the ventilation system in the battery room.

8.1.2.12

The charger unit shall have provision for temperature compensation for VRLA batteries, to control the battery charging voltage with an accuracy of ± 1 %.

8.1.2.13

The charger unit shall permit adjustment of output parameters to suit the type of battery selected for energy storage.

8.1.2.14

The charger unit shall be rated to recharge the battery to a nominal 90 % within 10 hours and 100 % within 24 hours following a discharge at rated load for the specified autonomy time, simultaneously delivering to the load its rated output.

8.1.2.15

The float or boost charge voltage shall be adjustable while the DC UPS is in operation.

8.1.2.16

If specified in the data sheet, the DC UPS shall permit a black start, delivering power to the load at the rated output, with only the batteries providing the input power.

8.1.2.17

If specified in the data sheet, the DC UPS shall permit an ESD override feature.

8.1.2.18

The DC UPS shall permit parallel operation with more units of the same nominal DC output voltage, irrespective of whether its individual input power supplies are in synchronism or not.

8.2 Measurement, protection and control

8.2.1 General

The DC UPS shall be equipped with necessary equipment to:

- provide the required measurements;
- generate required indications and alarms; and
- initiate protection to mitigate the consequences of internal/external faults and component and control circuit malfunctions.

8.2.2 Indication and display

8.2.2.1

The DC UPS shall have an interactive operator interface using a microprocessor based human machine interface (HMI) mounted on the front door to:

- indicate UPS operation status;
- accept input commands;
- monitor operating parameters; and
- display fault diagnostics.

8.2.2.2

The following statuses shall be displayed on the HMI or by LED signalling lights located on the DC UPS front panel:

- AC input power supply healthy;
- Charger ON (Float);
- Charger ON (Boost);
- Battery breaker ON;
- Load on battery;
- Charger Fault.

8.2.2.3

This HMI display shall have a mimic diagram representing the power flow path, as a single line diagram of the DC UPS and status of components.

8.2.2.4

Failure of the HMI display or indicating equipment on the DC UPS shall not compromise the operation of DC UPS.

8.2.2.5

The HMI shall have password protected multiple levels of access:

- for viewing (by the operator);
- settings (by trained operating personnel); and
- service (by the manufacturer's personnel).

8.2.2.6

The HMI shall have storage for retaining:

- historical data;
- event/alarm logging with time, date stamping; and
- historical trending for assisting troubleshooting and failure analysis.

8.2.2.7

The HMI shall have a communication feature for remote monitoring and control via a serial interface.

8.2.2.8

If specified in the data sheet, necessary software/hardware shall be provided for monitoring, review and control of settings on the DC UPS, on- or off-line.

8.2.3 Measurements

The following measurement data shall be displayed on the HMI or by discrete measuring or display instruments located on the front panel of the DC UPS:

- DC UPS input voltage per phase;
- DC UPS input current per phase;
- DC output voltage;
- DC output current;
- battery voltage;
- battery current (+/-);
- remaining autonomy time of the battery (percentage or minutes).

8.2.4 Alarms and protections

8.2.4.1

The alarm and protection functions shall be identified on the operator interface HMI by indicators with a first failure feature.

8.2.4.2

Alarm and trip functions shall be provided in accordance with Table 6 as a minimum.

Add new table

Table 6 – Minimum alarm and trip functions

Trouble description	Alarm	Charger Trip
AC input power supply - undervoltage	✓	Off ^{a b}
Charger failure	✓	✓
DC output overvoltage	✓	✓
DC output undervoltage	✓	
Battery discharging	✓	
Battery breaker off / battery disconnected	✓	
Battery temperature high (VRLA batteries only)	✓	
DC earth leakage detection	✓	
Cooling fan failure	✓	
^a In case the AC input power supply falls below allowable limits, the rectifier shall shut down. ^b When the AC input power supply resumes and remains within allowable limits, the rectifier shall start automatically and no reset is required.		

8.2.4.3

Alarms associated with trip functions shall be reset manually, locally or remotely, except for the AC input power supply alarm (see Table 6).

8.2.4.4

Alarms shall activate a common relay with two potential free contacts, one normally open and one normally closed, wired to a terminal block for connection to a remote common DC UPS alarm.

8.2.4.5

Alarms and changes in operation modes shall be time stamped and stored chronologically in a non-volatile memory of the HMI in a “first in – first out” rolling manner.

8.2.5 Controls

8.2.5.1

The timer settings and threshold limits of specific parameters shall be adjustable on-line without requiring the outage of the DC UPS.

8.2.5.2

The charger unit shall permit battery boost charge operation for vented batteries and valve regulated Nickel Cadmium (Ni Cd) batteries, in manual and automatic modes.

8.2.5.3

After batteries undergo a period of discharge, boost charging shall be automatically initiated and continue until the batteries are fully recharged.

8.2.5.4

The following controls (push buttons, switches and setting potentiometers) shall be provided on the DC UPS:

- AC input power supply circuit breaker;
- charger float voltage adjustment;
- charger boost voltage adjustment;
- charger boost current adjustment;
- charger output current limit adjustment;
- auto/manual mode selection;
- float control;
- boost control;
- lamp test control;
- battery breaker control;
- output circuit breaker.

NOTE The controls listed above will vary as per the project requirements and type of battery selected.

8.2.5.5

The internal control supply of the DC UPS shall be available as long as any of the power sources to the DC UPS is present.

9 Packing, handling, preservation and storage

9.1

The DC UPS and associated equipment and components shall be packed to protect against damage during transportation.

9.2

The packing shall be suitable for storing the DC UPS in the environmental conditions, for the duration specified.

NOTE The choice of the packing type and the requirement of particular protections depend on characteristics of the equipment and material to be packed, its handling requirements and kind of transport (air, sea, truck, rail or container) chosen.

9.3

Additional storage and preservation requirements to be followed during storage of the DC UPS shall be provided.

9.4

Packing, handling and transportation methods shall be provided, if the purchaser is responsible for transportation of the DC UPS.

9.5

Special handling instructions, including "fragile", "keep dry", "this side up" and "sling here", accompanied by internationally recognized symbols, shall be applied to the external packaging, where applicable.

9.6

A packing list containing the following details as a minimum, shall be provided for each package:

- number of packages;
- type of package;
- item description;
- quantity of items;
- net weight;
- gross weight; and
- package dimensions.

Bibliography

IEC 62402, *Obsolescence management*

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