

Uninterruptible Power system - Continuous Current for Industrial Use

Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.

The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."

CONTEC

Comissão de Normalização
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SC - 06

Electricity

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 09/2013) of PETROBRAS N-332 REV. E 12/2012. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard specifies the conditions required for the purchase of Uninterrupted Power System CC (UPS-CC) for industrial facilities belonging to PETROBRAS.

1.2 This Standard does not apply to UPS-CC used in telecommunication facilities and in cathodic protection systems of onshore and offshore facilities.

1.3 The scope of this standard does not include storage batteries, which shall be specified and testes according to the requirements of PETROBRAS [N-329](#).

1.4 This Standard applies to procedures started as of their date of issuance.

1.5 This Standard contains only Technical Requirements.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-329](#) - Storage Battery;

PETROBRAS [N-898](#) - Graphical Symbols and Designations for Electrical Diagrams;

PETROBRAS [N-2760](#) - Sistema Ininterrupto de Energia para Uso Industrial;

PETROBRAS [N-2841](#) - Qualificação e Aplicação de Revestimentos Anticorrosivos, à Base de Tintas em Pó;

ABNT [NBR IEC 60529](#) - Graus de Proteção para Invólucros de Equipamentos Elétricos (Código IP);

ISO [7779](#) - Acoustics - Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment;

IEC [60068-2-6](#) - Environmental Testing - Part 2-6: Tests - Test FC: Vibration (Sinusoidal);

IEC [60068-2-27](#) - Environmental Testing - Part 2-27: Tests - Test Ea and Guidance: Shock;

IEC [60146-1-1](#) - Semiconductor Converters - General Requirements and Line Commutated Converters - Part 1-1: Specifications of Basic Requirements;

IEC [61000-2-2](#) - Electromagnetic Compatibility (EMC) Part 2-2: Environment - Compatibility Levels for Low-Frequency Conducted Disturbances and Signaling in Public Low-Voltage Power Supply Systems;

IEC [62040-1](#) - Uninterruptible Power Systems (UPS) - Part 1: General and Safety Requirements for UPS;

IEC [62040-2](#) - Uninterruptible Power Systems (UPS) - Part 2: Electromagnetic Compatibility (EMC) Requirements;

IEC 62040-3 - Uninterruptible Power Systems (UPS) - Part 3: Method of Specifying the Performance and Test Requirements;

IEC CISPR 16-1-1 - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-1: Radio Disturbance and Immunity Measuring Apparatus - Measuring Apparatus;

IEC CISPR 16-1-2 - Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1-2: Radio Disturbance and Immunity Measuring Apparatus - Ancillary Equipment - Conducted Disturbances;

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions are applicable.

3.1

UPS-CC (Uninterruptible Power system - Continuous Current)

Uninterruptible Power System in Continuous Current, with AC inlet and DC outlet, also known as battery charger

3.2

automatic recharge

automatic operation initiated by the UPS-CC when the need for recharging is detected due to the current drained by the battery. The UPS-CC returns to float charge mode after recharging the battery

3.3

manual recharge

manual operation initiated by the user when the need for recharging is detected, since the automatic recharge option is not enabled or operational

3.4

ripple

component of alternating voltage superimposed on continuous voltage

3.5

charge current

current supplied to the accumulator in the charging process

3.6

ambient temperature

temperature of the location where the UPS-CC is installed

3.7

fluctuation voltage

voltage above the open-circuit voltage established for the charged cell plus that needed to make up for self-discharge losses by keeping the cell charged

3.8

overload

value of current exceeding the rated current of equipment

3.9

modu code

english acronym that means “code for the construction and equipment of mobile offshore drilling units”. It refers to a set of requirements intended to ensure minimum operational safety standards compatible with the characteristics of drilling platforms

3.10

general current limit

maximum current to be provided by the UPS-CC

3.11

battery current limit

maximum current provided by the UPS-CC to the battery

3.12

LED

Light Emitting Diode

3.13

MMI

Man-Machine Interface

3.14

MTBF

Mean Time Between Failures

3.15

MTTR

Mean Time To Repair

3.16

TAC

Field Acceptance Test

3.17

TAF

Factory Acceptance Test

3.18

DCS

Direct Current Switchboard

3.19

RMS

Root Mean Square of voltage and current parameters

3.20**SPDT**

Single Pole Double Throw

3.21**Industrial UPS-CC**

UPS-CC intended to feed safety, protection and automation systems of critical industrial processes

3.22**operating mode of stored energy or battery in operation**

operating mode of UPS-CC when fed under the conditions below:

- a) main power supply disconnected or out of tolerance limits;
- b) energy storage system CC is discharging;
- c) the load is within the established limits of UPS-CC;
- d) the output voltage is within the established limits of UPS-CC.

3.23**normal operating mode**

stable operating mode which the UPS-CC reaches when fed under the conditions below:

- a) main power supply connected and within tolerance limits;
- b) storage battery is charged or recharging within the power recovery time;
- c) the operation is continuous or may be continuous;
- d) the load is within the established limits of UPS-CC;
- e) the output voltage is within the established limits of UPS-CC.

4 General Conditions

4.1 The equipment shall meet the regulating standards and government ordinances in force during its date of purchase.

4.2 Any discrepancy or alternative presented by the bidder in relation to the conditions originally specified by PETROBRAS shall be clearly indicated in its bid in an item entitled "deviations from and alternatives to specifications".

4.3 When "deviations or alternatives" occur the bid shall include matching references to the numbers of the corresponding paragraphs of this Standard, Data Sheet or Material Requisition (RM).

4.4 If "deviations or alternatives" are not mentioned, the manufacturer's supply will be considered to be fully in accordance with the specifications.

4.5 Any item not sufficiently covered by this Standard shall comply with the IEC standards and be subjected to approval by PETROBRAS during the bid submission phase.

4.6 Whenever there are discrepancies between the Data Sheet of Annex B and this Standard, the information contained in the former shall prevail.

4.7 The UPS-CC shall be designed to be a stationary, fixed, and integrated equipment to be installed in an area that may only be accessed by qualified personnel.

4.8 The UPS-CC shall be able to supply the load without storage battery or with storage battery on float charge or recharge.

4.9 The specific characteristics of the UPS-CC are those indicated on the Data Sheet of Annex B.

4.10 The Data Sheet of UPS-CC shall be followed by the Data Sheet of Storage Battery, as specified in PETROBRAS [N-329](#).

4.11 The supplier shall complete all blank items on the Data Sheet of Annex B (technical data, list of standards used in the design, manufacturing, and testing as well as the list of tests) and return the Data Sheet to PETROBRAS duly authenticated.

4.12 The specific characteristics of each UPS-CC are indicated on its respective Data Sheets, which are numbered according to each design. The (blank) form of these Data Sheets is standardized as per Data Sheet of Annex B.

4.13 When the UPS-CC is installed on offshore production units it shall follow the recommendations of the classification societies. In the case of a floating type offshore unit, the inclination requirements specified in IMO and in the modu code shall also be observed.

4.14 The UPS-CC shall be designed to provide a mean time between failures (MTBF) of over 180 000 hours and a mean time to repair (MTTR) not exceeding 4 hours.

4.15 Provision shall be made for a DCS for the UPS-CC or UPS-CC set, as per Petrobras' design. The DCS shall be supplied by the UPS-CC manufacturer if requested in Data Sheet of Annex B.

4.16 The degree of protection of the DCS shall be the same as that of the UPS-CC, as indicated on the Data Sheet of Annex B and in accordance with ABNT [NBR IEC 60529](#).

4.17 When indicated on the Data Sheet of Annex B, the DCS shall have an insulation monitoring system capable of identifying the branch of the charge with low insulation.

4.18 According to definitions of IEC [62040-2](#), the UPS-CC listed in this document are Category C2 or C3 and belong to the Second Ambient.

5 Service Conditions

5.1 The equipment shall operate in a sheltered location and in a non-hazardous area.

5.2 The ambient temperature range is -10 °C to 40 °C, with 100 % of load up to 1 000 m, or as defined on the Data Sheet of Annex B.

5.3 The relative air humidity ranges from 30 % to 95 %, without condensation, at 25 °C.

5.4 The maximum altitude is 1 000 m, unless otherwise indicated on the Data Sheet of Annex B.

6 Constructive Characteristics

6.1 The equipment painting shall comply with the recommendations of PETROBRAS [N-2841](#).

6.2 It shall be possible to intervene in the UPS-CC even with the battery discharging to the consumer.

6.3 All UPS-CC settings shall be accessible to the user. In case the adjustments are made through software, there shall be no obstructions requiring PETROBRAS to pay for the assignment of the license for using the software. The software shall be supplied with the equipment, be active at the time of supply and its license shall be valid for an indefinite period of time. The circuits shall have means to avoid accidental contact to energized parts.

6.4 The UPS-CC shall comply with IEC [62040-2](#) with respect to electromagnetic compatibility requirements, e the circuits shall have means to avoid accidental contact to energized parts.

6.4.1 When indicated on the Data Sheet of Annex B the need for cooling with forced ventilation, it shall be monitored redundant with failure alarm indication.

6.4.2 Forced ventilation shall be accessible so as to allow replacement of the fans with the equipment in operation, without jeopardizing the safety or people and equipment.

6.5 The UPS-CC shall present the degree of protection indicated on the Data Sheet of Annex B, according to ABNT [NBR IEC 60529](#).

6.6 The UPS-CC shall be resistant to corrosion caused by the characteristic atmosphere of the facility environment, as indicated on the Data Sheet of Annex B.

6.7 The final finish color shall be as indicated in Data Sheet of Annex B.

6.8 The metal parts comprising the UPS-CC, which are not intended to carry current, shall have electrical continuity and be connected to the grounding busbar of the UPS-CC. The doors shall have electrical continuity with the metallic structure of the UPS-CC through flexible copper braid.

6.9 The ground busbar of the UPS-CC shall be run along its entire length and have a compression connector, suitable for the connection of a stranded bare copper ground cable with the nominal cross-sectional area indicated on the Data Sheet of Annex B.

6.10 The UPS-CC identification plate shall be attached to the outside of the UPS-CC and shall be made of series AISI 300 stainless steel. This plate shall contain at least the following data:

- a) manufacturer's name or brand name;
- b) supply voltage, number of phases, and rated frequency;
- c) rated power supply current;
- d) rated power in kVA and rated power factor;
- e) rated output voltage;
- f) rated output current;
- g) degree of protection;
- h) weight;
- o) serial number;

p) model.

6.11 The switchgear shall be provided with a supplementary identification plate made of series AISI 300 stainless steel containing at least the following data:

- a) Petróleo Brasileiro S.A. - PETROBRAS;
- b) name of PETROBRAS department;
- c) project name;
- d) UPS-CC identification;
- e) RM number;
- f) Purchase and Service Order number (PCS);
- g) as an alternative to f), the contract number, in case the acquisition is made under a Turn Key, Lump Sum, and other similar types of contracts.

7 Electrical Characteristics

7.1 The UPS-CC shall be of the industrial type and operate with vented or valve-regulated lead acid alkaline batteries.

7.2 It shall be possible to select the rating of the UPS-CC through the command located on the front panel of the equipment, with the functions:

- a) float;
- b) manual recharge;
- c) automatic.

NOTE When the need for automatic recharge is indicated on the Data Sheet of Annex B, there shall also be the command for controlling MANUAL RECHARGE and AUTOMATIC RECHARGE situations.

7.2.1 Manual recharging shall be started manually and ended automatically for a specified period of time, adjusted by the user, or ended manually at any time.

7.2.2 Automatic recharging shall be ended in all cases due to idle current of the battery, returning automatically to the float regime.

7.3 Static regulation of the output voltage shall be ± 1 %, as per test conditions.

7.4 The dynamic regulation shall be less than 10 %, with time less than 100 ms, as per test conditions.

7.5 The current limiting device of the UPS-CC shall operate both in the float regime and in the recharge regime, allowing adjustment from 50 % to 100 % of the rated current of the UPS-CC.

7.6 The current limiting device for the battery shall operate both in the float regime and in the recharge regime and allow adjustment of the battery charging current to a maximum value, numerically equal to 0.25 times, for the acid battery, or 0.4 times, for the alkaline battery, the value of the rated capacity, in Ampere-hour (Ah), of the battery.

7.7 The maximum ripple shall be 2 % RMS rated output voltage without battery, or as requested on the Data Sheet of Annex B.

7.8 The efficiency shall be more than 90 % with 100 % of load.

7.9 The need for drop diodes and number of stages shall be indicated in the Data Sheet of Annex B.

7.10 The rectifier shall have a device allowing the adjustment of float and recharge voltages according to battery type and ambient temperature. When specified in the Data Sheet of Annex B, the battery float voltage shall be automatically corrected with the ambient temperature.

7.11 There shall be a control device requiring disconnection of the battery when the latter reaches the minimum discharge voltage.

7.12 Unless otherwise indicated on the Data Sheet of Annex B, the UPS-CC shall contain an alphanumeric digital display (IHM) to indicate the voltage and current variables, historical recording of failures, displaying of local alarms, setpoint parameter values:

- a) UPS-CC output current;
- b) battery current;
- c) battery voltage;
- d) consumer output voltage.

7.13 The diagnosed failures described in 7.16 shall be available in a memory accessible via digital communication, which may be archived and viewed on a portable computer. The UPS-CC shall keep in non-volatile memory a historical record of at least the last 200 events. The man-machine interface shall allow the reading of failures and events described in 7.19 through scrolls.

7.14 The UPS-CC shall be provided with a UPS-CC ON condition indicating pilot LED.

7.15 If requested on the Data Sheet of Annex B, the UPS-CC shall have a remote monitoring and communication system as described in PETROBRAS [N-2760](#) in the sections on the digital panel for local control, communication of the UPS-CC and configuration.

7.16 The UPS-CC shall be provided with the following local signaling devices, through high luminosity LEDs or alphanumeric displays:

- a) battery discharging;
- b) disconnected battery;
- c) discharged battery;
- d) overvoltage in battery;
- e) undervoltage in consumer;
- f) overvoltage in consumer;
- g) ac undervoltage;
- h) ac overvoltage;
- i) abnormal UPS-CC;
- j) lack of phase;
- k) DC leakage to ground at UPS-CC output;
- l) activation of fuses or other overcurrent protection devices at the UPS-CC input and in the circuits of the consumer and battery;
- m) summary of alarms.

NOTE 1 The summary of alarms shall not contain the alarm of dc leakage to ground at the UPS-CC output.

NOTE 2 If remote communication is requested on the Data Sheet of Annex B, the summary of alarms shall also be activated by loss of communication.

7.17 The UPS-CC shall have, at least, remote alarms of battery supplying load and summary of failures. These alarms shall be made available through voltage-free SPDT contacts.

7.18 As established in the Data Sheet of Annex B, the information shall be available through a serial communication and dry contacts, having a single pole and 2 positions, for remote alarm.

7.19 The UPS-CC shall contain protections inhibiting its operation at the time of failures that may cause physical damages to the UPS-CC and the consumer.

7.20 The UPS-CC input, the consumer outputs and the battery outputs shall be provided with suitable overcurrent protection with short-circuit capacity suitable to the short-circuit conditions indicated on the Data Sheet of Annex B. These devices shall be selective with the internal protection devices of the UPS-CC.

7.21 The UPS-CC shall be supplied with the following accessories:

- a) battery output disconnect device;
- b) UPS-CC power supply disconnect device;
- c) consumer output disconnect device.

7.22 The electrical insulation used in all components shall be non-hygroscopic and nonflammable.

7.23 If the UPS-CC is provided with an LED signaling, there shall be a test push button.

7.24 When specified on the Data Sheet of Annex B, there shall be a heating resistor with power supply at the indicated voltage. External power supply to the heating resistor shall be possible during the transportation and storage period without having to open the packaging. The temperature shall be controlled by an adjustable thermostat with a maximum adjustment value of 60 °C, supplied with the UPS-CC. The power supply voltage of heating resistor shall be clearly indicated in the external side of package.

8 Inspection and Tests

8.1 The supplier shall complete, on the Data Sheet of Annex A, the field corresponding to the list of standards applicable to the design, manufacturing, and testing of equipment.

8.2 The tests applicable to the UPS-CC are listed in Table 1, and the test descriptions shall be checked in Annex A, Test Definition. TAF and TAC tests to be presented are marked as per Data Sheet of Annex B.

Table 1 - List of Tests Applicable to UPS-CC

Test	Type	TAF	TAC
Control and monitoring signals		X	X
Check of interconnection cables		X	X
Test of UPS-CC auxiliary devices		X	X
Light load test		X	X
AC input voltage tolerance in permanent condition	X	X	
Inrush current	X		
UPS-CC output static tests		X	X
Degrees of load	X	X	
Input efficiency and power factor	X	X	
Emission	X		
Immunity (electromagnetic susceptibility)	X		
Ripple test (residual ripple)	X		
Harmonic components test	X	X	
Ground fault test	X	X	
Temperature rise test	X	X	
Electrical insulation	X	X	
Environmental tests	X		
Shock test	X		
Connector vibration and shock test	X		
Audible noise	X		

9 Documentation

9.1 The symbology used in the documentation to be submitted by the manufacturer, especially one-line and functional diagrams, shall be in accordance with PETROBRAS [N-898](#).

9.2 Required documents, drawings, and manuals shall be prepared in non-recordable and non-erasable digital media and also in printed media. "As purchased" and "as built" documents supplied in electronic medium shall be editable.

9.3 All documents shall be prepared minimum size A4, in a legible manner, and contain at least the following information:

- a) identification of PETROBRAS department;
- b) identification of operating unit;
- c) identification of project;
- d) RM number;
- e) UPS-CC number;
- f) Purchase and Service Order number (PCS);
- g) as an alternative to f), the contract number, in case the acquisition is made under a Turn Key, Lump Sum, and other similar types of contracts.

9.4 Minimum documentation that shall be submitted together with the bid for technical analysis:

- a) it shall be informed the maximum heat dissipation for ambient of equipment and component assembly in varied operation possibilities with rated load (normal mode, with battery in recharge; or stored energy mode, or alternate power supply mode);
- b) It shall be informed the characteristic of voltage versus current of battery current-limiting circuit;
- c) catalog of parts and components of UPS-CC, containing all technical information and characteristics;

- d) it shall be provided the full internal electronic diagrams, containing list of materials, in addition to block diagrams;
- e) block diagram, identifying the basic systems of UPS-CC and their interconnections;
- f) dimensional drawings of front and side views and cross-section of UPS-CC, with approximate dimensions;
- g) list of technical standards applicable to design, manufacturing and tests, relating to the country of origin of technology, followed by manufacturer, which supplement the list of technical standards in Chapter 2 of this Standard;
- h) Data Sheet completed and authenticated by the manufacturer, including the fields regarding standards applicable to design, manufacturing and tests of UPS-CC;
- i) control and quality plan to be performed, containing at least the tests and trials required in this Standard, supplemented by tests proposed by the manufacturer;

NOTE This test plan shall be detailed, containing all stages and procedures to be followed and performed during the construction of UPS-CC, with indications of used reference standards and their respective items.

- j) list of spare parts, as required in RM, with description of part-numbers and unit prices;
- k) approximate weight of UPS-CC;
- l) list of deviations or alternatives to specifications. Deviations will not be accepted in tests;
- m) the UPS-CC manufacturer shall present a supply list of similar equipment with minimum operation of 3 years;
- n) the UPS-CC manufacturer shall present a copy of the Type Tests required in this Standard.

9.5 Minimum documentation to be submitted for approval or acknowledgement:

- a) dimensional drawings of views and sections, including clear area for entry and exit of power and ground cables, thermal dissipation value, and weight of UPS-CC;
- b) location drawings, dimensions and types of devices used for attaching the UPS-CC;
- c) functional, control and wiring (interconnection) diagrams, indicating all terminal strips, including those needed for interconnection to other equipment or systems outside the manufacturer's scope of supply, clearly showing the identified terminals;
- d) drawings of input and output terminal strips of power and command circuits;
- e) list of all UPS-CC components, indicating at least the description, quantity, and complete coding of the manufacturer;
- f) one-line power diagram;
- g) power interface drawings;
- h) technical specifications for the UPS-CC, as well as for all components and accessories requested in accordance with:
 - all approved requirements of the original bid;
 - all revisions made at the time of technical clarifications and/or technical report;
- i) electronic diagrams of all printed circuit boards;
- k) list of spare parts with description of respective part-numbers of the component manufacturer.

9.6 After final approval of all documents mentioned in 9.4, the manufacturer shall submit the following specified documentation, as per 9.2, also subject to comments. The manuals shall be prepared in Portuguese and English, and organized according to the criteria below:

- a) diagrams and physical layouts of electronic cards;
- b) detailed description of operation of electronic cards, including the wave and adjustment forms;
- c) specification of required adjustments to UPS-CC;
- d) assembly and installation manual, containing at least the following information:
 - procedures for storage of the UPS-CC as well as of any spare element;
 - procedures and details for mechanical assembly and installation of the UPS-CC and accessories;
 - procedures and details of power and ground electrical connections;
- e) operating manual in Portuguese, as per 9.2, containing at least the following information:

- description of UPS-CC;
- theoretical basis;
- instructions for commissioning;
- procedures for implementation of parameterization functions and adjustments;
- list of error messages, occurrence conditions and respective corrective actions;
- operating procedures in case of failures and trips;
- f) preventive and corrective maintenance manual in Portuguese, as per 9.2, containing at least the following information:
 - description of circuit operation, with their respective wave forms;
 - procedures for performance of internal adjustments;
 - detailed procedures for performance of adjustments and tests, as well as the list of materials and resources required for their execution;
 - procedures for maintenance to be performed for each failure symptom presented;
 - methods for locating defects, using information obtained in auto-diagnosis system and test and measurement instruments;
 - diagrams and identification of internal components, terminal strips and printed circuit boards;
 - list of components, containing their commercial identifications, brands and models;
 - connection and wiring diagrams;
 - physical layout drawings of the UPS-CC;
 - technical catalogs with characteristic data of accessories requested “as built”;
 - copy of drawings “as built”;
 - Data Sheet duly filled out “as purchased” and/or “as built”;
 - copy of all reports of all tests to which the UPS-CC was subjected.

NOTE Technical specifications for the UPS-CC, as well as for all used components and accessories, in accordance with:

- a) all approved requirements of the original bid;
- b) all revisions made at the time of technical clarifications;
- c) and/or technical report.

Annex A - Standardization of Tests of Industrial UPS-CC**A.1 General Conditions**

The tests defined in this document shall be performed in each unit of the UPS-CC assembly.

A.2 Requirements for Measurement Instruments

A.2.1 Measurement equipment and instruments used in test shall have certificates of calibration.

A.2.2 Instruments for measurement of electrical parameters shall have sufficient pass band to precisely measure real efficient values (True RMS) of wave forms which may be other than fundamental sinusoid, in order words, with significant harmonic content..

A.2.3 recording instrument (Ex. Oscilloscope with memory or oscillograph) with at least 4 galvanically insulated channels, CAT III (600 Vac), with x10, x100 voltage probes, current probes for 10 /100 /1 000 A, precision 0.2% and accuracy 3.5 digits.

A.3 Requirements for Test Load

The load to be used in all tests described shall be resistive, with tolerance of 5% and power factor $\geq 98\%$. The load shall have dynamic response under 20 ms $\pm 5\%$, after the temperature stabilizes.

A.4 Preliminary Tests (IEC 62040-3)

The tests described in this subsection shall be performed so as to check the correct assembly of the equipment before the main tests.

A.4.1 Control and Monitoring Signals

The operation of indications and signals shall be checked in all performed tests. Gauge tests shall be performed in all measurement equipment items of UPS-CC, including components for remote measuring through industrial networks. The manufacturer shall supply means to perform these measurements.

A.4.2 Check of Interconnection Cables

The test shall be performed after connecting the functional units which comprise the full UPS-CC. This test shall be performed in factory or at the installation site.

NOTE It shall be checked the phase and torque sequence in all power cables. For remote alarm cables, all connections shall be checked, as well as the proper torque in their connectors.

A.4.3 Test of UPS-CC Auxiliary Devices

Functionalities of the UPS-CC auxiliary devices, such as lighting, cooling, pumps, vents, alarms, and optional devices, shall be checked in the light load test or during other tests.

A.4.4 Light Load Test

A.4.4.1 Test Condition

This test shall be performed to check if the UPS-CC is correctly connected and if all functions are operating. The tests below shall be performed with or without the battery bank.

A.4.4.2 Measurements and checks:

- a) output voltage;
- b) operation of everything with controls, alarms, event logs, measurements and other means required for proper operation of the UPS-CC.

A.4.4.3 Acceptance Criterion

The UPS-CC functionalities shall be in accordance with the manufacturer's manual.

A.5 UPS-CC Input Feed Tests (IEC 62040-3)

The UPS-CC shall be in normal operating mode with rated output load. The input feed shall come from a variable voltage/frequency generator, which output impedance able to keep the voltage wave form within the limits of IEC 61000-2-2. In tests in which the frequency variation is not required, the UPS-CC may be fed by electrical power grid.

A.5.1 AC Input Voltage Tolerance in Permanent Condition

A.5.1.1 Test Condition

With the UPS-CC in normal operating mode and rated input frequency, the input voltage shall be adjusted to minimum and maximum values of tolerance range of $\pm 10\%$ of rated voltage, or higher values indicated by the manufacturer, until the stabilization of UPS-CC.

A.5.1.2 Measurements and Checks

The output voltage shall be measured and its tolerance registered in maximum and minimum input voltages.

A.5.1.3 Acceptance Criterion

The equipment shall operate normally and without damaging itself.

A.5.2 Inrush Current

A.5.2.1 Test Condition

- a) the Inrush current test shall be performed under two input voltage fault conditions:
 - after a lack of input voltage for more than 5 minutes;
 - after a lack of input voltage of 1s;
- b) the test shall be performed with no battery and no load;
- c) the UPS-CC shall be energized 10 times asynchronously and randomly for each condition of lack of voltage, so as to determine the worst case condition of inrush current:

- in units coupled to a transformer, when energized in zero voltage point;
- for resistive or capacitive loads, in peak of voltage wave form of input feed, or near it;
- d) for this test, initial current surges due to energizing of RFI capacitors in input filters with duration under 1ms shall be ignored;
- e) high frequency current transformers shall be used for oscillographic record;
- f) for this test, it shall be considered the manufacturer's standard complete UPS-CC, excluding voltage adapting transformers requested for specific use.

A.5.2.2 Measurements and Checks

- a) oscillographic record of UPS-CC Inrush current;
- b) oscillographic record of voltage at the moment of closing the switch energizing the UPS-CC, used as a trigger reference.

A.5.2.3 Acceptance Criterion

Maximum RMS Inrush current shall not be higher than $15 \times I_{rated}$, and the duration shall not be longer than two cycles.

A.6 UPS-CC Output Dynamic Tests (IEC 62040-3)

A.6.1 Degrees of Load (IEC 62040-3)

A.6.1.1 Test Condition:

- a) with the UPS-CC under normal operating mode and rated input voltage, apply a degree of resistive load equal to 100% of output power with no battery;
- f) for this test, it shall be considered the manufacturer's standard complete UPS-CC, excluding voltage adapting transformers requested for specific use.

A.6.1.2 Measurements and checks:

- a) oscillographic record of UPS-CC output voltage;
- b) reduce the load to 0%. Repeat previous measurements at the moment of disconnection, and compute the value which shall remain within the established limits;
- c) repeat the test 10 times and consider the worst case result.

A.6.1.3 Acceptance Criterion

According to Static and Dynamic Regulation established.

A.6.2 Input Efficiency and Power Factor

A.6.2.1 Test Condition:

- a) stable input conditions shall be reached;
- b) with the UPS-CC under normal operating mode and rated input voltage, apply 100 % of rated output power;
- f) for this test, it shall be considered the manufacturer's standard complete UPS-CC, excluding voltage adapting transformers requested for specific use.

A.6.2.2 Measurements and Checks

Record the following input and output parameters for each load condition established in test condition:

- a) current;
- b) voltage;
- c) power.

A.6.2.3 Acceptance Criterion:

- a) efficiency shall be better than 90 %;
- b) input power factor shall higher than 0.75 inductive.

A.7 Emission, Radio Frequency Interference Supportability and Conducted Noise Tests (see IEC [62040-2](#) e [62040-3](#))

A.7.1 Emission

A.7.1.1 Test Condition

- a) in accordance with 4.18 of this Standard;
- b) rated input voltage;
- c) in normal operating mode and accumulated energy mode;
- d) load resulting in the highest levels of emission;
- e) the installation site conditions shall not cause deviations due to pre-existing emissions in site and to emissions caused by equipment fed by the UPS-CC;
- d) measurements shall be made in operating mode that produces the highest emission in frequency range;
- e) Average and Quasi-peak detecting receptors shall comply with IEC [CISPR 16-1-1](#) and [CISPR 16-1-2](#).

A.7.1.2 Acceptance Criterion

Ensure that disturbances generated by UPS-CC in normal operation do not reach level which may prevent other equipment items from operating as intended. The limits established in IEC [62040-2](#) about interference in feeding terminals, interference in AC output and electromagnetic emission shall not be exceeded.

A.7.2 Immunity (Electromagnetic Susceptibility)

A.7.2.1 Test Condition:

- a) rated input voltage;
- b) normal mode operations;
- c) linear load in rated output power.

A.7.2.2 Acceptance Criterion

The UPS-CC shall comply with established criteria of IEC [62040-2](#).

A.8 Ripple Test (Residual Ripple) (see IEC 62040-3)**A.8.1 Test Condition**

The test shall be performed with rated active load applied to the UPS-CC, with stabilized internal temperature and disconnected battery.

A.8.2 Measurements and Checks

Ripple voltage in direct current bar.

A.8.3 Acceptance Criterion

The output voltage ripple of the UPS-CC shall not exceed effective 2 % with disconnected battery.

A.9 Harmonic Components Test (see IEC 62040-3)**A.9.1 Test Conditions:**

- a) the test shall be performed with rated load applied to the UPS-CC;
- b) the AC input power supply shall be within the limits specified in IEC 60146-1-1.

A.9.2 Measurements and checks:

- a) input voltage and current;
- b) individual harmonics and input current THD.

A.9.3 Acceptance Criterion

$THDi \leq 10 \%$ (UPS-CC input current).

A.10 Ground Fault Test (see IEC 62040-1)**A.10.1 Test Condition**

The UPS-CC output is insulated from ground, and loads are also insulated, counting on earth leakage detectors.

A.10.2 Measurements and Checks

Apply a ground fault through impedance, as specified in Data Sheet, to any output terminals and check the alarms, repeating the procedure for the other terminal.

A.10.3 Acceptance Criterion

The earth leakage indication shall occur from the leakage impedance value specified in Data Sheet.

A.11 Temperature Rise Test (see IEC 62040-3)

A.11.1 Test Condition:

- a) the temperature rise test of the UPS-CC shall be performed in the most critical condition to the equipment (maximum current);
- b) the UPS-CC to be tested shall have its temperature stabilized;
- c) AC input for the UPS-CC shall be in the minimum value within the admissible range of normal operation of the UPS-CC.

A.11.2 Measurements and Checks:

- a) the output voltage shall remain within the admissible range of normal operation, as specified;
- b) temperature conditions of UPS-CC cabinets shall be monitored;
- c) all critical components of UPS-CC (transformers, power supply electrolytic capacitors, UPS-CCa bridge, etc.) shall be monitored.

A.11.3 Acceptance Criterion

The internal temperature rise of electronic components, added to the ambient temperature of 40 °C, shall not exceed 80 % of its industrial line tolerance range used by the manufacturer.

A.12 Electrical Insulation (see IEC 62040-1)

A.12.1 Test Condition

Voltages specified in Table A.1 shall be applied to indicated circuits for one minute.

Table A.1 - Electrical Insulation

Measurement points	Electronic control circuits < 63 V	Power devices V1 (AC)	Auxiliary circuits V2 (AC)
	Withstand voltage		
To ground	700 VDC	$2 \times V1 + 1\,000\text{ V}$	$2 \times V2 + 1\,000\text{ V}$
For electronic control circuits	-	$2 \times V1 + 1\,000\text{ V}$	$2 \times V2 + 1\,000\text{ V}$
For power devices	$2 \times V1 + 1\,000\text{ V}$	-	$2 \times V1 + 1\,000\text{ V}$
For auxiliary circuits	$2 \times V2 + 1\,000\text{ V}$	$2 \times V1 + 1\,000\text{ V}$	-
NOTE DC instead of AC test voltage may be applied, but the magnitude shall be multiplied by 1.4.			

A.12.2 Measurements and checks according to Table A.1.

A.12.3 Acceptance criterion according to Table A.1.

A.13 Non-Electric Tests (see IEC 62040-3)**A.13.1 Environmental Tests**

Storage and operating tests under adverse weather conditions (cold, moist heat, dry heat, etc.) shall be performed as per IEC 62040-3.

A.13.2 Vibration and Shock Test (see IEC 62040-3)**A.13.2.1 Shock Test****A.13.2.1.1 Test Condition:**

- a) before the test, the UPS-CC output voltage shall be checked. During the test performance, the UPS-CC shall be in operating mode;
- b) the UPS-CC shall be subjected to two shock pulses of half sine of 15 g, with nominal duration of 11 ms, in the three plans. The test method indicated in IEC 60068-2-27 shall be followed;
- c) no reading shall be done during test.

A.13.2.1.2 Measurements and Checks:

- a) perform new UPS-CC output voltage measurement;
- b) check for physical damage and distortion of component parts.

A.13.2.1.3 Acceptance Criterion

Measurements shall be the same checked before testing.

A.13.2.2 Free Drop Test (IEC 62040-3)

This test shall be performed as described in IEC 62040-3.

A.13.2.3 Vibration and Shock Test of Connectors (see IEC 60068-2-6 and 60068-2-27)**A.13.2.3.1 Test Condition**

- a) all connectors used in all equipment items comprising the power supply critical systems shall comply with the tests, in accordance with IEC 60068-2-6 for sinusoidal vibration test, and with IEC 60068-2-27 for shock test;
- b) the equipment manufacturer shall supply the test report of used connectors. When the report is issued by a third-party laboratory, this shall be registered in the official bodies of the country of origin. If the report is issued by the manufacturer itself, PETROBRAS shall perform an initial inspection to authorize the supplying of the given connectors;
- c) parameters for the tests above comply with Tables A.2 and A.3.

Table A.2 - Sinusoidal Vibration Test

Frequency Range	5 Hz to 150 Hz
Cross-Over Frequency	25 Hz
Displacement amplitude below cross-over frequency	2 mm
Acceleration amplitude above cross-over frequency	5 g
Axes	X, Y, Z
Test Length	2 hours in each axis

Table A.3 - Shock Test

Pulse form	Half-wave
Peak acceleration	5 g
Corresponding length of rated pulse	50 ms
Number of shocks in each of the six directions	3
Axis	X, Y, Z (positive and negative)

A.3.2.3.2 Acceptance Criterion

Do not present physical damage and poor contact in wiring.

A.14 Audible Noise (see IEC 62040-3 and ISO 7779)**A.14.1 Test Condition:**


- a) the measurements shall be performed with the UPS-CC under normal operating mode, fed with rated voltage, under rated load;
- b) it shall be considered the operating mode which causes the highest value of audible noise;
- c) in equipment items with automatic fans, the fans shall be turned on. Sound alarms shall not be considered in measurement.


A.14.2 Measurements and Checks:


- a) the measurement method specified in ISO 7779 shall be used, considering the equipment use position;
- b) audible noise levels shall be determined in acoustic decibels (dBA) one meter away from the equipment item.

A.14.3 Acceptance Criterion

UPS-CC acoustic noise level under 75 dBA.

	Data Sheet		No.:						
	CLIENT:							SHEET:	
	PROGRAM:							of	
	AREA:								
	TITLE: Uninterruptible Power System - Continuous Current for Industrial Use								
REVISION INDEX									
REV.	DESCRIPTION AND/OR REVISED SHEETS								
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE									
DESIGN									
EXECUTION									
CHECK									
APPROVAL									
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FORM OWNED TO PETROBRAS N-332 REV. E ANNEX A- SHEET 01/03.									

	Data Sheet		No.		REV.		
	TITLE: Uninterruptible Power System - Continuous Current for Industrial Use				SHEET		
					of		
DOCUMENTATION							
THIS DATA SHEET IS COMPLETED BY THE FOLLOWING REFERENCE DOCUMENT: PETROBRAS N-332							
1	TAG		20	RECTIFIER POWER FACTOR:			
2	ENVIRONMENTAL CHARACTERISTICS		21	DEGREE OF MECHANICAL PROTECTION IP -			
	INSTALLATION:		22	FINAL FINISH COLOR <i>Light gray – Munsel N 6.5</i>			
	SHELTERED: YES		23	ENTRY AND EXIT OF CABLES LOWER			
	OUTDOOR: NO		24	COOLING NATURAL			
	AMBIENT TEMPERATURE: to °C		25	BATTERY SHUT DOWN BY MINIMUM VOLTAGE			
	ALTITUDE: m		26	EXTERNAL DIMENSIONS			
	PROXIMITY TO SEA:			LENGTH: mm			
	RELATIVE HUMIDITY:			WIDTH: mm			
	CHARACTERISTIC ATMOSPHERE:			HEIGHT: mm			
3	SPECIAL SERVICE CONDITIONS:		27	ANTICORROSIVE TREATMENT MANUFACTURER STANDARD			
			28	FLOOR TYPE FOR SWITCH ATTACHMENT CONCRETE			
			29	DISTRIBUTION CENTER DCS			
4	POWER SUPPLY SOURCE		30	DEVICES			
	VOLTAGE 480 V			31.1	INSULATION MONITORING SYSTEM		
	No. PHASES: 3			31.2	AUTOMATIC RECHARGE		
	FREQUENCY 60 Hz			31.3	EARTH LEAKAGE MINIMUM IMPEDANCE		
	SHORT-CIRCUIT CURRENT kA			31.4	SUPERV. AND REMOTE COMMUNICATION SYSTEM YES		
	GROUNDED NEUTRAL SYSTEM				PHYSICAL MEAN RS485 PROTOCOL MODBUS		
5	BATTERY DATA:		31.5	CONSUMER VOLTAGE CONTROL			
	BATTERY RATED CAPACITY: Ah/h			31.7.1	DROP DIODES		
	BATTERY RECHARGE REGIME 0.1 C 10			31.7.2	NUMBER OF STAGES:		
6	DIRECT CURRENT SYSTEM CHARACTERISTICS		31.7.3	RATED CAPACITY: A			
	6.1	RATED VOLTAGE: V	31.6	DIGITAL ALPHANUMERIC DISPLAY (HMI) YES			
	6.2	MAXIMUM VOLTAGE AT CONSUMER: V	31.7	VOLTMETER AT AC CIRCUIT NO			
	6.3	MINIMUM VOLTAGE AT CONSUMER: V	31.8	VOLTMETER OF BATTERY NO			
	6.4	CONSUMER CURRENT	31.9	VOLTMETER AT CONSUMER OUTPUT NO			
		6.4.1	MINIMUM CURRENT: A	31.10	AMMETER AT AC. CIRCUIT NO		
		6.4.2	MAXIMUM CURRENT: A	31.11	AMMETER AT RECTIFIER OUTPUT NO		
		6.4.3	MOMENTARY PEAK CURRENT: A in MS	31.12	AMMETER AT OUTPUT TO BATTERY NO		
		6.5	SYSTEM WITH POLES Insulated	31	SIGNALING AND ALARM DEVICE		
	6.6	D.C. SHORT-CIRCUIT CURRENT			32.1	BATTERY DISCHARGING LOCAL AND REMOTE	
		6.6.1	BATTERY CONTRIBUTION: A		32.2	DISCHARGED BATTERY LOCAL	
6.6.2		RECTIFIER CONTRIBUTION: A	32.3		DISCONNECTED BATTERY LOCAL		
6.6.3		TOTAL CONTRIBUTION: A	32.4		BROKEN DC FUSE LOCAL		
7	RECTIFIER RATED CURRENT: A	32.5	OVERVOLTAGE IN BATTERY LOCAL				
8	FLUCTUATION VOLTAGE: V	32.6	UNDERVOLTAGE IN CONSUMER LOCAL				
9	RECHARGE VOLTAGE: V	32.7	OVERVOLTAGE IN CONSUMER LOCAL				
10	FLUCTUATION VOLTAGE ADJUSTMENT RANGE: V	32.8	AC UNDERVOLTAGE LOCAL				
11	RECHARGE VOLTAGE ADJUSTMENT RANGE: V	32.9	AC OVERVOLTAGE LOCAL				
12	CURRENT LIMITING ADJUSTMENT RANGE: A	32.10	ABNORMAL RECTIFIER LOCAL				
13	AUTOMATIC CORRECTION OF BATTERY FLUCTUATION VOLTAGE ACCORDING TO TEMPERATURE NO		32.11	LACK OF PHASE LOCAL			
14	NUMBER OF PULSES OF RECTIFIER: 6	32	32.12	D.C. EARTH LEAKAGE LOCAL AND REMOTE			
15	RECTIFYING CIRCUIT: THREE-PHASE		32.13	ACTUATION OF OVERCUR. PROT. LOCAL			
16	VOLTAGE RIPPLE: %		32.14	SUMMARY OF ALARMS LOCAL AND REMOTE			
17	STATIC/DYNAMIC REGULATION: ± % / % ms		ACCESSORIES				
18	RECTIFIER CONSUMPTION: kW		32.1	CABLE ENTRY TERMINAL (a.c.): mm²			
19	RECTIFIER EFFICIENCY: %	32.2	CABLE EXIT TERMINAL (d.c.) mm²				
			32.2.1	BATTERY: mm²			
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 PETROBRAS		Data Sheet		No.		REV.	
						SHEET	
						of	
		Uninterruptible Power System - Continuous Current for Industrial Use					

32	32.2.2	CONSUMER:	mm ²				
	32.3	TERMINAL FOR HOUSING GROUND			32.5	ANCHOR BOLT	YES
	32.3.1	NOMINAL SECTION	mm ²		32.6	LIFTING LOOP	YES
	32.3.2	EXTERNAL			32.7	REMOTE INDICATION OF DEFECT	YES
	32.3	HEATING RESISTOR	YES		32.8	WIRE ROPE GRIPS	YES
		POWER W / VOLTAGE	V		32.9	TYPE OF CABLE:	
	32.4	SUPPORT FOR FLOOR ATTACHMENT	YES				

33 - APPLICABLE STANDARDIZATION

33.1 ENTITIES:

ABNT ☐ IEC ☒ IEEE ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐

ENTITY	No. OF STANDARD
	DESIGN / FABRICATION TESTS

34 – LIST OF TESTS, AS PER ANNEX A OF STANDARD PETROBRAS N- 332.

TEST	Type	TAF	TAC
Control and monitoring signals	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Check of interconnection cables	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Test of UPS-CC auxiliary devices	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Light load test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
AC input voltage tolerance in permanent condition	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Inrush current	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UPS-CC output static tests	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Degrees of load	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Input efficiency and power factor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Emission	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Immunity (electromagnetic susceptibility)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ripple test (residual ripple)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Harmonic components test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ground fault test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Temperature rise test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Electrical insulation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Environmental tests	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shock test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Connector vibration and shock test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Audible noise	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NOTES:

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REV. A, B and C

There is no index of revisions.

REV. D

Affected Parts	Description of Alteration
	All items

REV. E

[illegible]