

CONTECComissão de Normalização
Técnica**SC-11**

Machines

**Centrifugal Pumps for Petroleum,
Petrochemical and Natural Gas Industries****1st Amendment**

This is the 1st Amendment to PETROBRAS N-553 REV. E and it is used to alter the text of the Standard in the parts indicated below:

NOTE 1 The news pages with the performed amendments are placed in its corresponding positions.

NOTE 2 The amended pages, indicated the date of the amendment, are placed at the end of this standard, in chronological order, and shall not be used.

CONTENTS OF THE 1st AMENDMENT - 04/2015

- Section 2:

Exclusion of ISO 10441 and ISO 21049 and replace ISO 13709:2009 by API [STD 610:2010](#).

- All Sections and Subsections:

Replace ISO 13709:2009 by API [STD 610:2010](#).

- Subsection 7.25:

Replace ISO 21049 by API [STD 682](#).

- Subsection 7.29:

Replace ISO 21049 by API [STD 682](#).

- Subsection 8.4:

Exclusion of ISO 10441.

- Annex A - Sheet 03 and 04:

Replace ISO 13709:2009 by API [STD 610:2010](#).

- Annex B - Sheet 03 and 04:

Replace ISO 13709:2009 by API [STD 610:2010](#).

- Annex C - Sheet 02:

Replace ISO 13709:2009 by API [STD 610:2010](#).

- Annex G - Sheet 03:

Replace ISO 21049 by API [STD 682](#).

Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

Specification

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.

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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 04/2013) of PETROBRAS N-553 REV. E 04/2013. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

This Standard is based on API [STD 610:2010](#) (Eleventh Edition).

1 Scope

1.1 This Standard establishes the minimum conditions required for centrifugal pumps and their auxiliary systems for refinery services, process plants and the like, to be supplied in accordance with API [STD 610:2010](#).

1.2 Pumps shall be in accordance with API [STD 610:2010](#), plus the changes indicated in the paragraphs of this Standard, according to the description stated below:

- Addition: continuation of the paragraph indicated in parenthesis of API [STD 610:2010](#);
- Modification: replacement of part of the paragraph indicated in parenthesis of API [STD 610:2010](#);
- Substitution: total replacement of the paragraph indicated in parenthesis of API [STD 610:2010](#);
- New: insertion of a paragraph not found in API [STD 610:2010](#);
- Deletion: removal of the paragraph indicated in parenthesis of API [STD 610:2010](#).

NOTE 1 PETROBRAS considers all items of API [STD 610:2010](#), other than those mentioned herein, as valid to this Standard.

NOTE 2 All paragraphs, tables, annexes etc mentioned in paragraphs of API [STD 610:2010](#) that was changed herein shall be considered when read in API [STD 610:2010](#) according to the new terminology adopted in this Standard. For example, although paragraph 8.2.2.1 of API [STD 610:2010](#) has not been changed herein, Table 14, which is mentioned in this paragraph shall be read as "Table 1 of PETROBRAS N-553", because Table 14 of API [STD 610:2010](#) was replaced by Table 1 of this Standard.

1.3 All deviations from the requirements in this Standard and/or API [STD 610:2010](#) must be clearly identified in the proposal and submitted to PETROBRAS for approval. Any deviation from the requirements or from any of the listed documents in material requisition, not clearly mentioned in the proposal will be considered by PETROBRAS as full compliance with the material requisition.

1.4 Vendor's compliance with the requirements in this Standard and/or API [STD 610:2010](#) does not exempt him from the responsibility of supplying equipment and accessories suitable for the specified service conditions.

1.5 This Standard applies to design starting from its issue date.

1.6 This Standard only contains 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-906](#) - Medium Duty Centrifugal Pumps;

PETROBRAS [N-2919](#) - Motores Elétricos Trifásicos de Indução ou Síncronos;

ISO [1940-1](#) - Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances;

ISO [4200](#) - Plain End Steel Tubes, Welded and Seamless - General Tables of Dimensions and Masses per Unit Length;

ISO [4991](#) - Steel Castings for Pressure Purposes;

ISO [9712](#) - Non-Destructive Testing - Qualification and Certification of Personnel;

ISO [10684](#) - Fasteners Hot Dip Galvanized Coatings;

ISO/IEC [17024](#) - Conformity Assessment - General Requirements for Bodies Operating Certification of Persons;

ANSI/HI [9.6.7](#) - Effects of Liquid Viscosity on Rotodynamic (Centrifugal and Vertical) Pump Performance;

API [STD 610:2010](#) - Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries;

API [STD 671](#) - Special-Purpose Couplings for Petroleum, Chemical and Gas Industry Services;

API [STD 682](#) - Pumps - Shaft Sealing Systems for Centrifugal and Rotary Pumps;

ASME [BPVC Section V](#) - Nondestructive Examination;

ASME [BPVC Section VIII Division 1](#) - Rules for Construction of Pressure Vessels;

ASTM [A153/A153M](#) - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware;

ASTM [A193/A193M](#) - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications;

ASTM [A352/A352M](#) - Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service;

ASTM [B 841](#) - Standard Specification for Electrodeposited Coatings of Zinc Nickel Alloy Deposits;

ASTM [B 849](#) - Standard Specification for Pre-Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement;

ASTM [B 850](#) - Standard Guide for Post-Coating Treatments of Steel for Reducing Risk of Hydrogen Embrittlement;

ASTM [E 388](#) - Standard Test Method for Wavelength Accuracy and Spectral Bandwidth of Fluorescence Spectrometers;

MSS [SP55](#) - Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities

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 apply.

3.1 New (3.65) hazardous service

refers to the service where pumped liquid presents any characteristic below:

- a) H₂S (Hydrogen Sulphide) concentrations above 500 ppm (mass);
- b) hydrocarbons with hydrogen at a partial pressure above 700 kPa (abs);
- c) hydrocarbons at pumping temperatures above their auto-ignition temperatures;
- d) other toxic and lethal substances, which will result in death or permanent personal injury through inhalation, exposition, or contact, to be specified and defined in the inquiry documents.

3.2 New (3.66) labyrinth “L” type

shaft seal applied in bearing housing which design contemplate only one deflector that allows air circulation through the bearing housing.

3.3 New (3.67) labyrinth “U” type

shaft seal applied in bearing housing which design contemplate two deflectors (internal and external) that obstruct air movement through the bearing housing.

3.4 New (3.68) Material Requisition (RM)

document that aims to establish the scope of supply, technical requirements and additional instructions required to acquisition of materials, systems and equipment.

4 Scope - Modification (Section 1 of API STD 610:2010)

Replace the third paragraph by: Pumps not handling hazardous fluids (hazardous services) and not exceeding any of the conditions below, shall comply with PETROBRAS N-906 instead of this PETROBRAS Standard.

- a) discharge pressure (gauge) of 1 900 kPa;
- b) suction pressure (gauge) of 500 kPa;
- c) pumping temperature of 150 °C for non-hydrocarbon and of 50 °C for hydrocarbon;
- d) rotative speed of 3 600 rpm;
- e) rated total head of 120 m;
- f) impeller diameter, overhung pumps of 330 mm.

5 General - Addition (4.2.2.7 of API STD 610:2010)

NOTE This pump type can be vertically or horizontally mounted.

6 Requirements (Section 5 of API STD 610:2010)

6.1 Modification (5.1 of API STD 610:2010)

Unless otherwise specified, data, drawings, and maintenance dimensions of pumps shall be in the International System of Units (SI).

6.2 Substitution (5.3.1 of API STD 610:2010)

In case of conflict between the inquiry documents, the following priority shall govern:

- 1º) data sheets;
- 2º) supplementary Job Specifications (if any);
- 3º) this PETROBRAS Standard and all other PETROBRAS Standards specifically referenced in the inquiry;
- 4º) API STD 610:2010.

Concerning any conflict after placement of order, the following priority shall govern:

- 1º) formal correspondence regarding any changes in the scope of supply or technical specifications, mutually agreed upon by PETROBRAS and vendor;
- 2º) approved documentation;
- 3º) revised data sheets and other material requisition documents (applicable to purchase);
- 4º) revised vendor's proposal (if any);
- 5º) this PETROBRAS Standard and all other PETROBRAS Standard specifically referenced in the inquiry or order;
- 6º) API STD 610:2010;
- 7º) vendor's proposal.

7 Basic Design (Section 6 of API STD 610:2010)

7.1 Substitution (6.1.4 of API STD 610:2010)

Pumps shall be capable of at least a 5 % head increase at rated conditions by replacement of the impeller(s) with one(s) of larger diameter or different hydraulic design. PETROBRAS may consider the use of variable speed and/or blank stages (to add impellers in the future) for multistage pump to meet this requirement.

7.2 Substitution (6.1.6 of API STD 610:2010)

Variable-speed pumps shall be designed for excursions to driver trip speed without damage.

7.3 Addition (6.1.8 of API STD 610:2010)

At rated flow, the NPSH available shall exceed the NPSH required by at least 0,8 m and the NPSH ratio ($NPSH_a / NPSH_r$) shall be at least 1,15. Nevertheless, some services may require larger NPSH margins to be either specified on data sheets or recommended by vendor.

7.4 Substitution (6.1.9 of API STD 610:2010)

The pump suction-specific speed shall be calculated in accordance with Annex A of API STD 610:2010 and shall be limited as follows:

- a) pumps (in general) shall not have N_{ss} greater than 213 (11 000, in English Units);

- b) the use of inducers shall be approved by PETROBRAS and, if used, shall be taken into account when calculating Nss. Higher Nss values (e.g. for OH6) shall be submitted for PETROBRAS' specific approval.

7.5 Addition (6.1.10 of API STD 610:2010)

Calculation sheets shall be submitted with proposal whenever operating conditions fall outside ANSI/HI 9.6.7 limits.

7.6 Substitution (6.1.11 of API STD 610:2010)

Pumps shall have stable head vs. flow curves (continuous head rise to shutoff) for all applications. If parallel operation is specified, the head rise from rated point to shutoff shall be at least 10 %.

Whenever orifices are used to correct lower head rises to shutoff, it shall be submitted to PETROBRAS for approval. Pumps for parallel operation shall be designed for adequate flow sharing, i.e., equal shutoff heads and similar performance curves. Whenever different models of pumps are to be operated in parallel (e.g., when a second pumps is purchased to operate with an already existing one), the differences among their shutoff heads and head rises shall be mutually agreed upon by PETROBRAS and vendor.

7.7 Modification (6.1.14 of API STD 610:2010)

Vendor shall provide both maximum sound pressure and sound power level data per octave band for the equipment. Control of the sound pressure level (SPL) of all equipment furnished shall be a joint effort of the purchaser and the vendor who has unit responsibility. The equipment furnished by the vendor (pump and driver train), unless otherwise specified on the data sheets, shall conform to the maximum allowable sound pressure level of 85 dB(A), slow-response, measured at 1 m from the equipment surfaces.

7.8 Addition (6.1.20 of API STD 610:2010)

Minimum temperature rise shall be 10 K.

7.9 New (6.1.35)

If fasteners are not required in stainless steel (Annex H of API STD 610:2010) they shall be low-alloy steel (e.g. ASTM A193/A193M, Grade B7) and coated with Zinc-Nickel according to ASTM B841, class 1, type B/E, grade 5 to 8, with stress and hydrogen relief treatment, according to ASTM B849 and ASTM B850. Alternatives may be offered and shall be agreed between purchaser and vendor.

7.10 New (6.1.36)

Diffusers or double volutes pumps are required for discharge nozzle sizes DN 100 (NPS 4) or larger.

7.11 Addition (6.2 of API STD 610:2010)

The following pumps configurations shall not be furnished unless approved by PETROBRAS for the specific application:

- a) rigidly or close coupled;
- b) two-stage overhung;
- c) double suction overhung;

- d) multistage ring-section single casing;
- e) vertical (other than in-line) above 1 800 rpm;
- f) OH1 construction.

7.12 Substitution (6.3.1 of API STD 610:2010)

The maximum discharge pressure shall be the maximum suction pressure plus the maximum differential pressure that the pump is able to develop (head at shutoff including all tolerances described in Table 16 of API STD 610:2010) when operating with the furnished impeller at the rated speed and maximum specified liquid relative density.

NOTE 1 If is specified more of one operational condition, the highest maximum discharge pressure shall be considered.

NOTE 2 The maximum discharge pressure shall not exceed pressure limitations for downstream piping and equipment as informed by purchaser on data sheet.

7.13 Deletion (6.3.2 of API STD 610:2010)

Removed from API STD 610:2010.

7.14 Addition (6.3.2 of API STD 610:2010)

- d) Driver maximum speed (in case of variable-speed pumps).

7.15 Substitution (6.3.6 of API STD 610:2010)

Except for wet pit and sump pumps, suction region shall be designed for the same MAWP as the discharge section.

7.16 Substitution (6.4.2.1 of API STD 610:2010)

Suction and discharge nozzles shall be flanged, except those on pumps with forged casings, which shall be flanged or machined and studded. Unless otherwise specified all pumps shall have suction and discharge nozzles of equal ratings.

NOTE When machined and studded suction and discharge nozzles are provided, short-length piping spool pieces shall be supplied with the pump, to minimize assembly/disassembly of machined and studded connections, and to avoid the need to remove large sections of piping in order to slide the pump out from under the piping during overhauls.

7.17 Substitution (6.4.2.4 of API STD 610:2010)

Flanges in all materials that are thicker or have a larger outside diameter than required by the relevant ISO (ASME) standards mentioned in API STD 610:2010 are not acceptable. Whenever nonstandard flanges are approved by purchaser, their respective companions shall also be furnished, which shall require studs or bolts of standard lengths.

NOTE The references for thickness dimension of flanges shall be on machined faces (full faced or spot faced on the back).

7.18 Substitution (6.4.3.14 of API STD 610:2010)

All pumps shall be provided with vent and drain connections, except that vent connections may be omitted if the pump is made self-venting by the arrangement of the nozzles. Pumps that are not self-venting shall be provided with vent connections in the pressure casing, as required (see 6.8.10 of API STD 610:2010). All pumps shall be provided so as to allow casing to be completely drained, except multistage pumps. In order to permit a complete drainage of the volute, a drain hole shall be provided at the low point of the inner volute of pumps with double volute construction whenever this results in an internal liquid trap. Valves shall be furnished for vent and drain connections.

As a guide, a pump is considered functionally self-venting if the nozzle arrangement and the casing configuration permit sufficient venting of gases from the first-stage impeller and volute area to prevent loss of prime during the starting sequence.

NOTE If the pump cannot be completely drained for geometrical reasons, it shall be stated in the proposal. The operating manual shall include a drawing indicating the quantity and location(s) of the liquid remaining in the pump.

7.19 Substitution (6.5.5 of API STD 610:2010)

Annex F of API STD 610:2010 methods shall not be used.

7.20 Substitution (6.6.1 of API STD 610:2010)

Impellers shall be fully enclosed type. Open impellers are not acceptable. Semi-open impellers are acceptable for low-flow, high-head pump design.

7.21 Substitution (6.6.2 of API STD 610:2010)

Impellers shall be single-piece casting or forging. Fabricated impellers require PETROBRAS approval.

7.22 Substitution (6.7.1 of API STD 610:2010)

Radial running clearances shall be used to limit internal leakage and, where necessary, balance axial thrust. Close axial clearances shall not be used to balance axial thrust. Impeller pumping vanes may be used on semi-open impellers to balance axial thrust.

Renewable wear rings shall be provided on both the casing and the impeller. Impellers with integral wear surfaces may be proposed for special cases only if PETROBRAS accepts all the explanation/reasons presented by vendor. Stationary split wear rings shall be used only with PETROBRAS approval.

7.23 Addition (6.7.2 of API STD 610:2010)

For hardenable materials with Brinell hardness below 400, stationary wear ring mating surface shall be harder than rotating wear ring mating surface. For impellers with integral wear surfaces, the impeller wear surface shall be harder than stationary wear ring mating surface.

7.24 Addition (6.7.4 of API STD 610:2010)

- a) Should the quoted equipment require a warm-up procedure in order to prevent excessive thermal stresses, transient misalignment or reduction of clearances, this procedure shall be clearly stated and fully detailed in the vendor's proposal and, afterwards, included in the Pump Operation Manual. Warm-up lines (usually small reverse flow bypasses) shall divert only from the check valve. These lines shall be properly sized to provide the required uniform heating without causing the pump in standby condition to run backwards (usually a restriction device is necessary);
- d) actual running clearances shall not be reduced to less than 50 % of their design values even though parts are assembled under the most unfavorable stacking up of tolerances, clearances and eccentricities.

7.25 Substitution (6.8.1 of API STD 610:2010)

Pumps shall be equipped with mechanical seals and sealing systems in accordance with API STD 682. Pump and seal interface dimensions shall be in accordance with Table 7 and Figure 26 of API STD 610:2010, except for OH2 pumps type where dimensions shall be in accordance with Annex D of this PETROBRAS Standard. The purchaser shall specify the category of seal required. The purchaser should use the data sheets in Annex C of this PETROBRAS Standard for this purpose.

7.26 Substitution (6.8.3 of API STD 610:2010)

The seal chamber shall conform to the dimensions shown in Figure 26 and Table 7 of API STD 610:2010, except for OH2 pumps type where dimensions shall be in accordance with Annex D of this PETROBRAS Standard. For pumps with flange and pressure ratings in excess of the minimum values in 6.3.5 of API STD 610:2010, the gland stud size and circle (d_3) may increase. Larger studs shall be furnished only if required to meet the stress requirements of 6.3.4 of API STD 610:2010 or to sufficiently compress spiral-wound gaskets in accordance with manufacturer's specifications. If any modification in gland stud and circle (d_3) is required, it shall be stated in proposal.

7.27 Addition (6.8.8 of API STD 610:2010)

A close-clearance (floating) carbon throttle bushing shall be installed in the seal gland plate for arrangement 1 if the temperature exceeds 80 °C. The connection of the drain (outer seal) shall be at least 3/8 in NPT and the minimum diameter of the hole in the gland plate for drain (outer seal) shall be 3/16 in and be located at the lowest part of the seal gland plate.

7.28 Addition (6.8.13 of API STD 610:2010)

The mechanical seals shall be designed to withstand statically the maximum discharge pressure that the pump can develop as per defined in 7.12 of this PETROBRAS Standard, limited to 4 200 kPa (abs). For pump maximum discharge pressures higher than 4 200 kPa (abs), PETROBRAS and vendor shall agree on the maximum static sealing pressure.

7.29 New (6.8.14)

The seal leakage acceptance criteria shall be according to API STD 682. The seal leakage during the tests shall be within the limits defined in API STD 682. For higher seal leakages, the purchaser and the vendor shall agree on this value.

7.30 New (6.8.15)

Unless otherwise specified, but not limited to, double seal arrangements shall be used with:

- a) seal chamber vapour pressures above 400 kPa (abs) at 40 °C for hydrocarbons;
- b) services with H₂S, under the following conditions:
 - concentrations above 10 ppm (mass) for pumps located indoors;
 - concentrations above 500 ppm (mass) for pumps located outdoors. Double seal shall be non-pressurized from 500 ppm (mass) up to 5 000 ppm (mass). Double seal shall be pressurized above 5 000 ppm (mass);
- c) services with benzene content above 1 % (mass);
- d) other hazardous services, as per 3.1 of this PETROBRAS Standard.

7.31 Modification (6.9.3.3 of API STD 610:2010)

Replace the last sentence by: The plotted spectra shall be included with the pump test results.

7.32 New (6.9.4.5)

Balancing correction shall always be performed by means of mass removal. The reduction of wall thickness shall not exceed 30 % (at actual impeller tip), or the impeller shall otherwise be replaced.

7.33 New (6.9.4.6)

Rotor assembly balancing corrections at the coupling hub are not allowed, for any further hub replacement might compromise the pump overall vibration levels. Therefore, whenever any balancing of coupling hubs and spacers is required, it shall always be performed individually.

7.34 Substitution (6.10.1.7 of API STD 610:2010)

If loads exceed the capability of angular-contact bearings as described in 6.10.1.5 of API STD 610:2010, hydrodynamic bearings shall be used.

7.35 Addition (6.10.2.4 of API STD 610:2010)

- c) for oil mist systems, during shop testing bearing housing external surface temperature below 70 °C and outer ring / bearing metal temperatures shall not exceed 93 °C (if bearing-temperature sensors are supplied) and under the most adverse specified operating conditions, the bearing-oil housing temperature rise shall not exceed 35 K above the ambient temperature.

NOTE Vendor shall consider the highest bearing housing temperature. It is acceptable that the bearing housing contact seal temperature be higher than the bearing housing temperature. In case of use of non contact seal (labyrinth) the temperature should be the same as bearing housing.

7.36 Modification (Table 10 of API STD 610:2010)

Replace the second sentence of item “a” by: For ball bearings, factor nd_m for individual bearings shall not exceed 350 000 for oil lubricated and 150 000 for grease lubricated bearings.

7.37 Addition (6.10.2.6 of API STD 610:2010)

“U” type labyrinth shall be applied. “L” type labyrinth is not acceptable, except for BB and VS pumps. When specified for hermetic application, a special “U” type labyrinth with contact seal faces inside shall be provided.

7.38 Substitution (6.12.1.1 of API STD 610:2010)

The purchaser shall specify the material class for pump parts. Annex E of this Standard provides a guide showing material classes that can be appropriate for various services. Alternative materials recommended for the service by the vendor, including material that can improve life and performance in service, may also be included in the proposal and listed on the final data sheets.

7.39 Substitution (6.12.1.8 of API STD 610:2010)

The vendor shall furnish material certificates that include chemical analysis and mechanical properties for the heats from which the material is supplied for pressure-containing castings and forgings, impellers and shafts. These parts shall be identified with shop order number. Unless otherwise specified, piping nipples, auxiliary piping components, and bolting are excluded from this requirement.

7.40 Substitution (6.12.1.12.1 of API STD 610:2010)

Unless otherwise specified, reduced-hardness materials are required for services with H₂S concentration greater than 50 ppm (mass) and water in any concentration.

7.41 Deletion (6.12.2.3.b of API STD 610:2010)

Removed from API STD 610:2010.

7.42 Substitution (6.12.2.5 of API STD 610:2010)

For major casting repairs made in the vendor's shop and foundry, repair procedures including weld maps shall be submitted for purchaser's approval. The weld map shall be traceable. Vendor shall provide evidence of welding inspector participation during selection of welding procedures used for welds and welding repairs and post-weld heat-treatment. Major repairs made at vendor's shop and foundry level shall be controlled by the casting material specification ("producing specification").

7.43 Addition (6.12.3.2 of API STD 610:2010)

NOTE Weld repairs for pressure casings made of wrought materials shall be carried out only with purchaser's approval.

7.44 Modification (6.12.4.3 of API STD 610:2010)

ASME BPVC Section VIII Division 1 shall apply with regard to impact-testing requirements.

7.45 Substitution (6.13.3 of API STD 610:2010)

In addition to being stamped on the nameplate, the pump serial number and PETROBRAS TAG number shall be plainly and permanently marked on the pump casing.

8 Accessories (Section 7 of API STD 610:2010)**8.1 Addition (7.1.5 of API STD 610:2010)**

m) type of bearing and lubrication system.

8.2 Addition (7.2.2 of API STD 610:2010)

Unless otherwise specified, service factor shall be at least 1,25 for electric motor or steam turbine driven pumps.

8.3 Substitution (7.2.3 of API STD 610:2010)

Couplings shall be balanced to ISO 1940-1, grade G2.5 as minimum.

8.4 Addition (7.2.4 of API STD 610:2010)

Unless otherwise specified, couplings and coupling mountings shall conform to API STD 671 when the energy density (i. e. the product of pump rated power in kilowatts and rated speed in rpm) is $4,0 \times 10^6$ kW/min or greater.

8.5 Substitution (7.2.8 of API STD 610:2010)

For shaft diameters greater than 60 mm (2,5 in) and if it is necessary to remove the coupling hub to service the mechanical seal, the hub shall be mounted with a taper fit. The coupling fit taper for keyed couplings shall be 1 in 16 (60 mm/m, diametral). Other mounting methods and tapers shall be agreed upon by the PETROBRAS and the vendor. Coupling hubs with cylindrical bores shall not be supplied with slip fits to the shaft.

8.6 Addition (7.2.9 of API STD 610:2010)

Coupling hub mounting surface and shaft shall have a difference in Brinell hardness number of at least 50.

8.7 Modification (7.2.13 of API STD 610:2010)

Replace the item "d" by:

- d) be constructed of steel. Non-metallic (polymer) materials are not acceptable.
- e) the coupling guard design shall have opening to allow coupling visual inspection without its removal (e.g. inspection window).

NOTE Despite the design requirements described in a, b and c of item 7.2.13 of API STD 610:2010 are acceptable, providing the coupling guard as Patent PETROBRAS is preferable.

8.8 Modification (7.3.5 of API STD 610:2010)

Replace the second paragraph by: This requirement shall be demonstrated in the pump-vendor's shop with the baseplate supported on a leveled surface exclusively at the foundation bolts holes. Vendor shall provide a baseplate mounting pads flatness certificate.

8.9 Modification (7.3.6 of API STD 610:2010)

Replace the last sentence in the first paragraph by: Vendor can provide shims under the pump, after PETROBRAS approval, when the driver is a steam turbine and/or when there is a reducer or multiplier between pump and driver.

8.10 Modification (7.3.17 of API STD 610:2010)

Replace first sentence by: Transverse and axial alignment positioning jackscrews shall be provided for drive-train components having a mass greater than 100 kg to facilitate transverse horizontal and longitudinal adjustments.

8.11 Substitution (7.3.21 of API STD 610:2010)

Replace the paragraph by: Vendor shall test to demonstrate that the pump and its baseplate assembly, anchored at foundation bolt hole locations, are in compliance with 7.3.20 of API STD 610:2010 all pumps classified as inspection class II or III (Table 1 of this Standard). The pump casing shall be subjected to moments M_{Yc} and M_{Zc} applied to either nozzle, but not both, such that the corresponding shaft displacements can be measured and recorded. M_{Yc} and M_{Zc} shall not be applied simultaneously to either nozzle. The shaft displacement measurements shall be absolute (not relative to the baseplate). For record purposes, the vendor's test data shall include a schematic drawing of test set-up, the calculated moment loads (M_{Yc} and M_{Zc}), and the applied moment loads and their corresponding displacements at the drive end of the pump shaft.

NOTE Considering the same pump model/size and the same baseplate design, and already existing certificates approved by purchaser or by an independent and internationally recognized inspection / certification agency or institution, it is not necessary vendor carries out the nozzle load test. In these cases, vendor shall demonstrate the nozzle load test report approved by purchaser during the proposal phase.

8.12 Substitution (7.5.1.6 of API STD 610:2010)

Each piping system shall be manifolded to a single purchaser's inlet or outlet connection near the edge and within the confines of the baseplate.

8.13 Modification (7.5.1.7 of API STD 610:2010)

Replace the last sentence by: If the purchaser does not specify stainless steel fasteners, they shall be according to 7.9 of this Standard.

8.14 New (7.5.1.9)

Piping, valves and other appurtenances that are to be supplied by vendor shall comply also with the piping standardization specified by PETROBRAS.

8.15 New (7.5.1.10)

During assembly of the system before testing, each component (including cast-in passages of these components) and all piping and appurtenances shall be cleaned chemically or by another appropriate method to remove foreign materials, corrosion products, and mill scale.

8.16 New (7.5.1.11)

Slip-on or lap-joint type flanges are not allowed for parts in contact with pumped fluid.

8.17 Addition (7.5.2.3 of API STD 610:2010)

AISI 316 L stainless steel shall be used when chlorides are present in a concentration above 10 ppm (mass).

8.18 Substitution (7.5.2.5 of API STD 610:2010)

Drain manifold (when applicable) and drain valves shall be supplied for all pumps. The drain manifold shall be inside the drain pan limits.

8.19 Deletion (7.5.2.6 of API STD 610:2010)

Removed from API STD 610:2010.

8.20 New (7.5.2.11)

Flanges are required for balance lines, whatever the pumped liquid is, in order to facilitate removal and inspection.

9 Inspection, Testing, and Preparation for Shipment (Section 8 of API STD 610:2010)**9.1 Addition (8.1.1 of API STD 610:2010)**

- d) The vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser has specified to be witnessed or observed.
- e) The purchaser will specify the extent of his participation in the inspection and testing and the amount of advance notification required.
- f) When shop inspection and testing have been specified the purchaser and the vendor shall coordinate manufacturing hold points and inspector's visits.

9.2 Substitution (8.1.3 of API STD 610:2010)

After advance notification to the purchaser by the vendor, the purchaser's representative shall have entry to all vendor and sub-vendor plants where manufacturing, testing, or inspection of the equipment is in progress.

9.3 Addition (8.1.4 of API STD 610:2010)

Calibration schedules of the instruments to be used for inspection and testing shall be duly recorded for PETROBRAS review. The accuracy and/or resolution of these instruments shall be finer than the tolerance of what is to be measured. Test reports shall inform the type and serial number of instruments used during the test / inspection.

9.4 Modification (8.2.1.1 of API STD 610:2010)

Replace the item "c" by:

- c) details of all repairs and records of all heat-treatment performed as part of a repair procedure;

9.5 Addition (8.2.2.3 of API STD 610:2010)

- d) VI/MT/PT shall be performed after final machining, except for austenitic stainless and duplex / super-duplex steels.

- e) Inspections required by Table 1 of this Standard shall be performed again after any repair.

9.6 Addition (8.2.2.7 of API STD 610:2010)

Except for austenitic stainless steels, the hardness test of parts, welds, and heat-affected zones, when they are to be exposed to H₂S, shall be performed in order to verify if the hardness is within the allowable values.

9.7 Addition (8.3.1.1 of API STD 610:2010)

Regardless specification, if requested by the inspector, vendor shall present the test procedures only for information.

9.8 Modification (8.3.2.10 of API STD 610:2010)

Replace the first sentence by: Austenitic or duplex stainless steel pressure casing components shall be hydrostatically tested at the final machined condition.

9.9 New (8.3.2.17)

Vises or any other devices for clamp pressing of nozzle flanges shall not be used during hydrostatic test.

9.10 New (8.3.2.18)

PTFE tape or any threaded compounds shall not be used in order to help prevent leakage of threaded plugs and connections during hydrostatic tests.

9.11 Addition (8.3.3.1 of API STD 610:2010)

NOTE When assembled spare multistage rotors are supplied, they shall be tested according to the same procedures and tolerances as the main rotor.

9.12 Modification (8.3.3.2 of API STD 610:2010)

Replace the item "d" by:

- d) Seal leakage during test shall require the assembled pump and seal to be rerun to demonstrate satisfactory seal performance.

9.13 Modification (8.3.3.3 of API STD 610:2010)

Replace the item "a" by:

- a) The vendor shall take test data, including head, flow, power, and vibration at a minimum of five points. These points shall be:
- 1) shutoff (no vibration data required).
 - 2) minimum continuous stable flow.
 - 3) midway between minimum and rated flow.
 - 4) rated flow.
 - 5) end of allowable operating region.

Replace the item “c” by:

- c) Unless otherwise specified, the test speed shall be within 3 % of the rated speed shown on the pump data sheet. Test results shall be corrected to rated speed.

NOTE When the specified driver is an electric motor without variable speed drive, test results shall be corrected to actual driver speed.

9.14 Substitution (8.3.3.4 of API STD 610:2010)

For higher power pumps (drivers ≥ 1 MW), pump efficiency at rated flow shall be quoted to the tolerance -0 % and shall be included in the pump's rated performance.

NOTE The vendor shall include any cost and delivery impact during the proposal.

9.15 Modification (8.3.3.5 of API STD 610:2010)

Replace the items “a” and “b” by:

- a) Vibration values shall be recorded at each test point except shutoff during the test in accordance with 6.9.3.2 of API STD 610:2010. Vibration shall be measured at each point test flow ± 5 %. Vibration values shall not exceed those given in 6.9.3.6 of API STD 610:2010.
- b) For ring and splash oil systems, oil temperatures (at oil sump) and bearing temperatures shall be measured and recorded each 15 minutes up to temperature stabilization during the test. For pressurized systems, inlet and outlet oil temperatures (for each bearing) and bearing metal temperatures shall be measured and recorded each 15 minutes during the test.

Table 1 - Pressure Casing Material Inspection Requirements (Substitution of Table 14 of API [STD 610:2010](#))

Type of component	Requirements by inspection class ^a		
	I	II	III
-	Minimum	$P_{d_{max}} > 80 \% \text{ of MAWP}$ and $T_{max} > 200 \text{ }^{\circ}\text{C}$	$SG_{min} < 0,5$ or $T_{max} > 200 \text{ }^{\circ}\text{C}$ and $SG_{min} < 0,7$ or $T_{max} > 260 \text{ }^{\circ}\text{C}$ or Hazardous services ^e
Casing ^b : cast	VI	VI and 100 % MT or PT after final machining	VI and 100 % MT or PT after final machining and RT or UT of critical areas
Casing ^b : wrought ^c	VI	VI and MT or PT of critical areas	VI and MT or PT of critical areas and UT of critical areas
Nozzle weld: casing	VI and 100 % MT or PT	VI and 100 % MT or PT and 10 % RT or UT	VI and 100 % MT or PT and 100 % RT or UT
Auxiliary connection welds ^d	VI and 100 % MT or PT	VI and 100 % MT or PT	VI and 100 % MT or PT
Internals	VI	VI	VI and 100 % UT in the shaft (raw material) ^f and 100 % MT or PT on the impellers
Auxiliary process piping ^g : socket-welded	VI	VI and 100 % MT or PT	VI and 100 % MT or PT
Auxiliary process piping ^g : butt-welded	VI and 5 % RT	VI and 100 % MT or PT and 5 % RT	VI and 100 % MT or PT and 10 % RT

a Definition of abbreviations:

VI: Visual inspection
MT: Magnetic particle inspection
PT: Liquid penetrant inspection

RT: Radiographic inspection
UT: Ultrasonic examination

$P_{d_{max}}$: Maximum discharge pressure (shutoff condition)

T_{max} : Maximum operation temperature

SG_{min} : Minimum operation specific gravity

b Casing includes all items of the pressure boundary of the finished pump casing (e.g. the casing itself and other parts, such as nozzles, flanges etc. attached to the casing). "Critical areas" are inlet nozzle locations, outlet nozzle locations and casing wall thickness changes. The manufacturer shall submit details of the critical areas proposed to receive MT/PT/RT/UT inspection for purchaser's approval.

c Wrought materials include forgings, plate and tubular products.

d Due to complex geometry and thickness variations, it is not practical to RT butt-welded auxiliary casing connections.

e Hazardous services, as specified in 3.1 of this Standard.

f Shafts with diameters of 100 mm (4 in) or greater shall be inspected with UT according to ASTM [E 388](#).

g As per defined on item 7.5.2.1 of API [STD 610:2010](#).

Table 2 - Materials Inspection Standards^a (Substitution of Table 15 of API STD 610:2010)

Type of inspection	Methods	Acceptance criteria	
		For fabrications	For castings
Radiography	ASME BPVC, Section V, Articles 2 and 22	ASME BPVC, Section VIII, Division 1, UW-51 (for 100 % radiography) and UW-52 (for spot radiography)	ASME BPVC, Section VIII, Division 1, Appendix 7
Ultrasonic inspection	ASME BPVC, Section V, Articles 5 and 23	ASME BPVC, Section VIII, Division 1, Appendix 12	ASME BPVC, Section VIII, Division 1, Appendix 7
Liquid penetrant inspection	ASME BPVC, Section V, Articles 6 and 24	ASME BPVC, Section VIII, Division 1, Appendix 8	ASME BPVC, Section VIII, Division 1, Appendix 7
Magnetic particle inspection	ASME BPVC, Section V, Articles 7 and 25	ASME BPVC, Section VIII, Division 1, Appendix 6	ASME BPVC, Section VIII, Division 1, Appendix 7
Visual Inspection (all surfaces)	ASME BPVC, Section V, Article 9 ^(a)	In accordance with the material specification and the manufacturer's documented procedures	MSS SP-55
<p>NOTE The method applied for casting shall be according to vendor's procedures.</p> <p>^a Inspectors for non-destructive testing – in order to perform visual, liquid penetrant, magnetic particle, radiographic and ultrasonic testing in Brazil, qualification and certification shall be according to the National System of Personnel Qualification and Certification in NDT – SNCQ/END, ABENDI, Brazil –, in conformity with ISO 9712. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in ISO/IEC 17024 and that operate in conformity with ISO 9712.</p>			

9.16 Modification (8.3.3.7 of API STD 610:2010)

Replace the items “a”, “b” and “c” by:

- a) If it is necessary to dismantle a pump after the performance test for the sole purpose of machining impellers to meet the tolerances for head, no retest is required unless the reduction in diameter exceeds 5 % of the original diameter. The diameter of the impeller at the time of shop test, as well as the final diameter of the impeller, shall be recorded on a certified shop test curve that shows the operating characteristics after the diameter of the impeller has been reduced. A dynamic balance check of impellers machined shall be performed and recorded.

If the head adjustment requires reduction more than 5 % of the original impeller diameter, a dynamic balance check, mechanical test, performance test and NPSHr test shall be performed and duly recorded.

NOTE NPSHr test shall be retest when it is applicable.

- b) Disassembly of multistage pumps for any head adjustment (including less than 5 % diameter change) after test, shall be cause for retest.
- c) If it is necessary to dismantle a pump for any other correction (including any seal correction), such as hydraulic performance or mechanical operation, all initial tests shall not be acceptable, and all tests shall be run after the correction is made.

9.17 Substitution (8.3.3.8 of API STD 610:2010)

Pumps shall not be disassembled after final performance testing. The pump, including the seal chamber, shall be drained to the extent practical, filled with a water-displacing inhibitor within 4 h of testing and redrained.

9.18 New (8.3.3.9)

Hydrodynamic bearings shall be removed, inspected by the purchaser or his representative, and reassembled after the mechanical and performance tests are completed. An inspection report shall be included in the documentation. Antifriction bearings shall be partially disassembled for inspection and/or substitution only in case of any relevant abnormality is noticed during tests.

9.19 Substitution (8.3.4.1 of API STD 610:2010)

Unless otherwise specified, the mechanical run test described in 8.3.4.2 of API STD 610:2010 shall be performed. If specified, the shop tests described in 8.3.4.3 through 8.3.4.7 of API STD 610:2010 shall be performed. Test details and required data (such as vibration and temperature data) shall be agreed upon by the purchaser and the vendor prior to conducting the tests.

9.20 Substitution (8.3.4.2.1 of API STD 610:2010)

The pump shall be run on the test stand at the rated flow until oil and bearing temperature stabilization (6.10.2.4 of API STD 610:2010) has been achieved.

NOTE 1 Before taking test data, at least a one-hour warm-up period shall be awaited in order to such parameters stabilize or else, be considered steady enough to proceed.

NOTE 2 Stabilized temperature for oil and bearing shall be considered if there is no temperature rise more than 2 K during 30 minutes.

9.21 Substitution (8.3.4.2.2 of API STD 610:2010)

The pump shall be mechanically run at the rated flow for 4 h if, at least, one of the criteria below is met:

- a) nd_m factor $\geq 350\,000$;
- b) Energy density $> 4,0 \times 10^6$ kW/min.

9.22 Addition (8.3.4.3.1 of API STD 610:2010)

NOTE If at rated flow the NPSH margin ($NPSH_a - NPSH_r$) is less than 1 m or NPSH ratio ($NPSH_a / NPSH_r$) is less than 1,20, $NPSH_r$ shall be determined at each test point identified in 9.13 of this Standard except shutoff.

9.23 Addition (8.3.4.4 of API STD 610:2010)

All real-time data (vibration, speed, phase signals etc.) shall be recorded during the whole test.

9.24 New (8.3.4.8)

The following data shall be available, recorded and printed (or plotted):

- a) unfiltered and filtered vibration amplitude (FFT each 15 minutes during the test and unfiltered and filtered synchronous speed vibration amplitude trends);

- b) bearing temperature trend;
- c) oil temperature and pressure trends.

9.25 Substitution (8.4.2.6 of API STD 610:2010)

Besides the use of bolted wooden closures for protection during shipment, all flanged openings shall be provided with thin closures – e.g., paddle blinds – at least 5 mm thick, properly sealed in order to prevent entrance of foreign materials. As those closures will only be removed at the stage of mounting of definitive gaskets or joints, they shall neither obstruct nor restrain any work related to the installation of suction, discharge and auxiliary piping.

9.26 Addition (8.4.5 of API STD 610:2010)

Spare parts also shall be identified and tagged, as applicable to each case. When an assembled spare rotor is purchased, both main and spare rotors shall be identified (and indelibly stamped) with different serial numbers. Purchaser will state in the inquiry and/or purchase order the additional numbers and identification codes to be used in equipment and equipment data.

9.27 Addition (8.4.7 of API STD 610:2010)

The vendor shall specify the products to be used in preparation of the pump components, the methods of removal and reapplication, and inform the date of application. Such data shall be summarized in two tags to be securely affixed to the equipment and on the outside of the crate.

9.28 New (8.4.13)

When a spare rotor is purchased, the rotor shall be prepared for unheated indoor storage for a period of at least 3 years. The rotor shall be treated with a rust preventive and shall be housed in a vapor-barrier envelope with a slow vapor inhibitor. The rotor shall be suitably crated for the type of shipment specified. Suitable lead sheeting, at least 3,2 mm thick, shall be used between the rotor and the cradle at the support areas. The rotor shall not be supported at journals.

9.29 New (8.4.14)

Components (both individual pieces and packaged sets) shipped with mounted preassembled piping, tubing, or wiring shall comply with the requirements of safety and health.

9.30 New (8.4.15)

Vendor shall provide a pre-alignment report about complete pump train.

10 Specific Pump Types (Section 9 of API STD 610:2010)**10.1 Substitution (9.2.1.5 of API STD 610:2010)**

Refer to 7.16 of this Standard.

10.2 Modification (9.2.5.2.4 of API STD 610:2010)

Replace the item “c” by:

- c) maximum calculated babbitt surface temperature of 100 °C.

10.3 Addition (9.2.7.1 of API [STD 610:2010](#))

Test-stand oil filtration shall be 25 microns nominal or better with beta factor more than 200.

10.4 Substitution (9.2.7.5 of API [STD 610:2010](#))

See 9.18 of this Standard.

10.5 Substitution (9.3.10.7 of API [STD 610:2010](#))

Vertical pumps shall have their column and bowl assembly joints flanged.

10.6 Substitution (9.3.13.2 of API [STD 610:2010](#))

Bowls and column pipe shall be hydrostatically tested with liquid at a minimum of 1,5 times the maximum differential pressure developed by the bowl assembly. Hydrostatic testing shall be conducted in accordance with the requirements of 8.3.2 of API [STD 610:2010](#).


11 Vendor's Data (Section 10 of API [STD 610:2010](#))**11.1 Modification (10.2.1.1 of API [STD 610:2010](#))**


Replace "this International Standard" in the second sentence by: "this Standard and all technical documents listed in RM".

12 Annexes


- Annex A - OH and BB Centrifugal Pump Data Sheet;
- Annex B - VS Centrifugal Pump Data Sheet;
- Annex C - Mechanical Seal Data Sheet;
- Annex D - OH2 Pumps Seal Chambers Dimensions;
- Annex E - Materials Class Selection Guidance (Modification of Annex G of API [STD 610:2010](#));
- Annex F - Materials and Material Specifications for Centrifugal Pump Parts (Addition / Modification of Annex H of API [STD 610:2010](#));
- Annex G - Vendor Drawing and Data Requirements (Substitution of Figure L.1 of API [STD 610:2010](#));


Annex A - OH and BB Centrifugal Pump Data Sheet


 PETROBRAS	DATA SHEET		No.							
	CLIENT:							SHEET 1 of 6		
	JOB:									
	AREA:									
	TITLE: CENTRIFUGAL PUMP (OH / BB)									
INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
	REV. D	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H	
DATE										
DESIGN										
EXECUTION										
CHECK										
APPROVAL										
INFORMATION IN THIS DOCUMENT IS PROPERTY OF PETROBRAS, BEING PROHIBITED OUTSIDE OF THEIR PURPOSE.										
FORM OWNED TO PETROBRAS N-553 REV. E ANNEX A - SHEET 01/06.										

DATA SHEET		No.	REV.																																																																																																																																																																																																																																																																																														
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8	<table border="1"> <thead> <tr> <th colspan="2">OPERATING CONDITIONS</th> <th colspan="3">LIQUID</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>FLOW, NORMAL _____ m³/h RATED _____ m³/h</td> <td colspan="3">LIQUID TYPE OR NAME _____</td> </tr> <tr> <td>10</td> <td>MIN. _____ m³/h OTHER _____ m³/h</td> <td colspan="3"> <input type="checkbox"/> HAZARDOUS <input type="checkbox"/> FLAMMABLE <input type="checkbox"/> TOXIC </td> </tr> <tr> <td>11</td> <td>SUC. PRESSURE, MAX. / RATED _____ / _____ kgf/cm² g</td> <td colspan="3"> <table border="1"> <thead> <tr> <th>MIN.</th> <th>NOR.</th> <th>MAX.</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table> </td> </tr> <tr> <td>12</td> <td>DISCHARGE PRESSURE _____ kgf/cm² g</td> <td colspan="3">PUMPING TEMP., °C _____</td> </tr> <tr> <td>13</td> <td>DIFF. HEAD _____ m NPSHA _____ m</td> <td colspan="3">VAPOUR PRESS, kgf/cm² a _____</td> </tr> <tr> <td>14</td> <td>PROCESS VARIATIONS _____</td> <td colspan="3">RELATIVE DENSITY (SG) _____</td> </tr> <tr> <td>15</td> <td>STARTING CONDITIONS _____</td> <td colspan="3">VISCOSITY, cP _____</td> </tr> <tr> <td>16</td> <td>SERVICE <input type="checkbox"/> CONT. <input type="checkbox"/> INTERMIT. (STARTS / DAY) _____</td> <td colspan="3">SPECIFIC HEAT, kcal/kg °C _____</td> </tr> <tr> <td>17</td> <td><input type="checkbox"/> PARALLEL OPERATION REQ'D</td> <td colspan="3"> <input type="checkbox"/> CHLORIDE CONCENTRATION _____ ppm (mass) </td> </tr> <tr> <td>18</td> <td>DESIGN CONDITIONS</td> <td colspan="3"> <input type="checkbox"/> H₂S CONCENTRATION _____ ppm (mass) </td> </tr> <tr> <td>19</td> <td>UPSTREAM SYSTEM DESIGN TEMPERATURE _____ °C</td> <td colspan="3"> <input type="checkbox"/> CORROSIVE / EROSION AGENT _____ </td> </tr> <tr> <td>20</td> <td>UPSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm² g</td> <td colspan="3"> <input type="checkbox"/> SOLIDS MAX. DIA. _____ µm CONC. _____ ppm (mass) </td> </tr> <tr> <td>21</td> <td>DOWNSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm² g</td> <td colspan="3">UTILITY CONDITIONS</td> </tr> <tr> <td>22</td> <td>PROCESS CONTROL</td> <td colspan="3">ELECTRICITY: VOLTAGE _____ PHASE No. _____ FREQ. (Hz) _____</td> </tr> <tr> <td>23</td> <td><input type="checkbox"/> SPEED VARIATION <input type="checkbox"/> CONTROL VALVE <input type="checkbox"/> ON-OFF</td> <td colspan="3">DRIVER _____</td> </tr> <tr> <td>24</td> <td><input type="checkbox"/> NONE <input type="checkbox"/> OTHER _____</td> <td colspan="3">HEATING _____</td> </tr> <tr> <td>25</td> <td>LOCATION AND SITE DATA</td> <td colspan="3">CONTROL _____</td> </tr> <tr> <td>26</td> <td>LOCATION:</td> <td colspan="3">SHUTDOWN _____</td> </tr> <tr> <td>27</td> <td><input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input type="checkbox"/> HEATED <input type="checkbox"/> UNHEATED</td> <td colspan="3">SYSTEM VOLTAGE: DIP <input type="checkbox"/> 20 % <input type="checkbox"/> OTHER _____</td> </tr> <tr> <td>28</td> <td><input type="checkbox"/> ELECTRICAL AREA CLASSIFICATION</td> <td colspan="3">STEAM: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____</td> </tr> <tr> <td>29</td> <td>ZN _____ GR _____ CL _____</td> <td colspan="3">DRIVERS _____ kgf/cm² g _____ °C</td> </tr> <tr> <td>30</td> <td><input type="checkbox"/> WINTERIZATION REQ'D <input type="checkbox"/> TROPICALIZATION REQ'D</td> <td colspan="3">HEATING _____ kgf/cm² g _____ °C</td> </tr> <tr> <td>31</td> <td>SITE DATA:</td> <td colspan="3">COOLING WATER: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____</td> </tr> <tr> <td>32</td> <td><input type="checkbox"/> ALTITUDE _____ m ATMOSP. PRESS. _____ kgf/cm²</td> <td colspan="3">SUPPLY _____ kgf/cm² g _____ °C</td> </tr> <tr> <td>33</td> <td><input type="checkbox"/> AMBIENT TEMP. (MIN. / NOR. / MAX.) _____ °C</td> <td colspan="3">RETURN _____ kgf/cm² g _____ °C</td> </tr> <tr> <td>34</td> <td><input type="checkbox"/> REL. HUMIDITY (MIN. / NOR. / MAX.) _____ %</td> <td colspan="3">SOURCE _____</td> </tr> <tr> <td>35</td> <td>UNUSUAL CONDITIONS <input type="checkbox"/> DUST <input type="checkbox"/> FUMES</td> <td colspan="3">CHLORIDE CONC _____ ppm (mass)</td> </tr> <tr> <td>36</td> <td><input type="checkbox"/> OTHER _____</td> <td colspan="3">INSTRUMENT AIR: (MAX. / MIN.) _____ kgf/cm² g</td> </tr> <tr> <td>37</td> <td>DRIVER</td> <td colspan="3">PERFORMANCE</td> </tr> <tr> <td>38</td> <td>MAIN DRIVER:</td> <td colspan="3">PROPOSAL CURVE No. _____ SPEED _____ rpm</td> </tr> <tr> <td>39</td> <td><input type="checkbox"/> ELECTRIC MOTOR <input type="checkbox"/> STEAM TURBINE <input type="checkbox"/> OTHER _____</td> <td colspan="3"><input type="checkbox"/> No. OF IMPELLERS RATED _____ MAX. _____</td> </tr> <tr> <td>40</td> <td><input type="checkbox"/> VARIABLE SPEED REQUIRED <input type="checkbox"/> SOURCE _____</td> <td colspan="3"><input type="checkbox"/> IMPELLER DIA. RATED _____ MAX. _____ MIN. _____ mm</td> </tr> <tr> <td>41</td> <td><input type="checkbox"/> MANUFACTURER _____</td> <td colspan="3"><input type="checkbox"/> IMPELLER TYPE _____</td> </tr> <tr> <td>42</td> <td><input type="checkbox"/> DATA SHEET _____</td> <td colspan="3"><input type="checkbox"/> RATED POWER _____ kW <input type="checkbox"/> EFFICIENCY _____ %</td> </tr> <tr> <td>43</td> <td><input type="checkbox"/> FURNISHED / MOUNTED BY _____ / _____</td> <td colspan="3"><input type="checkbox"/> MIN. FLOW THERMAL _____ m³/h STABLE _____ m³/h</td> </tr> <tr> <td>44</td> <td><input type="checkbox"/> POWER _____ kW <input type="checkbox"/> SPEED _____ rpm</td> <td colspan="3"><input type="checkbox"/> HEAD RISE TO SHUT OFF _____ % <input type="checkbox"/> ORIFICE PLATE</td> </tr> <tr> <td>45</td> <td><input type="checkbox"/> TRANSMISSION <input type="checkbox"/> DIRECT <input type="checkbox"/> GEAR <input type="checkbox"/> OTHER _____</td> <td colspan="3"><input type="checkbox"/> PREFERRED OPER. REGION _____ TO _____ m³/h</td> </tr> <tr> <td>46</td> <td>SPARE DRIVER:</td> <td colspan="3"><input type="checkbox"/> ALLOWABLE OPEP. REGION _____ TO _____ m³/h</td> </tr> <tr> <td>47</td> <td><input type="checkbox"/> ELECTRIC MOTOR <input type="checkbox"/> STEAM TURBINE <input type="checkbox"/> OTHER _____</td> <td colspan="3"><input type="checkbox"/> MAX. HEAD @ RATED IMPELLER _____ m</td> </tr> <tr> <td>48</td> <td><input type="checkbox"/> VARIABLE SPEED REQUIRED <input type="checkbox"/> SOURCE _____</td> <td colspan="3"><input type="checkbox"/> MAX. POWER @ RATED IMPELLER _____ kW</td> </tr> <tr> <td>49</td> <td><input type="checkbox"/> MANUFACTURER _____</td> <td colspan="3"><input type="checkbox"/> NPSHR @ RAT. FLOW _____ m @ MAX. FLOW _____ m</td> </tr> <tr> <td>50</td> <td><input type="checkbox"/> DATA SHEET _____</td> <td colspan="3"><input type="checkbox"/> SUCTION SPECIFIC SPEED _____ IN US UNITS</td> </tr> <tr> <td>51</td> <td><input type="checkbox"/> FURNISHED / MOUNTED BY _____ / _____</td> <td colspan="3"><input type="checkbox"/> MAX. TRAIN SOUND PRESS. LEVEL (REQ/EST.) _____ / _____ dBA @ 1m</td> </tr> <tr> <td>52</td> <td><input type="checkbox"/> POWER _____ kW <input type="checkbox"/> SPEED _____ rpm</td> <td colspan="3"><input type="checkbox"/> MAX. TRAIN SOUND POWER LEVEL (REQ/EST.) _____ / _____</td> </tr> <tr> <td>53</td> <td><input type="checkbox"/> TRANSMISSION <input type="checkbox"/> DIRECT <input type="checkbox"/> GEAR <input type="checkbox"/> OTHER _____</td> <td colspan="3"></td> </tr> <tr> <td>54</td> <td colspan="4">REMARKS:</td> </tr> <tr> <td>55</td> <td colspan="4"></td> </tr> <tr> <td>56</td> <td colspan="4"></td> </tr> <tr> <td>57</td> <td colspan="4"></td> </tr> <tr> <td>58</td> <td colspan="4"></td> </tr> <tr> <td>59</td> <td colspan="4"></td> </tr> <tr> <td>60</td> <td colspan="4"></td> </tr> </tbody> </table>			OPERATING CONDITIONS		LIQUID			9	FLOW, NORMAL _____ m ³ /h RATED _____ m ³ /h	LIQUID TYPE OR NAME _____			10	MIN. _____ m ³ /h OTHER _____ m ³ /h	<input type="checkbox"/> HAZARDOUS <input type="checkbox"/> FLAMMABLE <input type="checkbox"/> TOXIC			11	SUC. PRESSURE, MAX. / RATED _____ / _____ kgf/cm ² g	<table border="1"> <thead> <tr> <th>MIN.</th> <th>NOR.</th> <th>MAX.</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>			MIN.	NOR.	MAX.																			12	DISCHARGE PRESSURE _____ kgf/cm ² g	PUMPING TEMP., °C _____			13	DIFF. HEAD _____ m NPSHA _____ m	VAPOUR PRESS, kgf/cm ² a _____			14	PROCESS VARIATIONS _____	RELATIVE DENSITY (SG) _____			15	STARTING CONDITIONS _____	VISCOSITY, cP _____			16	SERVICE <input type="checkbox"/> CONT. <input type="checkbox"/> INTERMIT. (STARTS / DAY) _____	SPECIFIC HEAT, kcal/kg °C _____			17	<input type="checkbox"/> PARALLEL OPERATION REQ'D	<input type="checkbox"/> CHLORIDE CONCENTRATION _____ ppm (mass)			18	DESIGN CONDITIONS	<input type="checkbox"/> H ₂ S CONCENTRATION _____ ppm (mass)			19	UPSTREAM SYSTEM DESIGN TEMPERATURE _____ °C	<input type="checkbox"/> CORROSIVE / EROSION AGENT _____			20	UPSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm ² g	<input type="checkbox"/> SOLIDS MAX. DIA. _____ µm CONC. _____ ppm (mass)			21	DOWNSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm ² g	UTILITY CONDITIONS			22	PROCESS CONTROL	ELECTRICITY: VOLTAGE _____ PHASE No. _____ FREQ. (Hz) _____			23	<input type="checkbox"/> SPEED VARIATION <input type="checkbox"/> CONTROL VALVE <input type="checkbox"/> ON-OFF	DRIVER _____			24	<input type="checkbox"/> NONE <input type="checkbox"/> OTHER _____	HEATING _____			25	LOCATION AND SITE DATA	CONTROL _____			26	LOCATION:	SHUTDOWN _____			27	<input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input type="checkbox"/> HEATED <input type="checkbox"/> UNHEATED	SYSTEM VOLTAGE: DIP <input type="checkbox"/> 20 % <input type="checkbox"/> OTHER _____			28	<input type="checkbox"/> ELECTRICAL AREA CLASSIFICATION	STEAM: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____			29	ZN _____ GR _____ CL _____	DRIVERS _____ kgf/cm ² g _____ °C			30	<input type="checkbox"/> WINTERIZATION REQ'D <input type="checkbox"/> TROPICALIZATION REQ'D	HEATING _____ kgf/cm ² g _____ °C			31	SITE DATA:	COOLING WATER: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____			32	<input type="checkbox"/> ALTITUDE _____ m ATMOSP. PRESS. _____ kgf/cm ²	SUPPLY _____ kgf/cm ² g _____ °C			33	<input type="checkbox"/> AMBIENT TEMP. (MIN. / NOR. / MAX.) _____ °C	RETURN _____ kgf/cm ² g _____ °C			34	<input type="checkbox"/> REL. HUMIDITY (MIN. / NOR. / MAX.) _____ %	SOURCE _____			35	UNUSUAL CONDITIONS <input type="checkbox"/> DUST <input type="checkbox"/> FUMES	CHLORIDE CONC _____ ppm (mass)			36	<input type="checkbox"/> OTHER _____	INSTRUMENT AIR: (MAX. / MIN.) _____ kgf/cm ² g			37	DRIVER	PERFORMANCE			38	MAIN DRIVER:	PROPOSAL CURVE No. _____ SPEED _____ rpm			39	<input type="checkbox"/> ELECTRIC MOTOR <input type="checkbox"/> STEAM TURBINE <input type="checkbox"/> OTHER _____	<input type="checkbox"/> No. OF IMPELLERS RATED _____ MAX. _____			40	<input type="checkbox"/> VARIABLE SPEED REQUIRED <input type="checkbox"/> SOURCE _____	<input type="checkbox"/> IMPELLER DIA. 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21	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Nº</th> <th style="width: 10%;">SIZE</th> <th style="width: 10%;">TYPE</th> <th style="width: 10%;">FAC.</th> <th style="width: 10%;">RAT.</th> <th style="width: 10%;">POS.</th> </tr> </thead> <tbody> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>			Nº	SIZE	TYPE	FAC.	RAT.	POS.																																																												
Nº	SIZE	TYPE	FAC.	RAT.	POS.																																																																
22	<input type="checkbox"/> DRAIN																																																																				
23	<input type="checkbox"/> VENT																																																																				
24	<input type="checkbox"/> PRESS. INSTRUM.																																																																				
25	<input type="checkbox"/> TEMP. INSTRUM.																																																																				
26	<input type="checkbox"/> WARM UP																																																																				
27	<input type="checkbox"/> BALANCE/LEAK-OFF																																																																				
28	<input type="checkbox"/> _____																																																																				
29	<input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS																																																																				
30	<input type="checkbox"/> CYLINDRICAL THREADS REQUIRED																																																																				
31	<input type="checkbox"/> GUSSET SUPPORT REQUIRED																																																																				
32	<input type="checkbox"/> SPECIAL FITTINGS FOR TRANSITIONING																																																																				
33	ROTOR:																																																																				
34	<input type="checkbox"/> COMPONENT BALANCE TO ISO 1940 G. 1.0																																																																				
35	<input type="checkbox"/> SHRINK FIT-LIMITED MOVEMENT IMPELLERS																																																																				
36	<input type="checkbox"/> 1 ST CRITICAL SPEED WET (MULTISTAGE PUMP ONLY) _____ rpm																																																																				
37	COUPLINGS:																																																																				
38	<input type="checkbox"/> MANUF. _____ <input type="checkbox"/> MODEL _____																																																																				
39	<input type="checkbox"/> TYPE _____ <input type="checkbox"/> SIZE _____																																																																				
40	<input type="checkbox"/> RATING (kW PER 100 rpm) _____																																																																				
41	<input type="checkbox"/> SPACER LENGTH (mm) _____ <input type="checkbox"/> S.F. _____																																																																				
42	<input type="checkbox"/> DRIVER HALF COUPLING MOUNTED BY _____																																																																				
43	<input type="checkbox"/> PUMP MFR <input type="checkbox"/> DRIVER MFR <input type="checkbox"/> PURCHASER																																																																				
44	<input type="checkbox"/> COUPLING WITH HYDRAULIC FIT																																																																				
45	<input type="checkbox"/> COUPLING WITH PROPRIETARY CLAMPING DEVICE																																																																				
46	<input type="checkbox"/> COUPLING IN COMPLIANCE WITH _____																																																																				
47	<input type="checkbox"/> COUPLING GUARD STANDARD PER _____																																																																				
48	BASEPLATE:																																																																				
49	<input type="checkbox"/> ISO BASEPLATE Nº. _____																																																																				
50	<input type="checkbox"/> MATERIAL _____																																																																				
51	<input type="checkbox"/> NON-GROUT CONSTRUCTION																																																																				
52	<input type="checkbox"/> OPEN DECK DESIGN																																																																				
53	<input type="checkbox"/> OTHER _____																																																																				
54	MECHANICAL SEAL: _____																																																																				
55	PACKING: _____																																																																				
56	REMARKS: _____																																																																				
57	_____																																																																				
58	_____																																																																				
59	_____																																																																				
60	_____																																																																				
CONSTRUCTION (CONT.)																																																																					
SHAFT:																																																																					
MAX. / MIN. DIAMETER _____ / _____ mm L3/D4 _____																																																																					
DIAMETER AT SLEEVE _____ mm																																																																					
DIAMETER AT COUPLING _____ mm																																																																					
DIAMETER BETWEEN BRGS _____ mm																																																																					
SPAN BETWEEN BRGS _____ mm																																																																					
SPAN BETWEEN BRG. / IMP. _____ mm																																																																					
TOTAL DEFLECTION AT SEAL CHAMBER _____ µm																																																																					
TOTAL DEFLECTION AT IMPELLER END _____ µm																																																																					
TOTAL DEFLECTION AT COUPLING END _____ µm																																																																					
MATERIAL																																																																					
<input type="checkbox"/> MATERIAL CLASS _____																																																																					
<input type="checkbox"/> MIN DESIGN METAL TEMP _____ °C																																																																					
<input type="checkbox"/> REDUCED HARDNESS MATERIALS																																																																					
<input type="checkbox"/> BARREL / CASE _____																																																																					
<input type="checkbox"/> DIFFUSERS _____																																																																					
<input type="checkbox"/> IMPELLER (S) _____																																																																					
<input type="checkbox"/> CASE WEAR RINGS _____																																																																					
<input type="checkbox"/> IMPELLER WEAR RINGS _____																																																																					
<input type="checkbox"/> SHAFT _____																																																																					
SURFACE PREPARATION AND PAINT																																																																					
<input type="checkbox"/> MANUFACTURER'S STANDARD <input type="checkbox"/> OTHER _____																																																																					
<input type="checkbox"/> SPECIFICATION _____																																																																					
PUMP:																																																																					
<input type="checkbox"/> PUMP SURFACE PREPARATION _____																																																																					
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____																																																																					
BASEPLATE:																																																																					
<input type="checkbox"/> BASEPLATE SURFACE PREPARATION _____																																																																					
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____																																																																					
<input type="checkbox"/> DETAILS OF LIFTING DEVICES _____																																																																					
SHIPMENT																																																																					
<input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQUIRED																																																																					
<input type="checkbox"/> OUTDOOR STORAGE FOR AT LEAST _____ MONTHS																																																																					
SPARE ROTOR ASSEMBLY PACKAGED FOR:																																																																					
<input type="checkbox"/> SHIPPING CONTAINER <input type="checkbox"/> N ₂ PURGE																																																																					
STORAGE <input type="checkbox"/> VERTICAL <input type="checkbox"/> HORIZONTAL																																																																					
<input type="checkbox"/> TYPE OF SHIPPING PREPARATION _____																																																																					
HEATING AND COOLING																																																																					
<input type="checkbox"/> HEATING JACKET REQ'D <input type="checkbox"/> COOLING REQ'D																																																																					
<input type="checkbox"/> COOLING WATER PIPING PLAN _____																																																																					
C. W. PIPING:																																																																					
<input type="checkbox"/> PIPE <input type="checkbox"/> TUBING FITTINGS _____																																																																					
C.W. PIPING MATERIALS:																																																																					
<input type="checkbox"/> S. STEEL <input type="checkbox"/> C. STEEL <input type="checkbox"/> OTHER _____																																																																					
COOLING WATER REQUIREMENTS:																																																																					
BEARING HOUSING _____ m ³ /h HEAT EXCHANGER _____ m ³ /h																																																																					
TOTAL COOLING WATER _____ m ³ /h																																																																					
HEATING MEDIUM <input type="checkbox"/> STEAM <input type="checkbox"/> OTHER _____																																																																					
HEATING PIPING <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE																																																																					
BEARINGS AND LUBRICATION																																																																					
BEARING (TYPE / NUMBER):																																																																					
<input type="checkbox"/> RADIAL _____ / _____																																																																					
<input type="checkbox"/> THRUST _____ / _____																																																																					
L ₁₀ @ RATED _____ / _____ @ MAX LOAD _____ / _____																																																																					
<input type="checkbox"/> REVIEW AND APPROVE THRUST/RADIAL BRG SIZE																																																																					
LUBRICATION: <input type="checkbox"/> GREASE <input type="checkbox"/> HYDRODYNAMIC. <input type="checkbox"/> RING OIL																																																																					
<input type="checkbox"/> PURGE OIL MIST <input type="checkbox"/> PURE OIL MIST																																																																					


		DATA SHEET		No.	REV.
				SHEET	4 of 6
TITLE:				CENTRIFUGAL PUMP (OH / BB)	
BEARINGS AND LUBRICATION (CONT.) <input type="checkbox"/> CONSTANT LEVEL OILER PREFERENCE _____ <input type="checkbox"/> PRESSURE L.O.S. <input type="checkbox"/> ISO 10438-3 <input type="checkbox"/> ISO 10438-2 <input type="checkbox"/> L.O.S. DATA SHEET _____ <input type="checkbox"/> L.O.S. MOUNTED ON PUMP BASEPLATE <input type="checkbox"/> INTERCONNECTING PIPING PROVIDED BY _____ <input type="checkbox"/> OIL VISC. ISO GRADE _____ <input type="checkbox"/> OIL PRESS TO BE GREATER THAN COOLANT PRESSURE <input type="checkbox"/> OIL HEATER REQ'D <input type="checkbox"/> STEAM <input type="checkbox"/> ELECTRIC			WEIGHTS AND DIMENSIONS WEIGHTS, kgf: PUMP _____ GEAR _____ BASE _____ DRIVER _____ COUP. _____ TOTAL _____ L.O.S. _____ (SEPARATE BASEPLATE) DIMENSIONS, mm: COMPLETE UNIT L _____ W _____ H _____ L.O.S. L _____ W _____ H _____		
INSTRUMENTATION					
FUNCTION LOCALLY LOCAL CONTROL MOUNTED PANEL ROOM SUCTION PRESSURE TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> DISCHARGE PRESSURE TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SUCTION TEMPERATURE TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SUCTION FILTER ΔP TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BALANCE PISTON ΔP TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> LUBE OIL PRESSURE TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> LUBE OIL TEMP. TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> LUBE OIL FILTER ΔP TRANSMITTER <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> LUBE OIL RESERVOIR LEVEL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> TRANSMITTER			BEARING / CASING VIBRATION AND TEMPERATURE <input type="checkbox"/> SEE ATTACHED MONITORING SYSTEM DATA SHEET <input type="checkbox"/> ACCELEROMETER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY QTY _____ MOUNTING LOCATION _____ <input type="checkbox"/> VIBRATION PROBES: <input type="checkbox"/> PROVISION FOR MOUNTING ONLY RADIAL _____ PER. BRG. AXIAL _____ PER. BRG. <input type="checkbox"/> FLAT SURFACE REQUIRED <input type="checkbox"/> TEMP. TRANSMITTER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY _____ PER RADIAL BRG. _____ PER THRUST BRG. <input type="checkbox"/> TEMP. TRANSMITTERS WITH THERMOWELLS <input type="checkbox"/> MONITORS AND CABLES SUPPLIED BY _____ <input type="checkbox"/> INTERCONNECTIONS AND WIRING TO JUNCTION BOXES		
ALARM AND TRIP					
LOW SUCTION / DISCHARGE PRESSURE ALARM TRIP <input type="checkbox"/> <input type="checkbox"/> HIGH DISCHARGE PRESSURE <input type="checkbox"/> <input type="checkbox"/> HIGH SUCTION FILTER ΔP <input type="checkbox"/> <input type="checkbox"/> EXCESSIVE VIBRATION <input type="checkbox"/> <input type="checkbox"/> EXCESSIVE AXIAL DISPLACEMENT <input type="checkbox"/> <input type="checkbox"/> HIGH BEARING TEMPERATURE <input type="checkbox"/> <input type="checkbox"/>			LOW / HIGH BALANCE PISTON ΔP <input type="checkbox"/> <input type="checkbox"/> LOW LUBE OIL PRESSURE <input type="checkbox"/> <input type="checkbox"/> HIGH LUBE OIL FILTER ΔP <input type="checkbox"/> <input type="checkbox"/> LOW LUBE OIL RESERVOIR TEMPERATURE <input type="checkbox"/> <input type="checkbox"/> LOW LUBE OIL RESERVOIR LEVEL <input type="checkbox"/> <input type="checkbox"/> AUX. LUBE OIL PUMP FAILURE <input type="checkbox"/> <input type="checkbox"/>		
PRESSURE VESSEL DESIGN CODE REFERENCES					
<input type="checkbox"/> THESE REFERENCES MUST BE LISTED BY THE MANUFACTURER CASTING FACTORS USED IN DESIGN <input type="checkbox"/> _____ SOURCE OF MATERIAL PROPERTIES <input type="checkbox"/> _____					
WELDING AND REPAIRS					
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO API 610 TABLE 11 IF NO PURCHASER PREFERENCE IS STATED)					
<input type="checkbox"/> ALTERNATIVE WELDING CODES AND STANDARDS					
WELDING REQUIREMENT (APPLICABLE CODE OR STANDARD)			PURCHASER DEFINED		PER TABLE 11
WELDER / OPERATOR QUALIFICATION			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
WELDING PROCEDURE QUALIFICATION			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
NON PRESS. RETAINING STRUC. WELDING SUCH AS BASEPLATES OR SUPPORTS			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
M.P. OR LIQUID PENETRANT EXAMINATION OF THE PLATE EDGES			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT OF CASING FABRICATION WELDS			<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
INSPEÇÃO DE MATERIAL					
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO PETROBRAS N-553 TABLE 2 IF NO PURCHASER PREFERENCE IS STATED)					
<input type="checkbox"/> ALTERNATIVE MATERIAL INSPECTIONS AND ACCEPTANCE CRITERIA					
TYPE OF INSPECTION		METHODS	FOR FABRICATIONS		FOR CASTINGS
RADIOGRAPHY	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
ULTRASONIC	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
MAGNETIC PARTICLE	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
LIQUID PENETRANT	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
REMARKS:					


		DATA SHEET		No.	REV.
		TITLE:		SHEET	5 of 6
		CENTRIFUGAL PUMP (OH / BB)			
1	SPARE PARTS		QA INSPECTION AND TESTING (CONT.)		
2	<input type="checkbox"/> START UP <input type="checkbox"/> NORMAL MAINTENANCE		TEST N-WIT WIT OBS		
3	<input type="checkbox"/> OTHER _____		HYDROSTATIC <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
4			FLUID _____		
5	OTHER PURCHASER REQUIREMENTS		PRESSURE _____ kgf/cm ² g		
6	<input type="checkbox"/> COORDINATION MEETING REQUIRED		PERFORMANCE <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
7	<input type="checkbox"/> MAXIMUM DISCHARGE PRESSURE TO INCLUDE		<input type="checkbox"/> NPSH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
8	<input type="checkbox"/> MAX. DIA. IMPELLERS AND/OR N° OF STAGES		<input type="checkbox"/> COMPLETE UNIT TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
9	<input type="checkbox"/> OPERATION TO TRIP SPEED		<input type="checkbox"/> SOUND LEVEL TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
10	<input type="checkbox"/> DRIVER MAXIMUM SPEED		<input type="checkbox"/> NOZZLE LOAD TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
11			MECHANICAL RUN <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
12	<input type="checkbox"/> CONNECTION DESIGN APPROVAL		<input type="checkbox"/> TRUE PEAK VELOCITY DATA <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
13	<input type="checkbox"/> INERT GAS INHIBITED STORAGE – SPACE CARTRIDGE		<input type="checkbox"/> BRG. HSG. RESONANCE TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
14	<input type="checkbox"/> TORSIONAL ANALYSIS REQUIRED <input type="checkbox"/> REPORT		<input type="checkbox"/> AUXILIARY EQUIPMENT TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
15	<input type="checkbox"/> PROGRESS REPORTS		<input type="checkbox"/> CHARPY TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
16	<input type="checkbox"/> OUTLINE OF PROCEDURES FOR OPTIONAL TESTS		<input type="checkbox"/> VENDOR KEEP REPAIR AND HT RECORDS		
17	<input type="checkbox"/> ADDITIONAL DATA REQUIRING 20 YEARS RETENTION		<input type="checkbox"/> VENDOR SHALL SUBMIT INSPECTION AND TEST PLAN FOR		
18	<input type="checkbox"/> REVIEW FOUNDATION AND PIPING DRAWINGS		PETROBRAS APPROVAL		
19	<input type="checkbox"/> PIPING CHECKS <input type="checkbox"/> INITIAL ALIGNMENT		<input type="checkbox"/> VENDOR SUBMIT TEST DATA WITHIN 24 HOURS		
20	<input type="checkbox"/> CHECK ALIGNMENT AT NORMAL TEMP.		<input type="checkbox"/> COMPLETION OF INSPECTION CHECK LIST		
21	<input type="checkbox"/> COMMISSIONING / START UP SUPERVISION		<input type="checkbox"/> INSPECTION CLASS <input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III		
22	<input type="checkbox"/> LATERAL ANALYSIS <input type="checkbox"/> PUMP <input type="checkbox"/> DRIVER				
23	<input type="checkbox"/> CRIT. SPEED ANALYSIS <input type="checkbox"/> DAMPED UNB. RESP. ANALYSIS				
24	<input type="checkbox"/> DYNAMIC BALANCE ROTOR				
25	<input type="checkbox"/> STIFFNESS MAP OF UNDAMPED ROTOR				
26	<input type="checkbox"/> REVIEW Q.A. PGM.				
27	<input type="checkbox"/> INSTALLATION LIST IN PROPOSAL				
28					
29	PIPING AND APPURTENANCES				
30	<input type="checkbox"/> MOUNT SEAL RESERVOIR OFF BASEPLATE				
31	<input type="checkbox"/> FLANGES REQ'D IN PLACE OF SOCKET WELD UNIONS				
32	CONNECTION FASTENERS				
33	<input type="checkbox"/> STANDARD ZINC-NICKEL COATED <input type="checkbox"/> S.S.				
34	QA INSPECTION AND TESTING				
35	<input type="checkbox"/> SHOP INSPECTION				
36	<input type="checkbox"/> PERFORMANCE CURVE APPROVAL				
37	<input type="checkbox"/> TEST WITH SUBSTITUTE SEAL				
38	<input type="checkbox"/> MATERIAL CERTIFICATION REQUIRED				
39	<input type="checkbox"/> CASING <input type="checkbox"/> IMPELLER <input type="checkbox"/> SHAFT				
40	<input type="checkbox"/> OTHER _____				
41	<input type="checkbox"/> INSPECTION REQUIRED FOR CONNECTION WELDS				
42	<input type="checkbox"/> MAG PARTICLE <input type="checkbox"/> LIQUID PENETRANT				
43	<input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC				
44	<input type="checkbox"/> INSPECTION REQUIRED FOR CASTINGS				
45	<input type="checkbox"/> MAG PARTICLE <input type="checkbox"/> LIQUID PENETRANT				
46	<input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC				
47	<input type="checkbox"/> HARDNESS TEST REQUIRED				
48	<input type="checkbox"/> ADDITIONAL SURFACE/ SUBSURFACE EXAMINATION				
49	FOR _____				
50	METHOD _____				
51					
52					
53	REMARKS:				
54					
55					
56					
57					
58					
59					
60					


	DATA SHEET		No.	REV.
				SHEET 6 of 6
	TITLE: CENTRIFUGAL PUMP (OH / BB)			
NOTES				


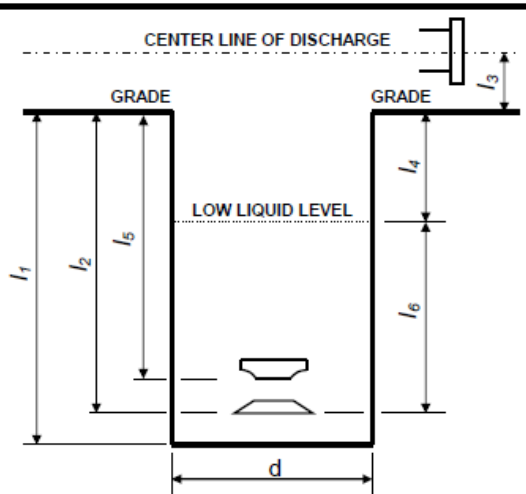
Annex B - VS Centrifugal Pump Data Sheet

[illegible]


DATA SHEET		No.	REV.																								
		SHEET 2 of 7																									
TITLE: CENTRIFUGAL PUMP (VS)																											
1 APPLICABLE TO <input type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS BUILT 2 FOR _____ UNIT _____ 3 SITE _____ SERVICE _____ 4 MANUFACTURER _____ QUANTITY _____ 5 VENDOR _____ SERIAL No. _____ 6 MODEL _____ DRIVER _____ / _____ 7 SIZE/TYPE _____ / _____																											
OPERATING CONDITIONS 9 FLOW, NORMAL _____ m ³ /h RATED _____ m ³ /h 10 MIN. _____ m ³ /h OTHER _____ m ³ /h 11 SUC. PRESSURE, MAX. / RATED _____ / _____ kgf/cm ² g 12 DISCHARGE PRESSURE _____ kgf/cm ² g 13 DIFF. HEAD _____ m NPSHA _____ m 14 PROCESS VARIATIONS _____ 15 STARTING CONDITIONS _____ 16 SERVICE <input type="checkbox"/> CONT. <input type="checkbox"/> INTERMIT. (STARTS / DAY) _____ 17 <input type="checkbox"/> PARALLEL OPERATION REQ'D		LIQUID LIQUID TYPE OR NAME _____ <input type="checkbox"/> HAZARDOUS <input type="checkbox"/> FLAMMABLE <input type="checkbox"/> TOXIC <table border="1"> <thead> <tr> <th></th> <th>MIN.</th> <th>NOR.</th> <th>MAX.</th> </tr> </thead> <tbody> <tr> <td>PUMPING TEMP., °C</td> <td></td> <td></td> <td></td> </tr> <tr> <td>VAPOUR PRESS, kgf/cm² a</td> <td></td> <td></td> <td></td> </tr> <tr> <td>RELATIVE DENSITY (SG)</td> <td></td> <td></td> <td></td> </tr> <tr> <td>VISCOSITY, cP</td> <td></td> <td></td> <td></td> </tr> <tr> <td>SPECIFIC HEAT, kcal/kg °C</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <input type="checkbox"/> CHLORIDE CONCENTRATION _____ ppm (mass) <input type="checkbox"/> H ₂ S CONCENTRATION _____ ppm (mass) <input type="checkbox"/> CORROSIVE / EROSION AGENT _____ <input type="checkbox"/> SOLIDS MAX. DIA. _____ µm CONC. _____ ppm (mass)			MIN.	NOR.	MAX.	PUMPING TEMP., °C				VAPOUR PRESS, kgf/cm ² a				RELATIVE DENSITY (SG)				VISCOSITY, cP				SPECIFIC HEAT, kcal/kg °C			
	MIN.	NOR.	MAX.																								
PUMPING TEMP., °C																											
VAPOUR PRESS, kgf/cm ² a																											
RELATIVE DENSITY (SG)																											
VISCOSITY, cP																											
SPECIFIC HEAT, kcal/kg °C																											
DESIGN CONDITIONS 19 UPSTREAM SYSTEM DESIGN TEMPERATURE _____ °C 20 UPSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm ² g 21 DOWNSTREAM SYSTEM DESIGN PRESSURE _____ kgf/cm ² g		UTILITY CONDITIONS ELECTRICITY: VOLTAGE _____ PHASE No. _____ FREQ. (Hz) _____ DRIVER _____ HEATING _____ CONTROL _____ SHUTDOWN _____ SYSTEM VOLTAGE: DIP <input type="checkbox"/> 20 % <input type="checkbox"/> OTHER _____ STEAM: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____ DRIVERS _____ kgf/cm ² g _____ °C HEATING _____ kgf/cm ² g _____ °C COOLING WATER: (DES. / MAX. / NOR. / MIN.), PRESS. AND TEMP. _____ SUPPLY _____ kgf/cm ² g _____ °C RETURN _____ kgf/cm ² g _____ °C SOURCE _____ CHLORIDE CONC _____ ppm (mass) INSTRUMENT AIR: (MAX. / MIN.) _____ kgf/cm ² g																									
PROCESS CONTROL 23 <input type="checkbox"/> SPEED VARIATION <input type="checkbox"/> CONTROL VALVE <input type="checkbox"/> ON-OFF 24 <input type="checkbox"/> NONE <input type="checkbox"/> OTHER _____																											
LOCATION AND SITE DATA 26 LOCATION: 27 <input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input type="checkbox"/> HEATED <input type="checkbox"/> UNHEATED 28 <input type="checkbox"/> ELECTRICAL AREA CLASSIFICATION 29 ZN _____ GR _____ CL _____ 30 <input type="checkbox"/> WINTERIZATION REQ'D <input type="checkbox"/> TROPICALIZATION REQ'D 31 SITE DATA: 32 <input type="checkbox"/> ALTITUDE _____ m ATMOSPHER. PRESS. _____ kgf/cm ² 33 <input type="checkbox"/> AMBIENT TEMP. (MIN. / NOR. / MAX.) _____ °C 34 <input type="checkbox"/> REL. HUMIDITY (MIN. / NOR. / MAX.) _____ % 35 UNUSUAL CONDITIONS <input type="checkbox"/> DUST <input type="checkbox"/> FUMES 36 <input type="checkbox"/> OTHER _____																											
DRIVER 38 MAIN DRIVER: 39 <input type="checkbox"/> ELECTRIC MOTOR <input type="checkbox"/> STEAM TURBINE <input type="checkbox"/> OTHER _____ 40 <input type="checkbox"/> VARIABLE SPEED REQUIRED <input type="checkbox"/> SOURCE _____ 41 <input type="checkbox"/> MANUFACTURER _____ 42 <input type="checkbox"/> DATA SHEET _____ 43 <input type="checkbox"/> FURNISHED / MOUNTED BY _____ / _____ 44 <input type="checkbox"/> POWER _____ kW <input type="checkbox"/> SPEED _____ rpm 45 <input type="checkbox"/> TRANSMISSION <input type="checkbox"/> DIRECT <input type="checkbox"/> GEAR <input type="checkbox"/> OTHER _____ 46 SPARE DRIVER: 47 <input type="checkbox"/> ELECTRIC MOTOR <input type="checkbox"/> STEAM TURBINE <input type="checkbox"/> OTHER _____ 48 <input type="checkbox"/> VARIABLE SPEED REQUIRED <input type="checkbox"/> SOURCE _____ 49 <input type="checkbox"/> MANUFACTURER _____ 50 <input type="checkbox"/> DATA SHEET _____ 51 <input type="checkbox"/> FURNISHED / MOUNTED BY _____ / _____ 52 <input type="checkbox"/> POWER _____ kW <input type="checkbox"/> SPEED _____ rpm 53 <input type="checkbox"/> TRANSMISSION <input type="checkbox"/> DIRECT <input type="checkbox"/> GEAR <input type="checkbox"/> OTHER _____		PERFORMANCE PROPOSAL CURVE No. _____ SPEED _____ rpm <input type="checkbox"/> No. OF IMPELLERS RATED _____ MAX. _____ <input type="checkbox"/> IMPELLER DIA. RATED _____ MAX. _____ MIN. _____ mm <input type="checkbox"/> IMPELLER TYPE _____ <input type="checkbox"/> RATED POWER _____ kW <input type="checkbox"/> EFFICIENCY _____ % <input type="checkbox"/> MIN. FLOW THERMAL _____ m ³ /h STABLE _____ m ³ /h <input type="checkbox"/> HEAD RISE TO SHUT OFF _____ % <input type="checkbox"/> ORIFICE PLATE <input type="checkbox"/> PREFERRED OPER. REGION _____ TO _____ m ³ /h <input type="checkbox"/> ALLOWABLE OPEP. REGION _____ TO _____ m ³ /h <input type="checkbox"/> MAX. HEAD @ RATED IMPELLER _____ m <input type="checkbox"/> MAX. POWER @ RATED IMPELLER _____ kW <input type="checkbox"/> NPSHR @ RAT. FLOW _____ m @ MAX. FLOW _____ m <input type="checkbox"/> SUCTION SPECIFIC SPEED _____ IN US UNITS <input type="checkbox"/> MAX. TRAIN SOUND PRESS. LEVEL (REQ/EST.) _____ / _____ dBA @ 1m <input type="checkbox"/> MAX. TRAIN SOUND POWER LEVEL (REQ/EST.) _____ / _____																									
54 REMARKS: 55 _____ 56 _____ 57 _____ 58 _____ 59 _____ 60 _____																											

DATA SHEET		No.	REV.																																																																		
		SHEET 3 of 7																																																																			
		TITLE: CENTRIFUGAL PUMP (VS)																																																																			
1	CONSTRUCTION																																																																				
2	ROTATION (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW																																																																				
3	PUMP API STD 610 DESIGNATION: _____																																																																				
4	CASING MOUNTING:																																																																				
5	<input type="checkbox"/> CENTERLINE <input type="checkbox"/> FOOT <input type="checkbox"/> IN-LINE																																																																				
6	<input type="checkbox"/> OTHER _____																																																																				
7	CASING SPLIT:																																																																				
8	<input type="checkbox"/> AXIAL <input type="checkbox"/> RADIAL																																																																				
9	CASING TYPE:																																																																				
10	<input type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> DOUBLE VOLUTE <input type="checkbox"/> DIFFUSER																																																																				
11	<input type="checkbox"/> SINGLE CASING <input type="checkbox"/> BARREL <input type="checkbox"/> OTHER _____																																																																				
12	CASE PRESSURE RATING:																																																																				
13	<input type="checkbox"/> MAWP _____ kgf/cm ² g @ _____ °C																																																																				
14	NOZZLE CONNECTIONS:																																																																				
15	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">SIZE</th> <th style="width: 25%;">RATING</th> <th style="width: 25%;">FACING</th> <th style="width: 25%;">POSITION</th> </tr> </thead> <tbody> <tr> <td>SUCTION</td> <td></td> <td></td> <td></td> </tr> <tr> <td>DISCHARGE</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			SIZE	RATING	FACING	POSITION	SUCTION				DISCHARGE																																																									
SIZE	RATING	FACING	POSITION																																																																		
SUCTION																																																																					
DISCHARGE																																																																					
16	PRESSURE CASING AUX. CONNECTIONS:																																																																				
17	<input type="checkbox"/> SOCKET WELD																																																																				
18	<input type="checkbox"/> BUTT WELD																																																																				
19	<input type="checkbox"/> DRAIN																																																																				
20	<input type="checkbox"/> VENT																																																																				
21	<input type="checkbox"/> PRESS. INSTRUM.																																																																				
22	<input type="checkbox"/> TEMP. INSTRUM.																																																																				
23	<input type="checkbox"/> WARM UP																																																																				
24	<input type="checkbox"/> BALANCE/LEAK-OFF																																																																				
25	<input type="checkbox"/> _____																																																																				
26	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">Nº</th> <th style="width: 15%;">SIZE</th> <th style="width: 10%;">TYPE</th> <th style="width: 10%;">FAC.</th> <th style="width: 10%;">RAT.</th> <th style="width: 10%;">POS.</th> </tr> </thead> <tbody> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>			Nº	SIZE	TYPE	FAC.	RAT.	POS.																																																												
Nº	SIZE	TYPE	FAC.	RAT.	POS.																																																																
27	<input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS																																																																				
28	<input type="checkbox"/> CYLINDRICAL THREADS REQUIRED																																																																				
29	<input type="checkbox"/> GUSSET SUPPORT REQUIRED																																																																				
30	<input type="checkbox"/> SPECIAL FITTINGS FOR TRANSITIONING																																																																				
31	ROTOR:																																																																				
32	<input type="checkbox"/> COMPONENT BALANCE TO ISO 1940 G. 1.0																																																																				
33	<input type="checkbox"/> SHRINK FIT-LIMITED MOVEMENT IMPELLERS																																																																				
34	<input type="checkbox"/> 1 ST CRITICAL SPEED WET (MULTISTAGE PUMP ONLY) _____ rpm																																																																				
35	COUPLINGS:																																																																				
36	<input type="checkbox"/> MANUF. _____ <input type="checkbox"/> MODEL _____																																																																				
37	<input type="checkbox"/> TYPE _____ <input type="checkbox"/> SIZE _____																																																																				
38	<input type="checkbox"/> RATING (kW PER 100 rpm) _____																																																																				
39	<input type="checkbox"/> SPACER LENGTH (mm) _____ <input type="checkbox"/> S.F. _____																																																																				
40	<input type="checkbox"/> DRIVER HALF COUPLING MOUNTED BY _____																																																																				
41	<input type="checkbox"/> PUMP MFR <input type="checkbox"/> DRIVER MFR <input type="checkbox"/> PURCHASER																																																																				
42	<input type="checkbox"/> COUPLING WITH HYDRAULIC FIT																																																																				
43	<input type="checkbox"/> COUPLING WITH PROPRIETARY CLAMPING DEVICE																																																																				
44	<input type="checkbox"/> COUPLING IN COMPLIANCE WITH _____																																																																				
45	<input type="checkbox"/> COUPLING GUARD STANDARD PER _____																																																																				
46	BASEPLATE:																																																																				
47	<input type="checkbox"/> ISO BASEPLATE Nº: _____																																																																				
48	<input type="checkbox"/> MATERIAL _____																																																																				
49	<input type="checkbox"/> NON-GROUT CONSTRUCTION																																																																				
50	<input type="checkbox"/> OPEN DECK DESIGN																																																																				
51	<input type="checkbox"/> OTHER _____																																																																				
52	MECHANICAL SEAL: _____																																																																				
53	PACKING: _____																																																																				
54	REMARKS:																																																																				
55																																																																					
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CONSTRUCTION (CONT.)																																																																					
SHAFT:																																																																					
MAX. / MIN. DIAMETER _____ / _____ mm L3/D4 _____																																																																					
DIAMETER AT SLEEVE _____ mm																																																																					
DIAMETER AT COUPLING _____ mm																																																																					
DIAMETER BETWEEN BRGS _____ mm																																																																					
SPAN BETWEEN BRGS _____ mm																																																																					
SPAN BETWEEN BRG. / IMP. _____ mm																																																																					
TOTAL DEFLECTION AT SEAL CHAMBER _____ µm																																																																					
TOTAL DEFLECTION AT IMPELLER END _____ µm																																																																					
TOTAL DEFLECTION AT COUPLING END _____ µm																																																																					
MATERIAL																																																																					
<input type="checkbox"/> MATERIAL CLASS _____																																																																					
<input type="checkbox"/> MIN DESIGN METAL TEMP _____ °C																																																																					
<input type="checkbox"/> REDUCED HARDNESS MATERIALS																																																																					
<input type="checkbox"/> BARREL / CASE _____																																																																					
<input type="checkbox"/> DIFFUSERS _____																																																																					
<input type="checkbox"/> IMPELLER (S) _____																																																																					
<input type="checkbox"/> CASE WEAR RINGS _____																																																																					
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<input type="checkbox"/> SHAFT _____																																																																					
SURFACE PREPARATION AND PAINT																																																																					
<input type="checkbox"/> MANUFACTURER'S STANDARD <input type="checkbox"/> OTHER _____																																																																					
<input type="checkbox"/> SPECIFICATION _____																																																																					
PUMP:																																																																					
<input type="checkbox"/> PUMP SURFACE PREPARATION _____																																																																					
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____																																																																					
BASEPLATE:																																																																					
<input type="checkbox"/> BASEPLATE SURFACE PREPARATION _____																																																																					
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____																																																																					
<input type="checkbox"/> DETAILS OF LIFTING DEVICES _____																																																																					
SHIPMENT																																																																					
<input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQUIRED																																																																					
<input type="checkbox"/> OUTDOOR STORAGE FOR AT LEAST _____ MONTHS																																																																					
SPARE ROTOR ASSEMBLY PACKAGED FOR:																																																																					
<input type="checkbox"/> SHIPPING CONTAINER <input type="checkbox"/> N ₂ PURGE																																																																					
STORAGE <input type="checkbox"/> VERTICAL <input type="checkbox"/> HORIZONTAL																																																																					
<input type="checkbox"/> TYPE OF SHIPPING PREPARATION _____																																																																					
HEATING AND COOLING																																																																					
<input type="checkbox"/> HEATING JACKET REQ'D <input type="checkbox"/> COOLING REQ'D																																																																					
<input type="checkbox"/> COOLING WATER PIPING PLAN _____																																																																					
C. W. PIPING:																																																																					
<input type="checkbox"/> PIPE <input type="checkbox"/> TUBING <input type="checkbox"/> FITTINGS _____																																																																					
C.W. PIPING MATERIALS:																																																																					
<input type="checkbox"/> S. STEEL <input type="checkbox"/> C. STEEL <input type="checkbox"/> OTHER _____																																																																					
COOLING WATER REQUIREMENTS:																																																																					
BEARING HOUSING _____ m ³ /h HEAT EXCHANGER _____ m ³ /h																																																																					
TOTAL COOLING WATER _____ m ³ /h																																																																					
HEATING MEDIUM <input type="checkbox"/> STEAM <input type="checkbox"/> OTHER _____																																																																					
HEATING PIPING <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE																																																																					
BEARINGS AND LUBRICATION																																																																					
BEARING (TYPE / NUMBER):																																																																					
<input type="checkbox"/> RADIAL _____ / _____																																																																					
<input type="checkbox"/> THRUST _____ / _____																																																																					
L ₁₀ @ RATED _____ / _____ @ MAX LOAD _____ / _____																																																																					
<input type="checkbox"/> REVIEW AND APPROVE THRUST/RADIAL BRG SIZE																																																																					
LUBRICATION: <input type="checkbox"/> GREASE <input type="checkbox"/> HYDRODYNAMIC. <input type="checkbox"/> RING OIL																																																																					
<input type="checkbox"/> PURGE OIL MIST <input type="checkbox"/> PURE OIL MIST																																																																					


 PETROBRAS	DATA SHEET		No. _____	REV. _____
				SHEET 4 of 7
	TITLE: CENTRIFUGAL PUMP (VS)			
BEARINGS AND LUBRICATION (CONT.)	WEIGHTS AND DIMENSIONS			
<input type="checkbox"/> CONSTANT LEVEL OILER PREFERENCE _____ <input type="checkbox"/> PRESSURE L.O.S. <input type="checkbox"/> ISO 10438-3 <input type="checkbox"/> ISO 10438-2 <input type="checkbox"/> L.O.S. DATA SHEET _____ <input type="checkbox"/> L.O.S. MOUNTED ON PUMP BASEPLATE <input type="checkbox"/> INTERCONNECTING PIPING PROVIDED BY _____ <input type="checkbox"/> OIL VISC. ISO GRADE _____ <input type="checkbox"/> OIL PRESS TO BE GREATER THAN COOLANT PRESSURE <input type="checkbox"/> OIL HEATER REQ'D <input type="checkbox"/> STEAM <input type="checkbox"/> ELECTRIC	WEIGHTS, kgf: PUMP _____ GEAR _____ BASE _____ DRIVER _____ COUP. _____ TOTAL _____ L.O.S. _____ (SEPARATE BASEPLATE) DIMENSIONS, mm: COMPLETE UNIT L _____ W _____ H _____ L.O.S. L _____ W _____ H _____			
INSTRUMENTATION				
FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	CONTROL ROOM	
SUCTION PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DISCHARGE PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
SUCTION TEMPERATURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
SUCTION FILTER ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BALANCE PISTON ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LUBE OIL PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LUBE OIL TEMP. TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LUBE OIL FILTER ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LUBE OIL RESERVOIR LEVEL TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BEARING / CASING VIBRATION AND TEMPERATURE <input type="checkbox"/> SEE ATTACHED MONITORING SYSTEM DATA SHEET <input type="checkbox"/> ACCELEROMETER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY QTY _____ MOUNTING LOCATION _____ <input type="checkbox"/> VIBRATION PROBES. <input type="checkbox"/> PROVISION FOR MOUNTING ONLY RADIAL _____ PER. BRG. AXIAL _____ PER. BRG. <input type="checkbox"/> FLAT SURFACE REQUIRED <input type="checkbox"/> TEMP. TRANSMITTER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY _____ PER RADIAL BRG. _____ PER THRUST BRG. <input type="checkbox"/> TEMP. TRANSMITTERS WITH THERMOWELLS <input type="checkbox"/> MONITORS AND CABLES SUPPLIED BY _____ <input type="checkbox"/> INTERCONNECTIONS AND WIRING TO JUNCTION BOXES				
ALARM AND TRIP				
	ALARM	TRIP		
LOW SUCTION / DISCHARGE PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>	LOW / HIGH BALANCE PISTON ΔP	<input type="checkbox"/>
HIGH DISCHARGE PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL PRESSURE	<input type="checkbox"/>
HIGH SUCTION FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	HIGH LUBE OIL FILTER ΔP	<input type="checkbox"/>
EXCESSIVE VIBRATION	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL RESERVOIR TEMPERATURE	<input type="checkbox"/>
EXCESSIVE AXIAL DISPLACEMENT	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL RESERVOIR LEVEL	<input type="checkbox"/>
HIGH BEARING TEMPERATURE	<input type="checkbox"/>	<input type="checkbox"/>	AUX. LUBE OIL PUMP FAILURE	<input type="checkbox"/>
PRESSURE VESSEL DESIGN CODE REFERENCES				
<input type="checkbox"/> THESE REFERENCES MUST BE LISTED BY THE MANUFACTURER CASTING FACTORS USED IN DESIGN <input type="checkbox"/> _____ SOURCE OF MATERIAL PROPERTIES <input type="checkbox"/> _____				
WELDING AND REPAIRS				
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO API 610 TABLE 11 IF NO PURCHASER PREFERENCE IS STATED)				
<input type="checkbox"/> ALTERNATIVE WELDING CODES AND STANDARDS				
WELDING REQUIREMENT (APPLICABLE CODE OR STANDARD)			PURCHASER DEFINED	PER TABLE 11
WELDER / OPERATOR QUALIFICATION			<input type="checkbox"/> _____	<input type="checkbox"/> _____
WELDING PROCEDURE QUALIFICATION			<input type="checkbox"/> _____	<input type="checkbox"/> _____
NON PRESS. RETAINING STRUC. WELDING SUCH AS BASEPLATES OR SUPPORTS			<input type="checkbox"/> _____	<input type="checkbox"/> _____
M.P. OR LIQUID PENETRANT EXAMINATION OF THE PLATE EDGES			<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT			<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT OF CASING FABRICATION WELDS			<input type="checkbox"/> _____	<input type="checkbox"/> _____
INSPEÇÃO DE MATERIAL				
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO PETROBRAS N-553 TABLE 2 IF NO PURCHASER PREFERENCE IS STATED)				
<input type="checkbox"/> ALTERNATIVE MATERIAL INSPECTIONS AND ACCEPTANCE CRITERIA				
TYPE OF INSPECTION	METHODS		FOR FABRICATIONS	FOR CASTINGS
RADIOGRAPHY	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____
ULTRASONIC	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____
MAGNETIC PARTICLE	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____
LIQUID PENETRANT	<input type="checkbox"/> _____		<input type="checkbox"/> _____	<input type="checkbox"/> _____
REMARKS: _____				


DATA SHEET		No.	REV.																												
		SHEET 5 of 7																													
		TITLE: CENTRIFUGAL PUMP (VS)																													
ADDITIONAL INFORMATION FOR VERTICAL PUMPS																															
<p>PUMP THRUST:</p> <table style="width: 100%;"> <tr> <th></th> <th style="text-align: center;">(+) UP</th> <th style="text-align: center;">(-) DOWN</th> </tr> <tr> <td>STATIC THRUST</td> <td>_____ kgf</td> <td>_____ kgf</td> </tr> <tr> <td>AT MINIMUM FLOW</td> <td>_____ kgf</td> <td>_____ kgf</td> </tr> <tr> <td>AT NORMAL FLOW</td> <td>_____ kgf</td> <td>_____ kgf</td> </tr> <tr> <td>AT RATED FLOW</td> <td>_____ kgf</td> <td>_____ kgf</td> </tr> <tr> <td>MAXIMUM THRUST</td> <td>_____ kgf</td> <td>_____ kgf</td> </tr> </table> <p>COLUMN PIPE:</p> <p>DIAMETER _____ mm</p> <p>TOTAL LENGTH _____ mm</p> <p>QUANTITY _____ SPACING _____ mm</p> <p>GUIDE BUSHINGS:</p> <p>QUANTITY _____</p> <p>LINE SHAFT BEARING SPACE _____ mm</p> <p>LUBE <input type="checkbox"/> WATER <input type="checkbox"/> GREASE <input type="checkbox"/> OIL</p> <p><input type="checkbox"/> PUMPAGE <input type="checkbox"/> _____</p> <p>LINE SHAFT:</p> <p><input type="checkbox"/> OPEN <input type="checkbox"/> CLOSED</p> <p>LINE SHAFT DIAMETER _____ mm</p> <p>TUBE DIAMETER _____ mm</p> <p>LINE SHAFT COUPLING:</p> <p>QUANTITY _____</p> <p>FIXATION <input type="checkbox"/> SLEEVE & KEY <input type="checkbox"/> THREADED</p> <p>SUCTION CAN:</p> <p>DIAMETER _____ mm LENGTH _____ mm</p> <p>THICKNESS _____ mm</p> <p>SURFACE PREPARATION AND PAINT:</p> <p>DISCHARGE HEAD</p> <p><input type="checkbox"/> SURFACE PREPARATION _____</p> <p><input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____</p> <p>COLUMN</p> <p><input type="checkbox"/> SURFACE PREPARATION _____</p> <p><input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____</p> <p>SOLEPLATE, MOUNTING PLATE AND COVER PLATE</p> <p><input type="checkbox"/> SURFACE PREPARATION _____</p> <p><input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____</p>		(+) UP	(-) DOWN	STATIC THRUST	_____ kgf	_____ kgf	AT MINIMUM FLOW	_____ kgf	_____ kgf	AT NORMAL FLOW	_____ kgf	_____ kgf	AT RATED FLOW	_____ kgf	_____ kgf	MAXIMUM THRUST	_____ kgf	_____ kgf	<p>MATERIAL:</p> <p>BOWL MAIN MATERIALS ON PAGE 3, LINES 12 TO 21</p> <p>BOWL BEARINGS, SLEEVE _____</p> <p>DISCHARGE HEAD _____</p> <p>COLUMN _____</p> <p>LINE SHAFT _____</p> <p>LINE SHAFT COUPLING _____</p> <p>LINE SHAFT BEARINGS, SLEEVE _____</p> <p>LINE SHAFT HARDFACING _____</p> <p>LINE SHAFT BEARING RETAINER _____</p> <p>LINE SHAFT ENCLOSING TUBE _____</p> <p>SUCTION BELL _____</p> <p>SUCTION CAN _____</p> <p>_____</p> <p>PRESSURE RATING:</p> <table style="width: 100%;"> <tr> <th></th> <th style="text-align: center;">MAWP</th> <th style="text-align: center;">HYDRO TEST</th> </tr> <tr> <td>DISCHARGE HEAD</td> <td>_____ kgf/cm²g</td> <td>_____ kgf/cm²g</td> </tr> <tr> <td>COLUMN PIPE</td> <td>_____ kgf/cm²g</td> <td>_____ kgf/cm²g</td> </tr> <tr> <td>BOWL</td> <td>PAGE 3, LINE 13</td> <td>PAGE 6, LINE 5</td> </tr> </table> <p>OTHER REQUIREMENTS:</p> <p><input type="checkbox"/> SUCTION STRAINER TYPE _____</p> <p><input type="checkbox"/> SOLEPLATE REQ'D L _____ mm x W _____ mm</p> <p>SOLEPLATE THICKNESS _____ mm</p> <p><input type="checkbox"/> SEPARATE SOLEPLATE REQUIRED</p> <p><input type="checkbox"/> MOUNTING PLATE REQUIRED <input type="checkbox"/> SEPARATE</p> <p><input type="checkbox"/> HARDENED SLEEVE UNDER BEARINGS</p> <p><input type="checkbox"/> IMPELLER COLLETS ACCEPTABLE</p> <p><input type="checkbox"/> STRUCTURAL ANALYSIS</p> <p><input type="checkbox"/> RESONANCE TEST</p> <p><input type="checkbox"/> DRAIN PIPED TO SURFACE</p> <p><input type="checkbox"/> SUMP COVER PLATE</p> <p>WEIGHTS, kgf:</p> <p>DISCHARGE HEAD _____ COLUMN _____</p> <p>COLUMN INTERNALS _____ SUCTION CAN _____</p> <p>TOTAL _____ (CONSIDERING WEIGHTS ON PAGE 4)</p>		MAWP	HYDRO TEST	DISCHARGE HEAD	_____ kgf/cm ² g	_____ kgf/cm ² g	COLUMN PIPE	_____ kgf/cm ² g	_____ kgf/cm ² g	BOWL	PAGE 3, LINE 13	PAGE 6, LINE 5
	(+) UP	(-) DOWN																													
STATIC THRUST	_____ kgf	_____ kgf																													
AT MINIMUM FLOW	_____ kgf	_____ kgf																													
AT NORMAL FLOW	_____ kgf	_____ kgf																													
AT RATED FLOW	_____ kgf	_____ kgf																													
MAXIMUM THRUST	_____ kgf	_____ kgf																													
	MAWP	HYDRO TEST																													
DISCHARGE HEAD	_____ kgf/cm ² g	_____ kgf/cm ² g																													
COLUMN PIPE	_____ kgf/cm ² g	_____ kgf/cm ² g																													
BOWL	PAGE 3, LINE 13	PAGE 6, LINE 5																													
SUMP ARRANGEMENT																															
<table style="width: 100%;"> <tr> <td>SUMP DEPTH</td> <td>l_1</td> <td>_____ m</td> </tr> <tr> <td>PUMP LENGTH</td> <td>l_2</td> <td>_____ m</td> </tr> <tr> <td>GRADE TO C.L. DISCHARGE</td> <td>l_3</td> <td>_____ m</td> </tr> <tr> <td>GRADE TO LOW LIQUID LEVEL</td> <td>l_4</td> <td>_____ m</td> </tr> <tr> <td>GRADE TO 1ST STAGE IMPELLER EYE*</td> <td>l_5</td> <td>_____ m</td> </tr> <tr> <td>MINIMUM SUBMERGENCE REQUIRED**</td> <td>l_6</td> <td>_____ m</td> </tr> <tr> <td>SUMP DIAMETER</td> <td>d</td> <td>_____ m</td> </tr> </table> <p>SUMP ABS. PRESS. (MIN/NOR/MAX) _____ kgf/cm²a</p> <p>*UPPER IMPELLER EYE FOR VS2 AND VS7 PUMPS</p> <p>**LLL TO UPPER SUCTION BELL FOR VS2 AND VS7 PUMPS</p> <p>FRICTION LOSSES (@ RATED FLOW) – F.L.:</p> <p>DISCH. HEAD _____ m COLUMN _____ m</p> <p>TOTAL F.L. _____ m</p> <p>DIFF. HEAD ADJUSTMENT:</p> <p>HEAD@DISCHARGE C.L. + $l_3 + l_4 +$ TOTAL F.L. = _____ m</p> <p>NPSHA:</p> <p>(SUMP MIN. ABS. PRESS. – VAPOUR PRESS.) / SPECIFIC WEIGHT +</p> <p>$l_5 - l_4 -$ TOTAL F.L. = _____ m</p>				SUMP DEPTH	l_1	_____ m	PUMP LENGTH	l_2	_____ m	GRADE TO C.L. DISCHARGE	l_3	_____ m	GRADE TO LOW LIQUID LEVEL	l_4	_____ m	GRADE TO 1ST STAGE IMPELLER EYE*	l_5	_____ m	MINIMUM SUBMERGENCE REQUIRED**	l_6	_____ m	SUMP DIAMETER	d	_____ m							
SUMP DEPTH	l_1	_____ m																													
PUMP LENGTH	l_2	_____ m																													
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MINIMUM SUBMERGENCE REQUIRED**	l_6	_____ m																													
SUMP DIAMETER	d	_____ m																													
																															
REMARKS:																															


DATA SHEET		No.	REV.
 PETROBRAS		SHEET 6 of 7	
		TITLE: CENTRIFUGAL PUMP (VS)	
1	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> SPARE PARTS </div> <div style="width: 50%;"> QA INSPECTION AND TESTING (CONT.) </div> </div>		
2	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> START UP <input type="checkbox"/> NORMAL MAINTENANCE </div> <div style="width: 50%;"> <div style="display: flex; justify-content: space-between;"> <div>TEST</div> <div>N-WIT</div> <div>WIT</div> <div>OBS</div> </div> </div> </div>		
3	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> OTHER _____ </div> <div style="width: 50%;"> HYDROSTATIC <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
4	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> </div> <div style="width: 50%;"> FLUID _____ </div> </div>		
5	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> OTHER PURCHASER REQUIREMENTS </div> <div style="width: 50%;"> PRESSURE _____ kgf/cm² g </div> </div>		
6	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> COORDINATION MEETING REQUIRED </div> <div style="width: 50%;"> PERFORMANCE <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
7	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> MAXIMUM DISCHARGE PRESSURE TO INCLUDE </div> <div style="width: 50%;"> <input type="checkbox"/> NPSH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
8	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> MAX. DIA. IMPELLERS AND/OR Nº OF STAGES </div> <div style="width: 50%;"> <input type="checkbox"/> COMPLETE UNIT TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
9	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> OPERATION TO TRIP SPEED </div> <div style="width: 50%;"> <input type="checkbox"/> SOUND LEVEL TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
10	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> DRIVER MAXIMUM SPEED </div> <div style="width: 50%;"> <input type="checkbox"/> NOZZLE LOAD TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
11	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> </div> <div style="width: 50%;"> MECHANICAL RUN <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
12	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> CONNECTION DESIGN APPROVAL </div> <div style="width: 50%;"> <input type="checkbox"/> TRUE PEAK VELOCITY DATA <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
13	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> INERT GAS INHIBITED STORAGE – SPACE CARTRIDGE </div> <div style="width: 50%;"> <input type="checkbox"/> BRG. HSG. RESONANCE TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
14	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> TORSIONAL ANALYSIS REQUIRED <input type="checkbox"/> REPORT </div> <div style="width: 50%;"> <input type="checkbox"/> AUXILIARY EQUIPMENT TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
15	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> PROGRESS REPORTS </div> <div style="width: 50%;"> <input type="checkbox"/> CHARPY TEST <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> </div>		
16	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> OUTLINE OF PROCEDURES FOR OPTIONAL TESTS </div> <div style="width: 50%;"> <input type="checkbox"/> VENDOR KEEP REPAIR AND HT RECORDS </div> </div>		
17	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> ADDITIONAL DATA REQUIRING 20 YEARS RETENTION </div> <div style="width: 50%;"> <input type="checkbox"/> VENDOR SHALL SUBMIT INSPECTION AND TEST PLAN FOR </div> </div>		
18	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> REVIEW FOUNDATION AND PIPING DRAWINGS </div> <div style="width: 50%;"> PETROBRAS APPROVAL </div> </div>		
19	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> PIPING CHECKS <input type="checkbox"/> INITIAL ALIGNMENT </div> <div style="width: 50%;"> <input type="checkbox"/> VENDOR SUBMIT TEST DATA WITHIN 24 HOURS </div> </div>		
20	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> CHECK ALIGNMENT AT NORMAL TEMP. </div> <div style="width: 50%;"> <input type="checkbox"/> COMPLETION OF INSPECTION CHECK LIST </div> </div>		
21	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> COMMISSIONING / START UP SUPERVISION </div> <div style="width: 50%;"> <input type="checkbox"/> INSPECTION CLASS <input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III </div> </div>		
22	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> LATERAL ANALYSIS <input type="checkbox"/> PUMP <input type="checkbox"/> DRIVER </div> <div style="width: 50%;"> </div> </div>		
23	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> CRIT. SPEED ANALYSIS <input type="checkbox"/> DAMPED UNB. RESP. ANALYSIS </div> <div style="width: 50%;"> </div> </div>		
24	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> DYNAMIC BALANCE ROTOR </div> <div style="width: 50%;"> </div> </div>		
25	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> STIFFNESS MAP OF UNDAMPED ROTOR </div> <div style="width: 50%;"> </div> </div>		
26	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> REVIEW Q.A. PGM. </div> <div style="width: 50%;"> </div> </div>		
27	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> INSTALLATION LIST IN PROPOSAL </div> <div style="width: 50%;"> </div> </div>		
28			
29	PIPING AND APPURTENANCES		
30	<input type="checkbox"/> MOUNT SEAL RESERVOIR OFF BASEPLATE		
31	<input type="checkbox"/> FLANGES REQ'D IN PLACE OF SOCKET WELD UNIONS		
32	CONNECTION FASTENERS		
33	<input type="checkbox"/> STANDARD ZINC-NICKEL COATED <input type="checkbox"/> S.S.		
34	QA INSPECTION AND TESTING		
35	<input type="checkbox"/> SHOP INSPECTION		
36	<input type="checkbox"/> PERFORMANCE CURVE APPROVAL		
37	<input type="checkbox"/> TEST WITH SUBSTITUTE SEAL		
38	<input type="checkbox"/> MATERIAL CERTIFICATION REQUIRED		
39	<input type="checkbox"/> CASING <input type="checkbox"/> IMPELLER <input type="checkbox"/> SHAFT		
40	<input type="checkbox"/> OTHER _____		
41	<input type="checkbox"/> INSPECTION REQUIRED FOR CONNECTION WELDS		
42	<input type="checkbox"/> MAG PARTICLE <input type="checkbox"/> LIQUID PENETRANT		
43	<input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC		
44	<input type="checkbox"/> INSPECTION REQUIRED FOR CASTINGS		
45	<input type="checkbox"/> MAG PARTICLE <input type="checkbox"/> LIQUID PENETRANT		
46	<input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC		
47	<input type="checkbox"/> HARDNESS TEST REQUIRED		
48	<input type="checkbox"/> ADDITIONAL SURFACE/ SUBSURFACE EXAMINATION		
49	FOR _____		
50	METHOD _____		
51			
52			
53	REMARKS: _____		
54	_____		
55	_____		
56	_____		
57	_____		
58	_____		
59	_____		
60	_____		


	DATA SHEET		No.	REV.
				SHEET <i>7</i> of <i>7</i>
	TITLE: CENTRIFUGAL PUMP (VS)			
NOTES				


Annex C - Mechanical Seal Data Sheet

 PETROBRAS	DATA SHEET				No.					
	CLIENT:							SHEET 1 of 5		
	JOB:									
	AREA:									
TITLE:							MECHANICAL SEAL			
INDEX OF REVISIONS										
REV.	DESCRIPTION AND/OR REVISED SHEETS									
	REV. D	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H	
DATE										
DESIGN										
EXECUTION										
CHECK										
APPROVAL										
INFORMATION IN THIS DOCUMENT IS PROPERTY OF PETROBRAS, BEING PROHIBITED OUTSIDE OF THEIR PURPOSE.										
FORM OWNED TO PETROBRAS N-553 REV. E ANNEX C - SHEET 01/05.										

DATA SHEET		No.	REV.
		SHEET 2 of 5	
		TITLE: MECHANICAL SEAL	
1	APPLICABLE TO <input type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS BUILT		
2	FOR _____ UNIT _____		
3	SITE _____ SERVICE _____		
4	MANUFACTURER _____ No. REQUIRED _____		
5	VENDOR _____ SERIAL No. _____		
6	MODEL _____ MAIN EQUIPMENT _____ / _____		
7	SIZE / TYPE _____ / _____		
8	SEAL SPECIFICATION		
9	CATEGORY <input type="checkbox"/> SEAL CATEGORY 1 <input type="checkbox"/> SEAL CATEGORY 2 <input type="checkbox"/> SEAL CATEGORY 3		
10	TYPE <input type="checkbox"/> TYPE A <input type="checkbox"/> TYPE B <input type="checkbox"/> ALTERNATIVE STATIONARY (TYPE A & B)		
11	(CODE-CW) <input type="checkbox"/> TYPE C <input type="checkbox"/> ALTERNATIVE ROTATING (TYPE C) <input type="checkbox"/> SINGLE SPRING (TYPE A)		
12	ARR'G'T	DEFAULT CONFIG.	FLUSH PLANS
13	1	(CAT. 1 & 2) <input type="checkbox"/> 1CW-FX	<input type="checkbox"/> 1 CW-FL (CAT. 1 & 2) <input type="checkbox"/> 01 <input type="checkbox"/> 11 <input type="checkbox"/> 14 <input type="checkbox"/> 23 <input type="checkbox"/> 32 <input type="checkbox"/> 51 <input type="checkbox"/> 62
14		(CAT. 3) <input type="checkbox"/> 1CW-FL	<input type="checkbox"/> DIST. FLUSH (CAT. 1 & 2) <input type="checkbox"/> 02 <input type="checkbox"/> 13 <input type="checkbox"/> 21 <input type="checkbox"/> 31 <input type="checkbox"/> 41 <input type="checkbox"/> 61 <input type="checkbox"/> 65
15		<input type="checkbox"/> ALTERNATIVE BUSH	
16	2	LIQUID <input type="checkbox"/> 2CW-CW	<input type="checkbox"/> TANGENTIAL LBO <input type="checkbox"/> FX <input type="checkbox"/> 01 <input type="checkbox"/> 13 <input type="checkbox"/> 23 <input type="checkbox"/> 41 <input type="checkbox"/> 62 <input type="checkbox"/> 75
17		CONN'N (CAT. 1 & 2) <input type="checkbox"/> DIST. FLUSH <input type="checkbox"/> 02 <input type="checkbox"/> 14 <input type="checkbox"/> 31 <input type="checkbox"/> 52 <input type="checkbox"/> 71 <input type="checkbox"/> 76	
18	3	GAS <input type="checkbox"/> 2CW-CS	<input type="checkbox"/> 2NC-CS <input type="checkbox"/> 11 <input type="checkbox"/> 21 <input type="checkbox"/> 32 <input type="checkbox"/> 61 <input type="checkbox"/> 72
19		LIQUID <input type="checkbox"/> 3CW-FB	<input type="checkbox"/> 3CW-BB <input type="checkbox"/> FX <input type="checkbox"/> 01 <input type="checkbox"/> 13 <input type="checkbox"/> 53A <input type="checkbox"/> 54 <input type="checkbox"/> 74
20	3	<input type="checkbox"/> 3CW-FF	<input type="checkbox"/> TANG. LBO. (CAT. 1 & 2) <input type="checkbox"/> 02 <input type="checkbox"/> 14 <input type="checkbox"/> 53B <input type="checkbox"/> 61
21		GAS <input type="checkbox"/> 3NC-BB	<input type="checkbox"/> 3NC-FF <input type="checkbox"/> 3NC-FB <input type="checkbox"/> 11 <input type="checkbox"/> 32 <input type="checkbox"/> 53C <input type="checkbox"/> 62
22	SLEEVE-SHAFT DRIVE <input type="checkbox"/> SET-SCREW ONTO SHAFT <input type="checkbox"/> ALTERNATIVE - SPECIFY _____		
23	MATERIAIS		
24	SECONDARY SEALS	SEALS FACES	METAL BELLOWS
25	<input type="checkbox"/> FKM <input type="checkbox"/> FFKM	<input type="checkbox"/> CARBON VS SIC	<input type="checkbox"/> UNS N10276 (TYPE B)
26	<input type="checkbox"/> SPIRAL-W GASKET	<input type="checkbox"/> SIC VS SIC	<input type="checkbox"/> UNS N07718 (TYPE C)
27	<input type="checkbox"/> FLEXIBLE GRAPHITE	<input type="checkbox"/> SS-SIC <input type="checkbox"/> RB-SIC	<input type="checkbox"/> UNS N08020
28	<input type="checkbox"/> NBR	<input type="checkbox"/> _____ VS _____	<input type="checkbox"/> OTHER _____
29	<input type="checkbox"/> OTHER _____		<input type="checkbox"/> UNS S31600 OR S31635
30			<input type="checkbox"/> UNS S31600 OR S31635
31	MECHANICAL SEAL DATA		
32	<input type="checkbox"/> SEAL VENDOR _____		<input type="checkbox"/> DYNAMIC SEALING PRESSURE RAT./MAX. _____ / _____ kgf/cm ² g
33	<input type="checkbox"/> C�DIGO _____		<input type="checkbox"/> STATIC SEALING PRESS. RAT./MAX. _____ / _____ kgf/cm ² g
34	<input type="checkbox"/> SIZE / TYPE _____		<input type="checkbox"/> MAXIMUM ALLOWABLE TEMPERATURE _____ �C
35	<input type="checkbox"/> SEAL DRAWING NUMBER _____		<input type="checkbox"/> MINIMUM DESIGN METAL TEMPERATURE _____ �C
36	<input type="checkbox"/> VENDOR'S SEAL CODE _____		<input type="checkbox"/> GENERATED HEAT @ NORMAL CONDITIONS _____ kW
37	<input type="checkbox"/> MODIFIED FACES FOR PUMP PERFORMANCE TEST		<input type="checkbox"/> HEAT SOAK @ NORMAL CONDITIONS _____ kW
38	<input type="checkbox"/> ALTERNATIVE SEAL FOR PUMP PERFORMANCE TEST		<input type="checkbox"/> TOTAL SEAL AXIAL THRUST ON SHAFT _____ kgf
39			<input type="checkbox"/> ALLOWABLE LEAKAGE RAT./MAX. _____ / _____ ml/h
40			
41	SEAL CHAMBER DATA		
42	<input type="checkbox"/> ASME B73.1 & 2 <input type="checkbox"/> CYLINDRICAL <input type="checkbox"/> TAPERED <input type="checkbox"/> API STD 610 <input type="checkbox"/> ISO 3089-C <input type="checkbox"/> OTHER _____		
43	<input type="checkbox"/> BOLT-ON CHAMBER <input type="checkbox"/> SEAL CHAMBER FLUSH PORT REQ'D <input type="checkbox"/> SEAL CHAMBER VENT REQ'D		
44	<input type="checkbox"/> FLOATING THROAT BUSH <input type="checkbox"/> FIXED THROAT BUSH <input type="checkbox"/> CHAMBER HEATING REQ'D		
45	PUMP DATA		
46	<input type="checkbox"/> SEE PUMP DATA SHEET _____		
47	PUMP DESIGN <input type="checkbox"/> MANUFAC. _____ <input type="checkbox"/> MODEL _____ <input type="checkbox"/> SIZE/TYPE _____ <input type="checkbox"/> CASE MAT. _____		
48	PUMP OPERATING PRESSURE <input type="checkbox"/> SUCTION PRESS. (RATED) _____ kgf/cm ² g <input type="checkbox"/> DISCHARGE PRESSURE _____ kgf/cm ² g		
49	SEAL CHAMBER <input type="checkbox"/> NORMAL _____ kgf/cm ² g <input type="checkbox"/> MIN./MAX. _____ / _____ kgf/cm ² g <input type="checkbox"/> MSSP _____ kgf/cm ² g		
50	SHAFT <input type="checkbox"/> HORIZONTAL <input type="checkbox"/> VERTICAL SHAFT ROTATION DIRECTION (FROM DRIVER) <input type="checkbox"/> CW <input type="checkbox"/> CCW		
51	<input type="checkbox"/> DIA _____ mm <input type="checkbox"/> SPEED _____ rpm		
52			
53	REMARKS:		
54			
55			
56			
57			
58			

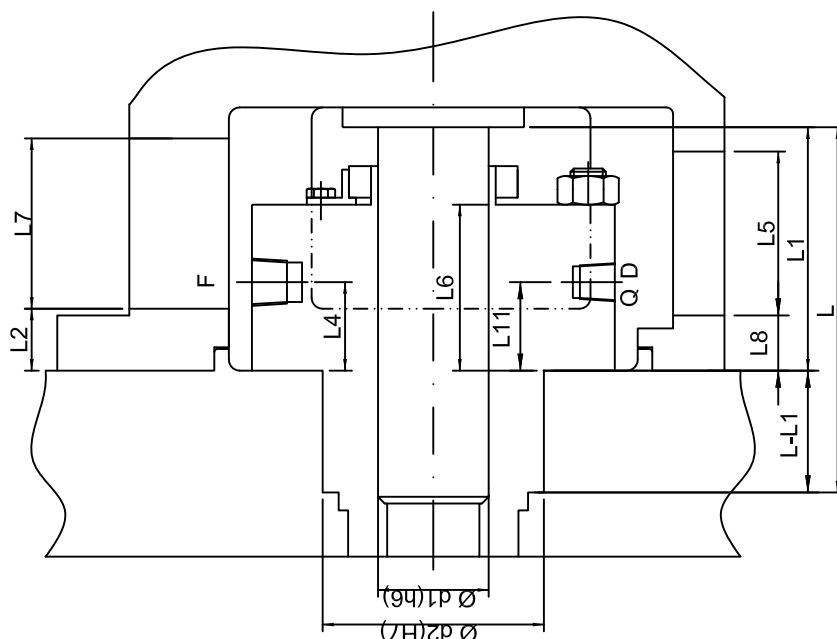
		DATA SHEET		No.	REV.
				SHEET 3 of 5	
TITLE:		MECHANICAL SEAL			
1 FLUID DATA					
2 PUMPED STREAM					
3 <input type="checkbox"/> TYPE OR NAME _____ CONC'C _____ %					
4 <input type="checkbox"/> DISSOLVED CONTAMINANT <input type="checkbox"/> H ₂ S ppm (mass) <input type="checkbox"/> WET					
5 <input type="checkbox"/> Cl ppm (mass) <input type="checkbox"/> OTHER _____ @ _____ ppm (mass)					
6 <input type="checkbox"/> SOLID CONTAMINANT _____					
7 <input type="checkbox"/> CONCENTRATION _____					
8 <input type="checkbox"/> TEMPERATURA DE BOMBEAMENTO					
9 MIN. _____ °C NORMAL _____ °C MAX. _____ °C					
10 <input type="checkbox"/> RELATIVE DENSITY (TO WATER @ 25°C) AT					
11 NORMAL TEMP. _____ MAX. TEMP. _____					
12 <input type="checkbox"/> ABSOLUTE VAPOR PRESSURE AT					
13 NORMAL TEMP. _____ kgf/cm ² MAX. TEMP. _____ kgf/cm ²					
14 <input type="checkbox"/> ATMOSPHERIC BOILING POINT _____ °C					
15 <input type="checkbox"/> VISCOSITY @ NORMAL PUMPING TEMP. _____ cP					
16 <input type="checkbox"/> SPECIFIC HEAT (C.P.) @ NORMAL TEMP. _____ kcal/kg°C					
17					
18 FLUSH (IF FLUSH IS PUMPAGE, THEN FLUSH DATA IS NOT REQUIRED)					
19 <input type="checkbox"/> TYPE OR NAME _____ CONC'N _____ %					
20 <input type="checkbox"/> FLUID PRESSURE NOR. _____ MIN. _____ kgf/cm ² g					
21 <input type="checkbox"/> FLUID TEMPERATURE					
22 MIN. _____ °C NOR. _____ °C MAX. _____ °C					
23 <input type="checkbox"/> RELATIVE DENSITY (TO WATER @ 25°C) AT					
24 NORMAL TEMP. _____ MAX. TEMP. _____					
25					
26 QUENCH MEDIUM					
27 <input type="checkbox"/> TYPE OR NAME _____					
28					
29 BUFFER/BARRIER MEDIUM					
30 <input type="checkbox"/> TYPE OR NAME _____					
31 <input type="checkbox"/> PURCHASER SELEC'N <input type="checkbox"/> SEAL VENDOR SELEC'N					
32 <input type="checkbox"/> SEAL VENDOR REVIEW <input type="checkbox"/> PURCHASER REVIEW					
33 <input type="checkbox"/> FLOW RATE REQ'D MAX./MIN. _____ / _____ l/min					
34 <input type="checkbox"/> COOLING/HEATING REQUIRED (±) _____ kW					
35 <input type="checkbox"/> SUPPLY PRESSURE MAX./MIN. _____ / _____ kgf/cm ² g					
36 <input type="checkbox"/> FLUID OPERATING TEMPERATURE					
37 MIN. _____ °C NOR. _____ °C MAX. _____ °C					
38					
39 SITE AND UTILITIES					
40 <input type="checkbox"/> CONTROL VOLTAGE _____ PHASE _____ HERTZ _____					
41 <input type="checkbox"/> ELECTRICAL AREA ZN _____ GR _____ CL _____					
42 <input type="checkbox"/> AMBIENT TEMP. MIN./MAX. _____ / _____ °C					
43 <input type="checkbox"/> ATEX (EC DIRETRIZ 94/9/EC) _____					
44					
45 REMARKS:					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
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59					
60					

DATA SHEET		No.	REV.
		SHEET	4 of 5
		TITLE: MECHANICAL SEAL	
ACCESSORIES			
GENERAL <input type="checkbox"/> JOINT USER / VENDOR LAYOUT OF EQUIPMENT <input type="checkbox"/> SPECIAL REQUIREMENTS FOR HAZARDOUS SERVICE <input type="checkbox"/> SPECIAL CLEANING AND DECONTAMINATION REQUIREMENTS <input type="checkbox"/> TYPE AND SPEC. OF HEAT TRACING <input type="checkbox"/> THERMAL RELIEF VALVES REQUIRED COOLING SYSTEM (PLANS 21, 22, 23, 41, 53B AND 53C) <input type="checkbox"/> HEAT EXCHANGER SUPPLIER <input type="checkbox"/> WATER COOLED <input type="checkbox"/> AIR COOLED <input type="checkbox"/> ASME B31.2 <input type="checkbox"/> EQUIPMENT REFERENCE/CODE <input type="checkbox"/> COOLING WATER LINES SUPPLIER <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE <input type="checkbox"/> COOLING WATER FLOW RATE ____ l/min <input type="checkbox"/> SIGHT FLOW INDICATORS <input type="checkbox"/> OPEN <input type="checkbox"/> CLOSED PLAN 11, 13, 14, 21, 23, 31, 32 AND 41 SYSTEMS <input type="checkbox"/> CONNECTING LINES SUPPLIER <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE <input type="checkbox"/> RESTRICTION ORIFICE NIPPLE IN FLUSH LINE <input type="checkbox"/> CYCLONE SEPARATOR SUPPLIER <input type="checkbox"/> PLAN 32 EQUIPMENT SUPPLIER <input type="checkbox"/> PLAN 32 <input type="checkbox"/> FLOW INDICATOR <input type="checkbox"/> TEMP. INDICATOR PLAN 52 AND 53 <input type="checkbox"/> STANDARD <input type="checkbox"/> ALTERNATIVE <input type="checkbox"/> DIMENSIONAL VARIATIONS TO STANDARD <input type="checkbox"/> DIMENSIONAL VARIATIONS TO ALTERNATIVE <input type="checkbox"/> ALTERNATIVE FABRICATION STD <input type="checkbox"/> PRIMARY EQUIPMENT SUPPLIER <input type="checkbox"/> SUPP. REFERENCE/CODE <input type="checkbox"/> CONNECTING LINES SUPPLIER <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE		PLAN 52 AND 53 (CONT.) <input type="checkbox"/> EQUIPMENT SUPPORT SUPPLIER <input type="checkbox"/> FILLING SYSTEM SUPPLIER <input type="checkbox"/> ASME CODE STAMP REQUIRED <input type="checkbox"/> OTHER CODE APPLICABLE <input type="checkbox"/> RESERVOIR CAPACITY ____ l <input type="checkbox"/> NLL TO GLAND PLATE HEIGHT ____ m <input type="checkbox"/> RESERVOIR MAWP ____ kgf/cm ² g @ ____ °C <input type="checkbox"/> SET PRESSURE RANGE, MAX/MIN ____ / ____ kgf/cm ² g <input type="checkbox"/> SYSTEM HOLD-UP PERIOD ____ DAYS (PLANS 53B AND 53C) <input type="checkbox"/> TEMPERATURE INDICATOR (PLANS 53B AND 53C) PRESSURE ALARM ON <input type="checkbox"/> RISING PRESSURE (ARR2) SET @ ____ kgf/cm ² g <input type="checkbox"/> FALLING PRESSURE (ARR3) SET @ ____ kgf/cm ² g <input type="checkbox"/> HIGH LEVEL ALARM REQUIRED <input type="checkbox"/> H/Q CURVE FOR INTERNAL CIRCULATING DEVICE <input type="checkbox"/> TEST BASED H/Q CURVE FOR INTERNAL CIRCULATING DEVICE <input type="checkbox"/> EXTERNAL CIRCULATING PUMP PLAN 72 AND 74 <input type="checkbox"/> EQUIPMENT SUPPLIER <input type="checkbox"/> HIGH FLOW ALARM PLAN 75 AND 76 <input type="checkbox"/> EQUIPMENT SUPPLIER <input type="checkbox"/> HIGH LEVEL ALARM FOR PLAN 75 <input type="checkbox"/> TEST CONNECTION INSTRUMENTATION <input type="checkbox"/> USER SPEC. REF. FOR INST. / CONTR PRESSURE INDICATORS <input type="checkbox"/> OIL FILLED PRESSURE GAUGES <input type="checkbox"/> PRESSURE TRANSMITTER <input type="checkbox"/> LEVEL TRANSMITTER <input type="checkbox"/> HYDROSTATIC <input type="checkbox"/> CAPACITANCE <input type="checkbox"/> ULTRASONIC <input type="checkbox"/> LEVEL TRANSMITTER <input type="checkbox"/> WELD PAD <input type="checkbox"/> EXTERNAL, REMOVABLE <input type="checkbox"/> FLOW TRANSMITTER <input type="checkbox"/> TEMPERATURE TRANSMITTER	
INSPECTION AND TESTING			
<input type="checkbox"/> PURCHASER PARTICIPATION IN INSPECTION & TEST SPECIFY <input type="checkbox"/> INSPECTOR'S CHECK LIST <input type="checkbox"/> OPTIONAL QUALIFICATION TESTING REQ'D <input type="checkbox"/> PURCHASER APPROVAL REQUIRED FOR WELDED CONNECTION DESIGNS <input type="checkbox"/> HARDNESS TEST REQUIRED FOR		<input type="checkbox"/> 100 % INSPECTION OF ALL WELDS USING <input type="checkbox"/> MAGNETIC PARTICLE <input type="checkbox"/> LIQUID PENETRANT <input type="checkbox"/> RADIOGRAPHIC <input type="checkbox"/> ULTRASONIC <input type="checkbox"/> MODIFIED FACES FOR PUMP TEST <input type="checkbox"/> ALTERNATIVE SEAL PUMP TEST	
REMARKS:			

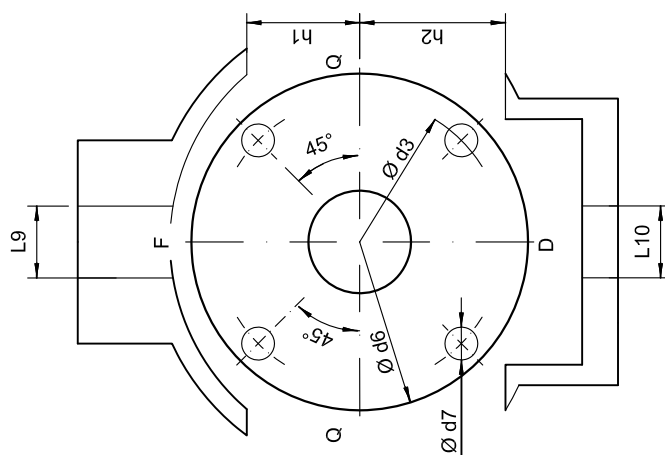
 PETROBRAS	DATA SHEET	No.	REV.
			SHEET 5 of 5
	TITLE:		
	MECHANICAL SEAL		
NOTES			



Annex D - OH2 Pumps Seal Chambers Dimensions



Plan API	FI NPT
11	F
12	F
13	F
21	F
22	F
31	F
41	F
61	Q/D
62	Q/D
65	D

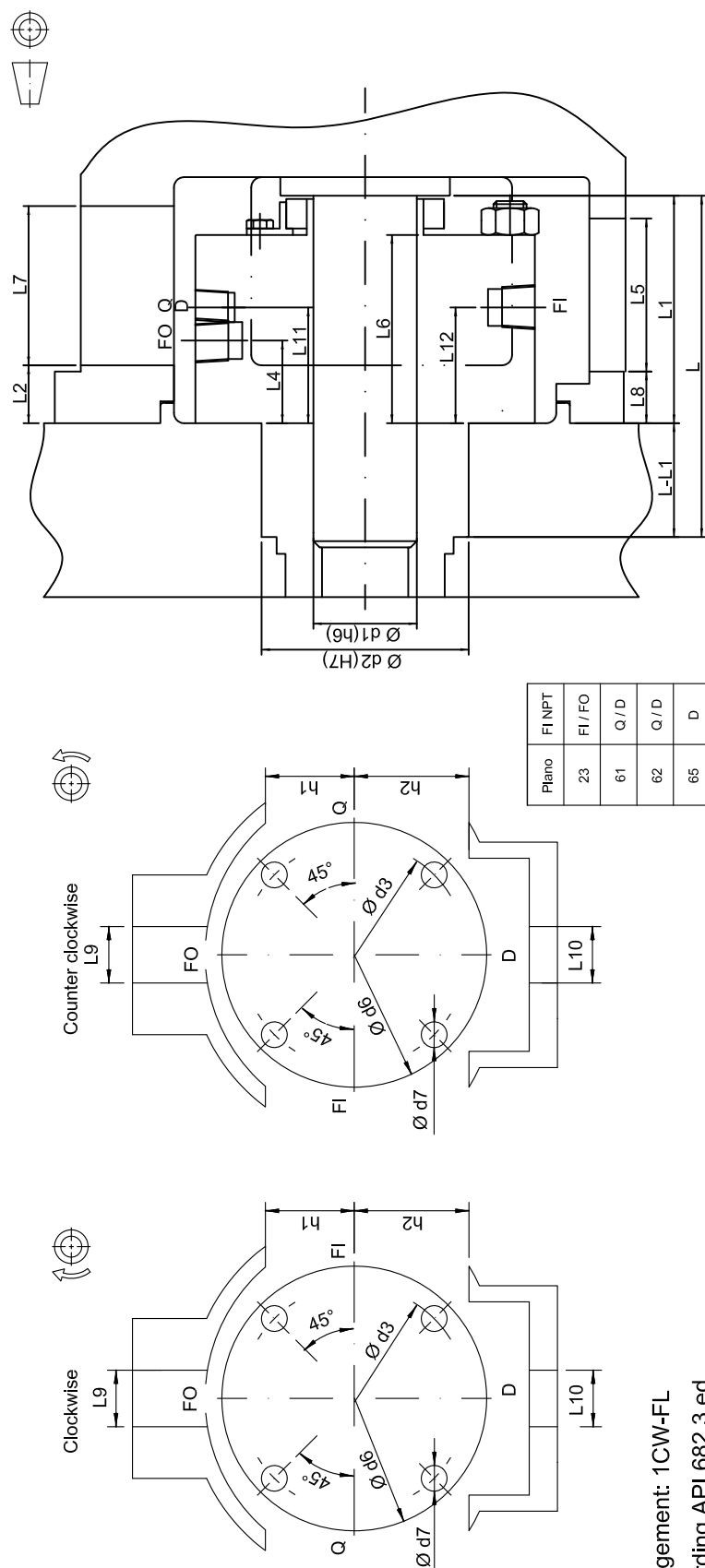


Arrangement: 1CW-FL
According API 682 3.ed

Chamber	F NPT	Q NPT	D NPT	Ø d1	Ø d2	Ø d3	Ø d6	Ø d7	L	L1	L-L1	L2	L4	L5	L6	L7	L8	L9	L10	L11	h1	h2
3	1/2" / NPT	3/8" / NPT	1/2" / NPT	40	90	125	150	M12 or 1/2"	170	100	70	29	43	72	76	80	28	35	35	62	55	65
4	1/2" / NPT	3/8" / NPT	1/2" / NPT	49	100	140	164	M16 or 5/8"	165	110	55	28	43	74	74	77	25	35	35	62	55	71
5	1/2" / NPT	3/8" / NPT	1/2" / NPT	59	120	160	190	M16 or 5/8"	170	110	60	30	45	80	74	80	30	35	35	62	65	85
6	1/2" / NPT	3/8" / NPT	1/2" / NPT	69	130	170	201	M16 or 5/8"	175	110	65	26	45	74	74	88	18	35	35	62	65	95
7	1/2" / NPT	3/8" / NPT	1/2" / NPT	79	140	180	211	M16 or 5/8"	180	110	70	30	45	66	77	84	30	35	35	62	70	100
7a	1/2" / NPT	3/8" / NPT	1/2" / NPT	74	140	180	211	M16 or 5/8"	180	110	70	30	45	66	77	84	30	35	35	62	70	100
8	1/2" / NPT	3/8" / NPT	1/2" / NPT	86	160	205	245	M20 or 3/4"	185	120	65	12	27	96	65	100	24	40	40	50	118	118
9	1/2" / NPT	3/8" / NPT	1/2" / NPT	99	170	215	247	M20 or 3/4"	185	120	65	40	55	80	87	81	40	35	35	72	85	85

NOTE All dimensions in millimeters, unless otherwise indicated.

Figure D.1 - Configuration 1

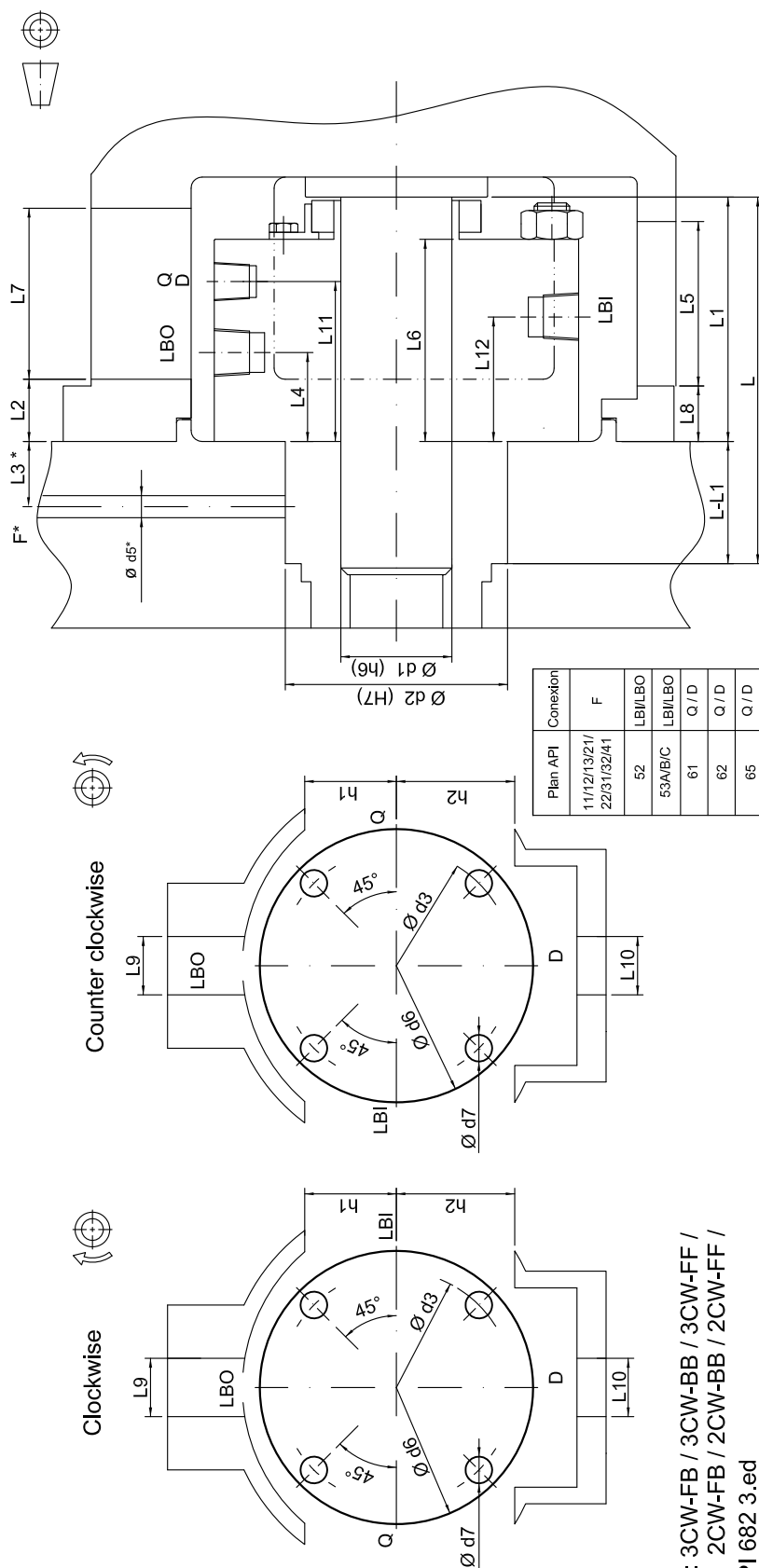


Arrangement: 1CW-FL
According API 682 3.ed

NOTE All dimensions in millimeters, unless otherwise indicated.

Chamber	FI NPT	FO NPT	Q NPT	D NPT	Ø d1	Ø d2	Ø d3	Ø d6	Ø d7	L	L1	L - L1	L2	L4	L5	L6 max	L7	L8	L9	L10	L11	L12	h1	h2
3	1 1/2" / NPT	1 1/2" / NPT	3/8" / NPT	1 1/2" / NPT	40	90	125	150	M12 or 1/2"	170	100	70	29	43	72	81	80	28	35	35	69	55	65	
4	1 1/2" / NPT	1 1/2" / NPT	3/8" / NPT	1 1/2" / NPT	49	100	140	164	M16 or 5/8"	165	110	55	28	43	74	87	77	25	35	35	75	56	71	
5	1 1/2" / NPT	1 1/2" / NPT	3/8" / NPT	1 1/2" / NPT	59	120	160	190	M16 or 5/8"	170	110	60	30	45	80	90	80	30	35	35	78	62	85	
6	3/4" / NPT	3/4" / NPT	3/8" / NPT	1 1/2" / NPT	69	130	170	201	M16 or 5/8"	175	110	65	26	45	74	90	88	18	35	35	78	62	95	
7	3/4" / NPT	3/4" / NPT	3/8" / NPT	1 1/2" / NPT	79	140	180	211	M16 or 5/8"	180	110	70	30	45	66	90	84	30	35	35	76	59	100	
7a	3/4" / NPT	3/4" / NPT	3/8" / NPT	1 1/2" / NPT	74	140	180	211	M16 or 5/8"	180	110	70	30	45	66	90	84	30	35	35	76	59	100	
8	3/4" / NPT	3/4" / NPT	3/8" / NPT	1 1/2" / NPT	86	160	205	245	M20 or 3/4"	185	120	65	12	45	96	101	100	24	40	40	87	70	118	
9	3/4" / NPT	3/4" / NPT	3/8" / NPT	1 1/2" / NPT	99	170	215	247	M20 or 3/4"	185	120	65	40	55	80	101	81	40	35	35	87	66	85	

Figure D.2 - Configuration 2



NOTE All dimensions in millimeters, unless otherwise indicated.

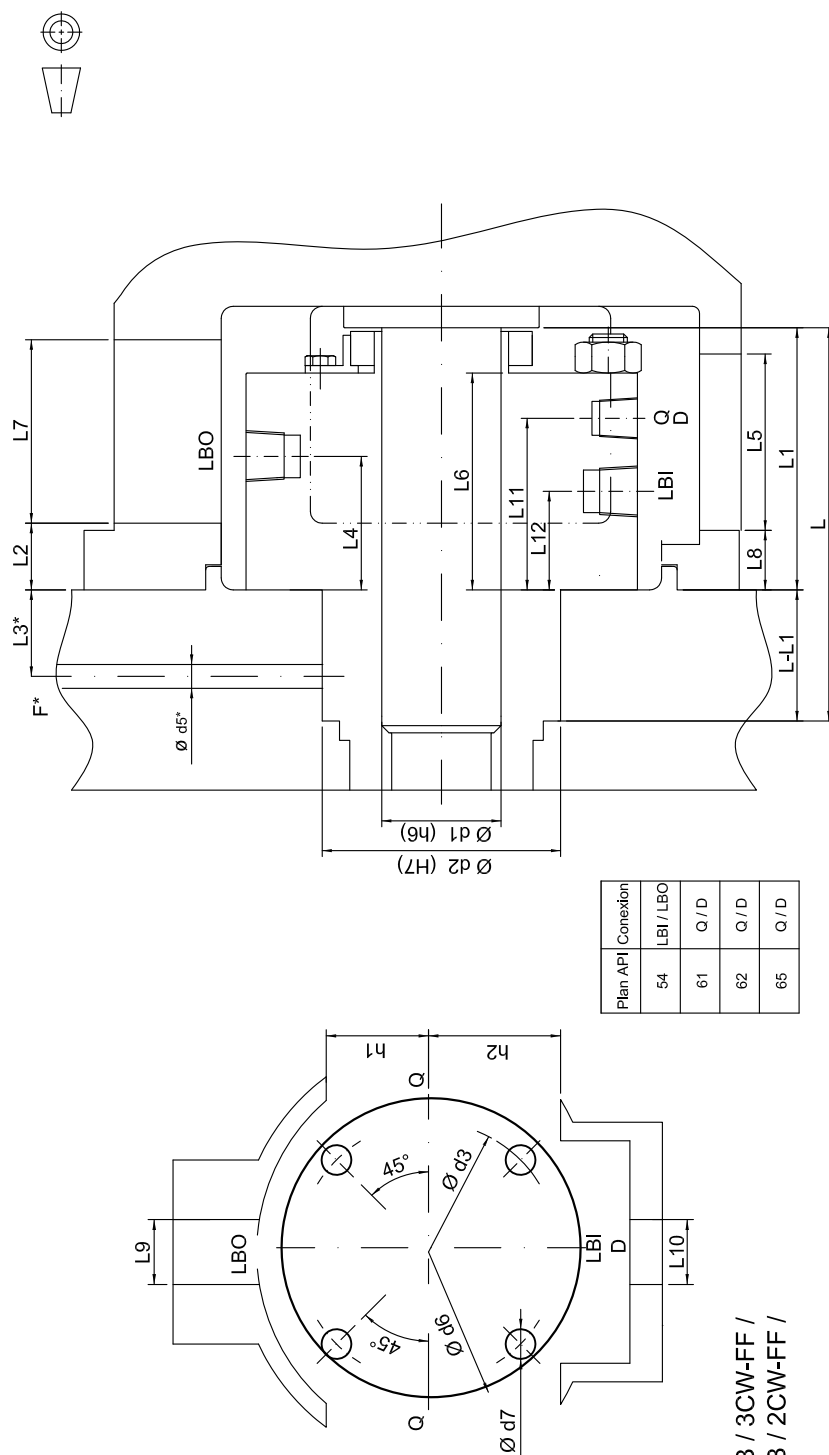
Arrangement: 3CW-FB / 3CW-BB / 3CW-FF /
2CW-FB / 2CW-BB / 2CW-FF /

According API 682 3.ed

* Flush connections (F) available only for FB (face to back) seals arrangement

Chamber	LBL NPT	LBO NPT	Q NPT	D NPT	Ø d1	Ø d2	Ø d3	Ø d5*	Ø d6	Ø d7	L	L1	L-L1	L2	L3 max*	L4	L5	L6 max	L7	L8	L9	L10	L11	L12	h1	h2
3	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	40	90	125	10	150	M12 or 1/2"	170	100	70	29	20	43	72	81	80	28	35	35	69	55	55	65
4	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	49	100	140	8	164	M16 or 5/8"	165	110	55	28	34	43	74	87	77	25	35	35	75	56	55	71
5	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	59	120	160	8	190	M16 or 5/8"	170	110	60	30	41	45	80	90	80	30	35	35	78	62	65	85
6	3/4" / NPT	3/4" / NPT	3/8" / NPT	1/2" / NPT	69	130	170	8	201	M16 or 5/8"	175	110	65	26	30	45	74	90	88	18	35	35	78	62	65	95
7	3/4" / NPT	3/4" / NPT	3/8" / NPT	1/2" / NPT	79	140	180	8	211	M16 or 5/8"	180	110	70	30	38	45	66	90	84	30	35	35	76	59	70	100
7a	3/4" / NPT	3/4" / NPT	3/8" / NPT	1/2" / NPT	74	140	180	8	211	M16 or 5/8"	180	110	70	30	38	45	66	90	84	30	35	35	76	59	70	100
8	3/4" / NPT	3/4" / NPT	3/8" / NPT	1/2" / NPT	86	160	205	12	245	M20 or 3/4"	185	120	65	12	35*	45	96	101	100	24	40	40	87	70	118	118
9	3/4" / NPT	3/4" / NPT	3/8" / NPT	1/2" / NPT	99	170	215	10	247	M20 or 3/4"	185	120	65	40	61	55	80	101	81	40	35	35	87	66	85	85

Figure D.3 - Configuration 3



Plan API	Conexión
54	LBI / LBO
61	Q / D
62	Q / D
65	Q / D

Arrangement: 3CW-FB / 3CW-BB / 3CW-FF /
2CW-FB / 2CW-BB / 2CW-FF /

According API 682 3.ed

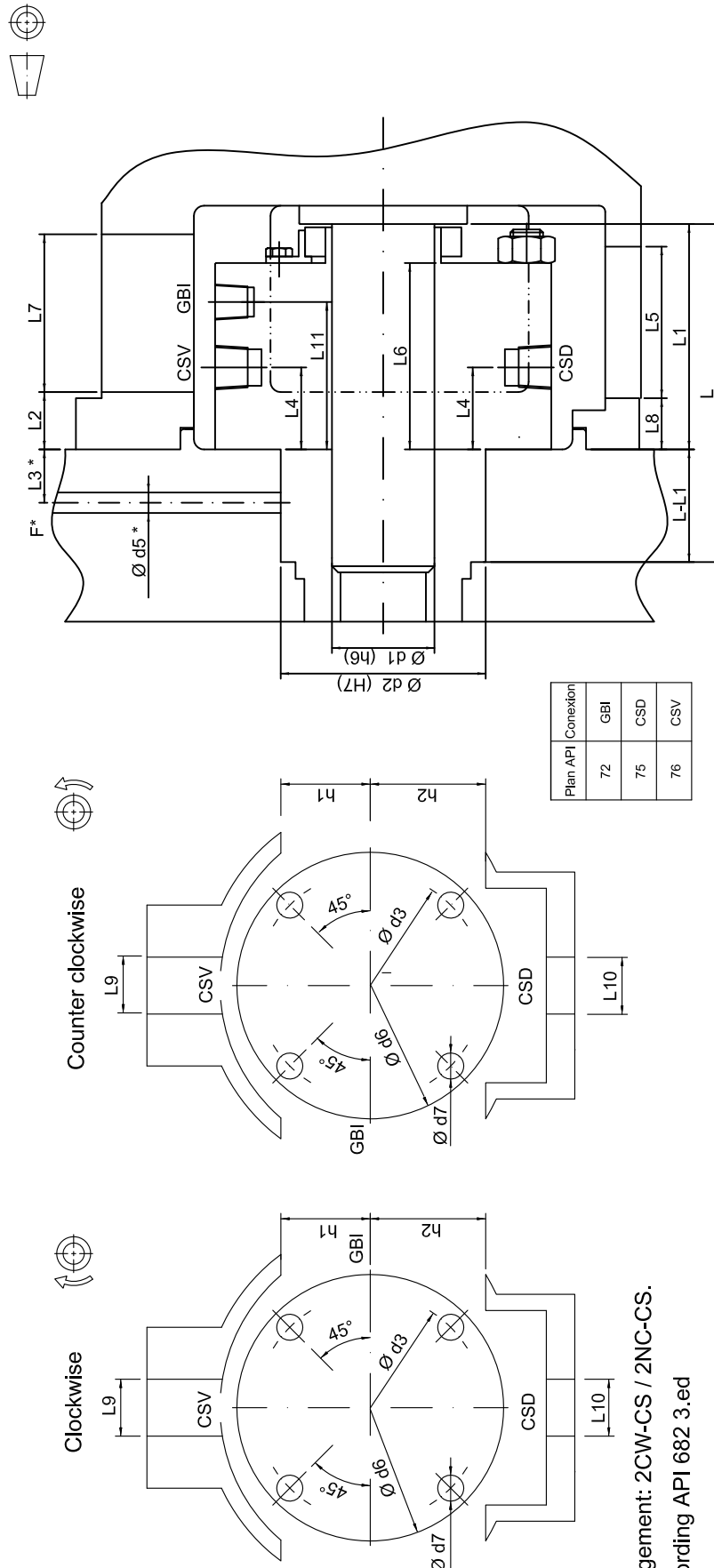
* Flush connections (F) available only for FB (face to back) seals arrangements.

Chamber	LBL NPT	LBO NPT	Q NPT	D NPT	Ø d1	Ø d2	Ø d3	Ø d5*	Ø d6	Ø d7	L	L1	L - L1	L2	L3 max*	L4	L5	L6 max	L7	L8	L9	L10	L11	L12	h1	h2	
3	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	40	90	125	10	150	M12 or 1/2"	170	100	70	29	20	55	72	81	80	28	35	35	35	69	43	55	65
4	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	49	100	140	8	164	M16 or 5/8"	165	110	55	28	34	56	74	87	77	25	35	35	35	75	43	55	71
5	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	59	120	160	8	190	M16 or 5/8"	170	110	60	30	41	62	80	90	80	30	35	35	35	78	45	65	85
6	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	69	130	170	8	201	M16 or 5/8"	175	110	65	26	30	62	74	90	88	18	35	35	35	78	45	65	95
7	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	79	140	180	8	211	M16 or 5/8"	180	110	70	30	38	59	66	90	84	30	35	35	35	76	45	70	100
7a	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	74	140	180	8	211	M16 or 5/8"	180	110	70	30	38	59	66	90	84	30	35	35	35	76	45	70	100
8	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	86	160	205	12	245	M20 or 3/4"	185	120	65	12	35*	70	96	101	100	24	40	40	40	87	45	118	118
9	1/2" / NPT	1/2" / NPT	3/8" / NPT	1/2" / NPT	99	170	215	10	247	M20 or 3/4"	185	120	65	40	61	66	80	101	81	40	35	35	35	87	55	85	85

NOTE All dimensions in millimeters, unless otherwise indicated.

Figure D.4 - Configuration 4

NOTE All dimensions in millimeters, unless otherwise indicated.



Arrangement: 2CW-CS / 2NC-CS.

According API 682 3.ed

* Flush connections (F) available only for FB (face to back) seals arrangement

Chamber	GBI NPT	CSV NPT	CSD NPT	Ø d1	Ø d2	Ø d3	Ø d5*	Ø d6	Ø d7	L	L1	L - L1	L2	L3 max*	L4	L5	L6 max	L7	L8	L9	L10	L11	h1	h2
3	3/8" / NPT	1/2" / NPT	1/2" / NPT	40	90	125	10	150	M12 or 1/2"	170	100	70	29	20	43	72	81	80	28	35	35	65	55	65
4	3/8" / NPT	1/2" / NPT	1/2" / NPT	49	100	140	8	164	M16 or 5/8"	165	110	55	28	34	43	74	87	77	25	35	35	75	55	71
5	3/8" / NPT	1/2" / NPT	1/2" / NPT	59	120	160	8	190	M16 or 5/8"	170	110	60	30	41	45	80	90	80	30	35	35	70	65	85
6	3/8" / NPT	1/2" / NPT	1/2" / NPT	69	130	170	8	201	M16 or 5/8"	175	110	65	26	30	45	74	90	88	18	35	35	70	65	95
7	3/8" / NPT	1/2" / NPT	1/2" / NPT	79	140	180	8	211	M16 or 5/8"	180	110	70	30	38	45	66	90	84	30	35	35	70	70	100
7a	3/8" / NPT	1/2" / NPT	1/2" / NPT	74	140	180	8	211	M16 or 5/8"	180	110	70	30	38	45	66	90	84	30	35	35	70	70	100
8	3/8" / NPT	1/2" / NPT	1/2" / NPT	86	160	205	12	245	M20 or 3/4"	185	120	65	12	35*	45	96	101	100	24	40	40	80	118	118
9	3/8" / NPT	1/2" / NPT	1/2" / NPT	99	170	215	10	247	M20 or 3/4"	185	120	65	40	61	55	80	101	81	40	35	35	80	85	85

Figure D.5 - Configuration 5

Annex E - Materials Class Selection Guidance (Modification of Annex G of API STD 610:2010)

Table E.1 is intended to provide general guidance for on-plot process plants and off-plot transfer and loading services. It should not be used without a knowledgeable review of the specific services involved.

Table E.1 - Materials Class Selection Guidance

Service	Temperature (°C)	Pressure range	Materials class	Ref. Note
Fresh water, condensate, cooling tower water	< 100	All	I-1 or I-2	—
Boiling water and process water	< 120 120 to 175 > 175	All All All	I-1 or I-2 S-5 S-6, C-6	a a a
Boiler feed water	> 95	All	C-6	—
Axially split	> 95	All	S-6	—
Double-casing (barrel)				
Boiler circulator water	> 95	All	C-6	—
Foul water, reflux drum water, water draw, and hydrocarbons containing these waters, including reflux streams	up to 175 > 175	All All	S-6 C-6	b —
Propane, butane, liquefied petroleum gas, ammonia, ethylene, low temperature services (minimum metal temperature)	-196 to -100 > -100 to -73 > -73 to -46 > -46 to -29 > -29 to 230	All All All All All	A-8 S-5(LC3) S-5(LC2) S-5(LCB) S-5	h,i h,i h h —
Diesel oil; gasoline; naphtha; kerosene; gas oils; light, medium and heavy lubricating oils; fuel oil; residuum; crude oil; asphalt; synthetic crude bottoms	< 230 230 to 370 > 370	All All All	S-5 S-6 C-6	— b,c b
Hydrocarbons with Total Acid Number (TAN) equal or greater than 0,5 mg KOH/g	220 to 400	All	A-7	j
Non-corrosive hydrocarbons, e.g. catalytic reformat, isomaxate, desulfurized oils	230 to 370	All	S-5	c
Xylene, toluene, acetone, benzene, furfural, MEK, cumene	< 230	All	S-5	—
Sodium carbonate	< 175	All	I-1	—
Caustic (sodium hydroxide), concentration < 20 %	up to 100 > 100	All All	S-5 —	d e
Seawater	< 95	All	—	f
Sour water				
without chloride	< 260	All	A-7	k
with chloride	up to 60	All	A-7	k
with chloride	> 60	All	D-1	—
Produced water, formation water and brine	All	All	D-1 or D-2	f
Sulfur (liquid state)	All	All	S-5	—
FCC slurry	< 370	All	C-6	—
Potassium carbonate	< 175 175 to 370	All All	C-6 A-8	— —
MEA, DEA, TEA stock solutions	< 120	All	S-5	—

Table E.1 - Materials Class Selection Guidance (Continuation)

Service	Temperature °C	Pressure range	Materials class	Ref. Note
DEA, TEA-lean solutions	< 120	All	S-5 or S-8	d,g
MEA-lean solution (CO ₂ only)	80 to 150	All	S-9	d
MEA-lean solution (CO ₂ and H ₂ S)	80 to 150	All	S-8	d,g
MEA-, DEA-, TEA-rich solutions	< 80	All	S-5 or S-8	d
Sulfuric acid concentration > 85 %	< 38	All	S-5	b
85 % to < 1 %	< 230	All	A-8	b
Hydrofluoric acid concentration > 96 %	< 38	All	S-9	b
<p>NOTE 1 The materials for pump parts for each material class are given in Annex H of API STD 610:2010.</p> <p>NOTE 2 Specific materials recommendations should be obtained for services not clearly identified by the service descriptions listed in this table.</p> <p>NOTE 3 Cast iron casings (6.12.1.6 of API STD 610:2010), if recommended for chemical services, are for non-hazardous locations only. Steel casings should be used for pumps in services located near process plants or in any location where released vapour from a failure can create a hazardous situation or where pumps can be subjected to hydraulic shock, for example in loading services.</p>				
<p>a Oxygen content and buffering of water should be considered in material selection.</p> <p>b The corrosiveness of foul waters, hydrocarbons over 230 °C, acids, and acid sludges can vary widely. Material recommendations should be obtained for each service. The materials class indicated above is satisfactory for many of these services, but shall be verified. The materials class S-8 may also be considered for operating temperatures below 95 °C.</p> <p>c If product corrosivity is low, materials class S-5 may be used for services at 230 °C to 370 °C. Specific material recommendations should be obtained in each instance.</p> <p>d All welds shall be stress-relieved.</p> <p>e UNS N08007 or Ni-Cu alloy pump material should be used.</p> <p>f For seawater, produced water, formation water and brine services, the purchaser and the vendor should agree on the construction materials that best suit the intended use.</p> <p>g The vendor shall consider the effects of differential material expansion between casing and rotor and confirm suitability if operating temperatures can exceed 95 °C.</p> <p>h Materials selected for low-temperature services shall meet the requirements of 6.12.1.6 and 6.12.4 of API STD 610:2010. Casting alloy grades LCB, LC2 and LC3 are shown only for reference. Grades LCB, LC2 and LC3 refer to ISO 4991. C23-45BL, C43E2aL and C43L are equivalent to ASTM A352/A352M, grades LCB, LC2 and LC3. Use equivalent materials for wrought alloys.</p> <p>i Material alloys based on aluminium, bronze, aluminium bronze and nickel, may also be considered for temperatures as low as -196 °C.</p> <p>j A-7 construction in 317L austenitic stainless steel.</p> <p>k A-7 construction in 304 austenitic stainless steel. Materials class A-8 can also be applied.</p>				

Annex F - Materials and Material Specifications for Centrifugal Pump Parts (Addition / Modification of Annex H of API [STD 610:2010](#))**F.1 Modification (Table H.1 of API [STD 610:2010](#))**

Replace the remark "c" for:

c Austenitic stainless steels include AISI standard types 302, 303, 304, 316, 317, 321, and 347.

F.2 Addition (Table H.2 of API [STD 610:2010](#))

ASTM Specifications for 317L Austenitic Stainless Steel (main components):

Pressure castings - A351 Gr CG3M

General castings - A743 Gr CG3M


Wrought/Forgings - A182 Gr F 317L


Bar stock - A276 Gr 317

Table F.1 - Piping Materials (Substitution of Table H.4 of API [STD 610:2010](#))

Component	Fluid					
	Auxiliary process liquid		Steam		Cooling water	
	Category		Gauge pressure kPa		Nominal size	
	Materials classes I-1 and I-2	All weldable materials	≤ 500	> 500	Standard ≤ DN 25 (NPS 1)	Optional ≥ DN 40 (NPS 1 1/2)
Pipe	Seamless ^a	Seamless ^a	Seamless ^a	Seamless ^a	-	Carbon steel (galvanized to ISO 10684 or ASTM A153/ A153M)
Tubing ^b	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	-
All valves	Class 800	Class 800	Class 800	Class 800	Class 200 Bronze	Class 200 Bronze
Gate and globe valve	Bolted bonnet and gland	Bolted bonnet and gland	Bolted bonnet and gland	Bolted bonnet and gland	-	-
Pipe fittings	Forged class 3 000	Forged class 3 000	Forged class 3 000	Forged class 3 000	Malleable iron (galvanized to ISO 10684 or ASTM A153/ A153M)	Malleable iron (galvanized to ISO 10684 or ASTM A153/ A153M)
Tubing fittings	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	-
Fabricated joints ≤ DN 25 (NPS 1)	Threaded	Socket-welded	Socket-welded	Socket-welded	Threaded	-
Fabricated joints ≥ DN 40 (NPS 1 1/2)	-	-	-	-	-	Purchaser to specify
Gaskets	Purchaser to specify	Austenitic stainless steel spiral-wound	-	Austenitic stainless steel spiral-wound	-	-
Flange bolting ^c	4140 alloy steel	4140 alloy steel	-	4140 alloy steel	-	-
<p>a Schedule 80 shall be used for pipe sizes from DN 15 to DN 50 (NPS 1/2 to NPS 2); schedule 40 shall be used for sizes larger than DN 50 (NPS 2);</p> <p>b Acceptable tubing sizes (in accordance with ISO 4200) are the following:</p> <ul style="list-style-type: none"> - 12,7 mm diameter, 1,66 mm wall (1/2 in diameter, 0,065 in wall); - 19 mm diameter, 2,6 mm wall (3/4 in diameter, 0,095 in wall); <p>c If the purchaser does not specify stainless steel fasteners, they shall be according to 7.9 of this PETROBRAS Standard.</p>						

**Annex G – Vendor Drawing and Data Requirements (Substitution of Figure L.1 of
API [STD 610:2010](#))**

	DATA SHEET		No.						
	CLIENT:		SHEET 1 of 4						
	JOB:								
	AREA:								
	TITLE:		VENDOR DRAWING AND DATA REQUIREMENTS						
INDEX OF REVISIONS									
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									
<small>INFORMATION IN THIS DOCUMENT IS PROPERTY OF PETROBRAS, BEING PROHIBITED OUTSIDE OF THEIR PURPOSE. FORM OWNED TO PETROBRAS N-553 REV. E ANNEX G - SHEET 01/05.</small>									

	DATA SHEET		No.		REV.	
					FOLHA 2 de 4	
	TÍTULO: VENDOR DRAWING AND DATA REQUIREMENTS					

THE DOCUMENTS STATED BELOW SHALL BE SUPPLIED IN ENGLISH OR BRAZILIAN PORTUGUESE

PROPOSAL: VENDOR SHALL FURNISH _____ HARD COPIE(S) OF DRAWINGS AND DATA INDICATED.

REVIEW: VENDOR SHALL FURNISH _____ HARD COPIE(S) AND AN ELETRONIC FILE OF DRAWINGS AND DATA INDICATED.

FINAL: VENDOR SHALL FURNISH _____ HARD COPIE(S) AND AN ELETRONIC FILE OF DRAWINGS AND DATA INDICATED.
VENDOR SHALL FURNISH _____ OPERATING AND MAINTENANCE MANUAL(S).

DISTRIBUTION RECORD

FINAL – RECEIVED FROM VENDOR

FINAL – DUE FROM VENDOR

ANÁLISE – RETURNED TO VENDOR

ANÁLISE – RECEIVED FROM VENDOR

ANÁLISE – DUE FROM VENDOR

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CENTRIFUGAL PUMP									
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. DRAWINGS AND DOCUMENTS INDEX						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. LIST OF EXCEPTIONS TO THE SPECIFICATIONS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. EQUIPMENT GENERAL DESCRIPTION AND CATALOGS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4. REFERENCE LIST						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5. PUMP TRAIN ARRANGEMENT DRAWING AND LIST OF CONNECTIONS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6. PUMP CERTIFIED DIMENSIONAL OUTLINE DRAWING AND LIST OF CONNECTIONS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7. PUMP CROSS-SECTIONAL DRAWING AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8. SHAFT SEAL CROSS-SECTIONAL DRAWING AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9. SHAFT COUPLING ASSEMBLY DRAWING AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10. PRIMARY AND AUXILIARY FLUSH PIPING SCHEMATICS AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.a. DETAILED DRAWING AND DATA SHEETS OF SEAL SYSTEM APPURTENANCES (RESERVOIR, HEAT EXCHANGERS ETC)						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11. COOLING OR HEATING SCHEMATIC AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11.a. COOLER OR HEATER CROSS SECTIONAL DRAWING AND DATA SHEET						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12. LUBE-OIL SCHEMATIC AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13. LUBE-OIL SYSTEM ARRANGEMENT DRAWING AND LIST OF CONNECTIONS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14. LUBE-OIL COMPONENT DRAWINGS AND DATA SHEETS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15. ELECTRICAL AND INSTRUMENTATION SCHEMATICS, WIRING DIAGRAMS, AND BILL OF MATERIALS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16. ELECTRICAL AND INSTRUMENTATION ARRANGEMENT DRAWING AND LIST OF CONNECTIONS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17. NAMEPLATE DRAWINGS (PUMP, DRIVER, OIL SYSTEM ETC)						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18. PERFORMANCE CURVES						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19. VIBRATION ANALYSIS DATA						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20. DAMPED UNBALANCE RESPONSE ANALYSIS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21. LATERAL CRITICAL SPEED ANALYSIS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22. TORSIONAL CRITICAL SPEED ANALYSIS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23. CERTIFIED HYDROSTATIC TEST DATA						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24. MATERIAL CERTIFICATES						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25. PROGRESS REPORTS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	26. WELD PROCEDURES						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	26.a. MAJOR WELD REPAIR DATA						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	27. PERFORMANCE TEST DATA AND REPORT						

 PETROBRAS			DATA SHEET		No.		REV.						
								FOLHA 3 de 4					
			TÍTULO: VENDOR DRAWING AND DATA REQUIREMENTS										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28. MECHANICAL RUNNING TEST DATA AND REPORT					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29. OPTIONAL TEST DATA AND REPORT					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30. MECHANICAL SEAL DRAWINGS AND DATA REQUIRED BY API STD 682					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31. CERTIFIED ROTOR BALANCE DATA FOR MULTISTAGE PUMPS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	32. RESIDUAL UNBALANCE CHECK					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	33. ROTOR MECHANICAL AND ELECTRICAL RUNOUT FOR PUMPS WITH NON-CONTACTING VIBRATION PROBES					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	34. INSPECTOR'S CHECKLIST					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	35. INSPECTION AND TESTING SCHEDULE AND SUMMARY					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	36. DATA SHEETS APPLICABLE TO PROPOSALS, PURCHASE AND AS-BUILT					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37. BEARING DATA SHEETS (PUMP TRAIN)					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37.a. THRUST BEARING SIZING CALCULATIONS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	38. NOISE DATA SHEETS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	39. AS-BUILT CLEARANCES					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	40. INSTALLATION, OPERATION AND MAINTENANCE MANUALS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	41. SPARE PARTS RECOMMENDATIONS AND PRICE LIST					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	42. PRESERVATION, PACKAGING AND SHIPPING PROCEDURES					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	43. LIST OF INTERCHANGEABLE PARTS (SAME MODEL PUMP OR TYPE)					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	44. MATERIAL SAFETY DATA SHEETS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	45. AUTOMATIC RECIRCULATION VALVE DATA SHEET, DIMENSIONAL AND SECTIONAL DRAWINGS AND BILL OF MATERIALS					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	46. EXPECTED AND GUARANTEED LEAKAGE RATES OF THE SEAL DURING TESTS AND NORMAL OPERATION					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	47. PAINTING SPECIFICATION					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	48. TECHNICAL DATA MANUAL (DATABOOK)					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ELECTRIC MOTOR													
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. DRAWINGS AND DATA REQUIRED IN PETROBRAS STANDARD N-2919 (WHERE APPLICABLE)					<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
REMARKS:													

 PETROBRAS	DATA SHEET	No.	REV.
			SHEET 4 of 4
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS		
NOTES			

REV. A, B and C

There is no index of revisions.

REV. D

Affected Parts	Description of Alteration
All	General revision

REV. E

[illegible]

Foreword

This Standard is the English version (issued in 04/2013) of PETROBRAS N-553 REV. E 04/2013. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

This Standard is based on ISO 13709:2009 (Second Edition).

1 Scope

1.1 This Standard establishes the minimum conditions required for centrifugal pumps and their auxiliary systems for refinery services, process plants and the like, to be supplied in accordance with ISO 13709:2009.

1.2 Pumps shall be in accordance with ISO 13709:2009, plus the changes indicated in the paragraphs of this Standard, according to the description stated below:

- Addition: continuation of the paragraph indicated in parenthesis of ISO 13709:2009;
- Modification: replacement of part of the paragraph indicated in parenthesis of ISO 13709:2009;
- Substitution: total replacement of the paragraph indicated in parenthesis of ISO 13709:2009;
- New: insertion of a paragraph not found in ISO 13709:2009;
- Deletion: removal of the paragraph indicated in parenthesis of ISO 13709:2009.

NOTE 1 PETROBRAS considers all items of ISO 13709:2009, other than those mentioned herein, as valid to this Standard.

NOTE 2 All paragraphs, tables, annexes etc mentioned in paragraphs of ISO 13709:2009 that was changed herein shall be considered when read in ISO 13709:2009 according to the new terminology adopted in this Standard. For example, although paragraph 8.2.2.1 of ISO 13709:2009 has not been changed herein, Table 14, which is mentioned in this paragraph shall be read as "Table 1 of PETROBRAS N-553", because Table 14 of ISO 13709: 2009 was replaced by Table 1 of this Standard.

1.3 All deviations from the requirements in this Standard and/or ISO 13709:2009 must be clearly identified in the proposal and submitted to PETROBRAS for approval. Any deviation from the requirements or from any of the listed documents in material requisition, not clearly mentioned in the proposal will be considered by PETROBRAS as full compliance with the material requisition.

1.4 Vendor's compliance with the requirements in this Standard and/or ISO 13709:2009 does not exempt him from the responsibility of supplying equipment and accessories suitable for the specified service conditions.

1.5 This Standard applies to design starting from its issue date.

1.6 This Standard only contains 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-906](#) - Medium Duty Centrifugal Pumps;

PETROBRAS [N-2919](#) - Motores Elétricos Trifásicos de Indução ou Síncronos;

ISO [1940-1](#) - Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances;

ISO [4200](#) - Plain End Steel Tubes, Welded and Seamless - General Tables of Dimensions and Masses per Unit Length;

ISO [4991](#) - Steel Castings for Pressure Purposes;

ISO [9712](#) - Non-Destructive Testing - Qualification and Certification of Personnel;

ISO [10441](#) - Petroleum, Petrochemical and Natural Gas Industries - Flexible Couplings for Mechanical Power Transmission - Special-Purpose Applications;

ISO [10684](#) - Fasteners Hot Dip Galvanized Coatings;

ISO [13709:2009](#) - Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries;

ISO [21049](#) - Pumps Shaft Sealing Systems for Centrifugal and Rotary Pumps;

ISO/IEC [17024](#) - Conformity Assessment - General Requirements for Bodies Operating Certification of Persons;

ANSI/HI [9.6.7](#) - Effects of Liquid Viscosity on Rotodynamic (Centrifugal and Vertical) Pump Performance;

API [STD 671](#) - Special-Purpose Couplings for Petroleum, Chemical and Gas Industry Services;

API [STD 682](#) - Pumps Shaft Sealing Systems for Centrifugal and Rotary Pumps - Mechanical Equipment Data Sheet;

ASME [BPVC Section V](#) - Nondestructive Examination;

ASME [BPVC Section VIII Division 1](#) - Rules for Construction of Pressure Vessels;

ASTM [A153/A153M](#) - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware;

ASTM [A193/A193M](#) - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications;

ASTM [A352/A352M](#) - Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service;

ASTM [B 841](#) - Standard Specification for Electrodeposited Coatings of Zinc Nickel Alloy Deposits;

ASTM [B 849](#) - Standard Specification for Pre-Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement;

ASTM [B 850](#) - Standard Guide for Post-Coating Treatments of Steel for Reducing Risk of Hydrogen Embrittlement;

ASTM [E 388](#) - Standard Test Method for Wavelength Accuracy and Spectral Bandwidth of Fluorescence Spectrometers;

MSS [SP55](#) - Quality Standard for Steel Castings for Valves, Flanges, Fittings, and Other Piping Components - Visual Method for Evaluation of Surface Irregularities

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 apply.

3.1 New (3.65)

hazardous service

refers to the service where pumped liquid presents any characteristic below:

- a) H₂S (Hydrogen Sulphide) concentrations above 500 ppm (mass);
- b) hydrocarbons with hydrogen at a partial pressure above 700 kPa (abs);
- c) hydrocarbons at pumping temperatures above their auto-ignition temperatures;
- d) other toxic and lethal substances, which will result in death or permanent personal injury through inhalation, exposition, or contact, to be specified and defined in the inquiry documents.

3.2 New (3.66)

labyrinth "L" type

shaft seal applied in bearing housing which design contemplate only one deflector that allows air circulation through the bearing housing.

3.3 New (3.67)

labyrinth "U" type

shaft seal applied in bearing housing which design contemplate two deflectors (internal and external) that obstruct air movement through the bearing housing.

3.4 New (3.68)

Material Requisition (RM)

document that aims to establish the scope of supply, technical requirements and additional instructions required to acquisition of materials, systems and equipment.

4 Scope - Modification (Section 1 of ISO 13709:2009)

Replace the third paragraph by: Pumps not handling hazardous fluids (hazardous services) and not exceeding any of the conditions below, shall comply with PETROBRAS N-906 instead of this PETROBRAS Standard.

- a) discharge pressure (gauge) of 1 900 kPa;
- b) suction pressure (gauge) of 500 kPa;
- c) pumping temperature of 150 °C for non-hydrocarbon and of 50 °C for hydrocarbon;
- d) rotative speed of 3 600 rpm;
- e) rated total head of 120 m;
- f) impeller diameter, overhung pumps of 330 mm.

5 General - Addition (4.2.2.7 of ISO 13709:2009)

NOTE This pump type can be vertically or horizontally mounted.

6 Requirements (Section 5 of ISO 13709:2009)

6.1 Modification (5.1 of ISO 13709:2009)

Unless otherwise specified, data, drawings, and maintenance dimensions of pumps shall be in the International System of Units (SI).

6.2 Substitution (5.3.1 of ISO 13709:2009)

In case of conflict between the inquiry documents, the following priority shall govern:

- 1º) data sheets;
- 2º) supplementary Job Specifications (if any);
- 3º) this PETROBRAS Standard and all other PETROBRAS Standards specifically referenced in the inquiry;
- 4º) ISO 13709:2009.

Concerning any conflict after placement of order, the following priority shall govern:

- 1º) formal correspondence regarding any changes in the scope of supply or technical specifications, mutually agreed upon by PETROBRAS and vendor;
- 2º) approved documentation;
- 3º) revised data sheets and other material requisition documents (applicable to purchase);
- 4º) revised vendor's proposal (if any);
- 5º) this PETROBRAS Standard and all other PETROBRAS Standard specifically referenced in the inquiry or order;
- 6º) ISO 13709:2009;
- 7º) vendor's proposal.

7 Basic Design (Section 6 of ISO 13709:2009)

7.1 Substitution (6.1.4 of ISO 13709:2009)

Pumps shall be capable of at least a 5 % head increase at rated conditions by replacement of the impeller(s) with one(s) of larger diameter or different hydraulic design. PETROBRAS may consider the use of variable speed and/or blank stages (to add impellers in the future) for multistage pump to meet this requirement.

7.2 Substitution (6.1.6 of ISO 13709:2009)

Variable-speed pumps shall be designed for excursions to driver trip speed without damage.

7.3 Addition (6.1.8 of ISO 13709:2009)

At rated flow, the NPSH available shall exceed the NPSH required by at least 0,8 m and the NPSH ratio ($NPSH_a / NPSH_r$) shall be at least 1,15. Nevertheless, some services may require larger NPSH margins to be either specified on data sheets or recommended by vendor.

7.4 Substitution (6.1.9 of ISO 13709:2009)

The pump suction-specific speed shall be calculated in accordance with Annex A of ISO 13709:2009 and shall be limited as follows:

- a) pumps (in general) shall not have N_{ss} greater than 213 (11 000, in English Units);

- b) the use of inducers shall be approved by PETROBRAS and, if used, shall be taken into account when calculating Nss. Higher Nss values (e.g. for OH6) shall be submitted for PETROBRAS' specific approval.

7.5 Addition (6.1.10 of ISO 13709:2009)

Calculation sheets shall be submitted with proposal whenever operating conditions fall outside ANSI/HI 9.6.7 limits.

7.6 Substitution (6.1.11 of ISO 13709:2009)

Pumps shall have stable head vs. flow curves (continuous head rise to shutoff) for all applications. If parallel operation is specified, the head rise from rated point to shutoff shall be at least 10 %.

Whenever orifices are used to correct lower head rises to shutoff, it shall be submitted to PETROBRAS for approval. Pumps for parallel operation shall be designed for adequate flow sharing, i.e., equal shutoff heads and similar performance curves. Whenever different models of pumps are to be operated in parallel (e.g., when a second pumps is purchased to operate with an already existing one), the differences among their shutoff heads and head rises shall be mutually agreed upon by PETROBRAS and vendor.

7.7 Modification (6.1.14 of ISO 13709:2009)

Vendor shall provide both maximum sound pressure and sound power level data per octave band for the equipment. Control of the sound pressure level (SPL) of all equipment furnished shall be a joint effort of the purchaser and the vendor who has unit responsibility. The equipment furnished by the vendor (pump and driver train), unless otherwise specified on the data sheets, shall conform to the maximum allowable sound pressure level of 85 dB(A), slow-response, measured at 1 m from the equipment surfaces.

7.8 Addition (6.1.20 of ISO 13709:2009)

Minimum temperature rise shall be 10 K.

7.9 New (6.1.35)

If fasteners are not required in stainless steel (Annex H of ISO 13709:2009) they shall be low-alloy steel (e.g. ASTM A193/A193M, Grade B7) and coated with Zinc-Nickel according to ASTM B841, class 1, type B/E, grade 5 to 8, with stress and hydrogen relief treatment, according to ASTM B849 and ASTM B850. Alternatives may be offered and shall be agreed between purchaser and vendor.

7.10 New (6.1.36)

Diffusers or double volutes pumps are required for discharge nozzle sizes DN 100 (NPS 4) or larger.

7.11 Addition (6.2 of ISO 13709:2009)

The following pumps configurations shall not be furnished unless approved by PETROBRAS for the specific application:

- a) rigidly or close coupled;
- b) two-stage overhung;
- c) double suction overhung;

- d) multistage ring-section single casing;
- e) vertical (other than in-line) above 1 800 rpm;
- f) OH1 construction.

7.12 Substitution (6.3.1 of ISO 13709:2009)

The maximum discharge pressure shall be the maximum suction pressure plus the maximum differential pressure that the pump is able to develop (head at shutoff including all tolerances described in Table 16 of ISO 13709:2009) when operating with the furnished impeller at the rated speed and maximum specified liquid relative density.

NOTE 1 If is specified more of one operational condition, the highest maximum discharge pressure shall be considered.

NOTE 2 The maximum discharge pressure shall not exceed pressure limitations for downstream piping and equipment as informed by purchaser on data sheet.

7.13 Deletion (6.3.2 of ISO 13709:2009)

Removed from ISO 13709:2009

7.14 Addition (6.3.2 of ISO 13709:2009)

- d) Driver maximum speed (in case of variable-speed pumps).

7.15 Substitution (6.3.6 of ISO 13709:2009)

Except for wet pit and sump pumps, suction region shall be designed for the same MAWP as the discharge section.

7.16 Substitution (6.4.2.1 of ISO 13709:2009)

Suction and discharge nozzles shall be flanged, except those on pumps with forged casings, which shall be flanged or machined and studded. Unless otherwise specified all pumps shall have suction and discharge nozzles of equal ratings.

NOTE When machined and studded suction and discharge nozzles are provided, short-length piping spool pieces shall be supplied with the pump, to minimize assembly/disassembly of machined and studded connections, and to avoid the need to remove large sections of piping in order to slide the pump out from under the piping during overhauls.

7.17 Substitution (6.4.2.4 of ISO 13709:2009)

Flanges in all materials that are thicker or have a larger outside diameter than required by the relevant ISO (ASME) standards mentioned in ISO 13709:2009 are not acceptable. Whenever nonstandard flanges are approved by purchaser, their respective companions shall also be furnished, which shall require studs or bolts of standard lengths.

NOTE The references for thickness dimension of flanges shall be on machined faces (full faced or spot faced on the back).

7.18 Substitution (6.4.3.14 of ISO 13709:2009)

All pumps shall be provided with vent and drain connections, except that vent connections may be omitted if the pump is made self-venting by the arrangement of the nozzles. Pumps that are not self-venting shall be provided with vent connections in the pressure casing, as required (see 6.8.10 of ISO 13709:2009). All pumps shall be provided so as to allow casing to be completely drained, except multistage pumps. In order to permit a complete drainage of the volute, a drain hole shall be provided at the low point of the inner volute of pumps with double volute construction whenever this results in an internal liquid trap. Valves shall be furnished for vent and drain connections.

As a guide, a pump is considered functionally self-venting if the nozzle arrangement and the casing configuration permit sufficient venting of gases from the first-stage impeller and volute area to prevent loss of prime during the starting sequence.

NOTE If the pump cannot be completely drained for geometrical reasons, it shall be stated in the proposal. The operating manual shall include a drawing indicating the quantity and location(s) of the liquid remaining in the pump.

7.19 Substitution (6.5.5 of ISO 13709:2009)

Annex F of ISO 13709:2009 methods shall not be used.

7.20 Substitution (6.6.1 of ISO 13709:2009)

Impellers shall be fully enclosed type. Open impellers are not acceptable. Semi-open impellers are acceptable for low-flow, high-head pump design.

7.21 Substitution (6.6.2 of ISO 13709:2009)

Impellers shall be single-piece casting or forging. Fabricated impellers require PETROBRAS approval.

7.22 Substitution (6.7.1 of ISO 13709:2009)

Radial running clearances shall be used to limit internal leakage and, where necessary, balance axial thrust. Close axial clearances shall not be used to balance axial thrust. Impeller pumping vanes may be used on semi-open impellers to balance axial thrust.

Renewable wear rings shall be provided on both the casing and the impeller. Impellers with integral wear surfaces may be proposed for special cases only if PETROBRAS accepts all the explanation/reasons presented by vendor. Stationary split wear rings shall be used only with PETROBRAS approval.

7.23 Addition (6.7.2 of ISO 13709:2009)

For hardenable materials with Brinell hardness below 400, stationary wear ring mating surface shall be harder than rotating wear ring mating surface. For impellers with integral wear surfaces, the impeller wear surface shall be harder than stationary wear ring mating surface.

7.24 Addition (6.7.4 of ISO 13709:2009)

- a) Should the quoted equipment require a warm-up procedure in order to prevent excessive thermal stresses, transient misalignment or reduction of clearances, this procedure shall be clearly stated and fully detailed in the vendor's proposal and, afterwards, included in the Pump Operation Manual. Warm-up lines (usually small reverse flow bypasses) shall divert only from the check valve. These lines shall be properly sized to provide the required uniform heating without causing the pump in standby condition to run backwards (usually a restriction device is necessary);
- d) actual running clearances shall not be reduced to less than 50 % of their design values even though parts are assembled under the most unfavorable stacking up of tolerances, clearances and eccentricities.

7.25 Substitution (6.8.1 of ISO 13709:2009)

Pumps shall be equipped with mechanical seals and sealing systems in accordance with ISO 21049. Pump and seal interface dimensions shall be in accordance with Table 7 and Figure 26 of ISO 13709:2009, except for OH2 pumps type where dimensions shall be in accordance with Annex D of this PETROBRAS Standard. The purchaser shall specify the category of seal required. The purchaser should use the data sheets in Annex C of this PETROBRAS Standard for this purpose.

7.26 Substitution (6.8.3 of ISO 13709:2009)

The seal chamber shall conform to the dimensions shown in Figure 26 and Table 7 of ISO 13709:2009, except for OH2 pumps type where dimensions shall be in accordance with Annex D of this PETROBRAS Standard. For pumps with flange and pressure ratings in excess of the minimum values in 6.3.5 of ISO 13709:2009, the gland stud size and circle (d_3) may increase. Larger studs shall be furnished only if required to meet the stress requirements of 6.3.4 of ISO 13709:2009 or to sufficiently compress spiral-wound gaskets in accordance with manufacturer's specifications. If any modification in gland stud and circle (d_3) is required, it shall be stated in proposal.

7.27 Addition (6.8.8 of ISO 13709:2009)

A close-clearance (floating) carbon throttle bushing shall be installed in the seal gland plate for arrangement 1 if the temperature exceeds 80 °C. The connection of the drain (outer seal) shall be at least 3/8 in NPT and the minimum diameter of the hole in the gland plate for drain (outer seal) shall be 3/16 in and be located at the lowest part of the seal gland plate.

7.28 Addition (6.8.13 of ISO 13709:2009)

The mechanical seals shall be designed to withstand statically the maximum discharge pressure that the pump can develop as per defined in 7.12 of this PETROBRAS Standard, limited to 4 200 kPa (abs). For pump maximum discharge pressures higher than 4 200 kPa (abs), PETROBRAS and vendor shall agree on the maximum static sealing pressure.

7.29 New (6.8.14)

The seal leakage acceptance criteria shall be according to ISO 21049. The seal leakage during the tests shall be within the limits defined in ISO 21049. For higher seal leakages, the purchaser and the vendor shall agree on this value.

7.30 New (6.8.15)

Unless otherwise specified, but not limited to, double seal arrangements shall be used with:

- a) seal chamber vapour pressures above 400 kPa (abs) at 40 °C for hydrocarbons;
- b) services with H₂S, under the following conditions:
 - concentrations above 10 ppm (mass) for pumps located indoors;
 - concentrations above 500 ppm (mass) for pumps located outdoors. Double seal shall be non-pressurized from 500 ppm (mass) up to 5 000 ppm (mass). Double seal shall be pressurized above 5 000 ppm (mass);
- c) services with benzene content above 1 % (mass);
- d) other hazardous services, as per 3.1 of this PETROBRAS Standard.

7.31 Modification (6.9.3.3 of ISO 13709:2009)

Replace the last sentence by: The plotted spectra shall be included with the pump test results.

7.32 New (6.9.4.5)

Balancing correction shall always be performed by means of mass removal. The reduction of wall thickness shall not exceed 30 % (at actual impeller tip), or the impeller shall otherwise be replaced.

7.33 New (6.9.4.6)

Rotor assembly balancing corrections at the coupling hub are not allowed, for any further hub replacement might compromise the pump overall vibration levels. Therefore, whenever any balancing of coupling hubs and spacers is required, it shall always be performed individually.

7.34 Substitution (6.10.1.7 of ISO 13709:2009)

If loads exceed the capability of angular-contact bearings as described in 6.10.1.5 of ISO 13709:2009, hydrodynamic bearings shall be used.

7.35 Addition (6.10.2.4 of ISO 13709:2009)

- c) for oil mist systems, during shop testing bearing housing external surface temperature below 70 °C and outer ring / bearing metal temperatures shall not exceed 93 °C (if bearing-temperature sensors are supplied) and under the most adverse specified operating conditions, the bearing-oil housing temperature rise shall not exceed 35 K above the ambient temperature.

NOTE Vendor shall consider the highest bearing housing temperature. It is acceptable that the bearing housing contact seal temperature be higher than the bearing housing temperature. In case of use of non contact seal (labyrinth) the temperature should be the same as bearing housing.

7.36 Modification (Table 10 of ISO 13709:2009)

Replace the second sentence of item “a” by: For ball bearings, factor nd_m for individual bearings shall not exceed 350 000 for oil lubricated and 150 000 for grease lubricated bearings.

7.37 Addition (6.10.2.6 of ISO 13709:2009)

“U” type labyrinth shall be applied. “L” type labyrinth is not acceptable, except for BB and VS pumps. When specified for hermetic application, a special “U” type labyrinth with contact seal faces inside shall be provided.

7.38 Substitution (6.12.1.1 of ISO 13709:2009)

The purchaser shall specify the material class for pump parts. Annex E of this Standard provides a guide showing material classes that can be appropriate for various services. Alternative materials recommended for the service by the vendor, including material that can improve life and performance in service, may also be included in the proposal and listed on the final data sheets.

7.39 Substitution (6.12.1.8 of ISO 13709:2009)

The vendor shall furnish material certificates that include chemical analysis and mechanical properties for the heats from which the material is supplied for pressure-containing castings and forgings, impellers and shafts. These parts shall be identified with shop order number. Unless otherwise specified, piping nipples, auxiliary piping components, and bolting are excluded from this requirement.

7.40 Substitution (6.12.1.12.1 of ISO 13709:2009)

Unless otherwise specified, reduced-hardness materials are required for services with H₂S concentration greater than 50 ppm (mass) and water in any concentration.

7.41 Deletion (6.12.2.3.b of ISO 13709:2009)

Removed from ISO 13709:2009.

7.42 Substitution (6.12.2.5 of ISO 13709:2009)

For major casting repairs made in the vendor's shop and foundry, repair procedures including weld maps shall be submitted for purchaser's approval. The weld map shall be traceable. Vendor shall provide evidence of welding inspector participation during selection of welding procedures used for welds and welding repairs and post-weld heat-treatment. Major repairs made at vendor's shop and foundry level shall be controlled by the casting material specification ("producing specification").

7.43 Addition (6.12.3.2 of ISO 13709:2009)

NOTE Weld repairs for pressure casings made of wrought materials shall be carried out only with purchaser's approval.

7.44 Modification (6.12.4.3 of ISO 13709:2009)

ASME BPVC Section VIII Division 1 shall apply with regard to impact-testing requirements.

7.45 Substitution (6.13.3 of ISO 13709:2009)

In addition to being stamped on the nameplate, the pump serial number and PETROBRAS TAG number shall be plainly and permanently marked on the pump casing.

8 Accessories (Section 7 of ISO 13709:2009)

8.1 Addition (7.1.5 of ISO 13709:2009)

m) type of bearing and lubrication system.

8.2 Addition (7.2.2 of ISO 13709:2009)

Unless otherwise specified, service factor shall be at least 1,25 for electric motor or steam turbine driven pumps.

8.3 Substitution (7.2.3 of ISO 13709:2009)

Couplings shall be balanced to ISO 1940-1, grade G2.5 as minimum.

8.4 Addition (7.2.4 of ISO 13709:2009)

Unless otherwise specified, couplings and coupling mountings shall conform to API STD 671/ ISO 10441 when the energy density (i. e. the product of pump rated power in kilowatts and rated speed in rpm) is $4,0 \times 10^6$ kW/min or greater.

8.5 Substitution (7.2.8 of ISO 13709:2009)

For shaft diameters greater than 60 mm (2,5 in) and if it is necessary to remove the coupling hub to service the mechanical seal, the hub shall be mounted with a taper fit. The coupling fit taper for keyed couplings shall be 1 in 16 (60 mm/m, diametral). Other mounting methods and tapers shall be agreed upon by the PETROBRAS and the vendor. Coupling hubs with cylindrical bores shall not be supplied with slip fits to the shaft.

8.6 Addition (7.2.9 of ISO 13709:2009)

Coupling hub mounting surface and shaft shall have a difference in Brinell hardness number of at least 50.

8.7 Modification (7.2.13 of ISO 13709:2009)

Replace the item "d" by:

- d) be constructed of steel. Non-metallic (polymer) materials are not acceptable.
- e) the coupling guard design shall have opening to allow coupling visual inspection without its removal (e.g. inspection window).

NOTE Despite the design requirements described in a, b and c of item 7.2.13 of ISO 13709:2009 are acceptable, providing the coupling guard as Patent PETROBRAS is preferable.

8.8 Modification (7.3.5 of ISO 13709:2009)

Replace the second paragraph by: This requirement shall be demonstrated in the pump-vendor's shop with the baseplate supported on a leveled surface exclusively at the foundation bolts holes. Vendor shall provide a baseplate mounting pads flatness certificate.

8.9 Modification (7.3.6 of ISO 13709:2009)

Replace the last sentence in the first paragraph by: Vendor can provide shims under the pump, after PETROBRAS approval, when the driver is a steam turbine and/or when there is a reducer or multiplier between pump and driver.

8.10 Modification (7.3.17 of ISO 13709:2009)

Replace first sentence by: Transverse and axial alignment positioning jackscrews shall be provided for drive-train components having a mass greater than 100 kg to facilitate transverse horizontal and longitudinal adjustments.

8.11 Substitution (7.3.21 of ISO 13709:2009)

Replace the paragraph by: Vendor shall test to demonstrate that the pump and its baseplate assembly, anchored at foundation bolt hole locations, are in compliance with 7.3.20 of ISO 13709:2009 all pumps classified as inspection class II or III (Table 1 of this Standard). The pump casing shall be subjected to moments M_{Yc} and M_{Zc} applied to either nozzle, but not both, such that the corresponding shaft displacements can be measured and recorded. M_{Yc} and M_{Zc} shall not be applied simultaneously to either nozzle. The shaft displacement measurements shall be absolute (not relative to the baseplate). For record purposes, the vendor's test data shall include a schematic drawing of test set-up, the calculated moment loads (M_{Yc} and M_{Zc}), and the applied moment loads and their corresponding displacements at the drive end of the pump shaft.

NOTE Considering the same pump model/size and the same baseplate design, and already existing certificates approved by purchaser or by an independent and internationally recognized inspection / certification agency or institution, it is not necessary vendor carries out the nozzle load test. In these cases, vendor shall demonstrate the nozzle load test report approved by purchaser during the proposal phase.

8.12 Substitution (7.5.1.6 of ISO 13709:2009)

Each piping system shall be manifolded to a single purchaser's inlet or outlet connection near the edge and within the confines of the baseplate.

8.13 Modification (7.5.1.7 of ISO 13709:2009)

Replace the last sentence by: If the purchaser does not specify stainless steel fasteners, they shall be according to 7.9 of this Standard.

8.14 New (7.5.1.9)

Piping, valves and other appurtenances that are to be supplied by vendor shall comply also with the piping standardization specified by PETROBRAS.

8.15 New (7.5.1.10)

During assembly of the system before testing, each component (including cast-in passages of these components) and all piping and appurtenances shall be cleaned chemically or by another appropriate method to remove foreign materials, corrosion products, and mill scale.

8.16 New (7.5.1.11)

Slip-on or lap-joint type flanges are not allowed for parts in contact with pumped fluid.

8.17 Addition (7.5.2.3 of ISO 13709:2009)

AISI 316 L stainless steel shall be used when chlorides are present in a concentration above 10 ppm (mass).

8.18 Substitution (7.5.2.5 of ISO 13709:2009)

Drain manifold (when applicable) and drain valves shall be supplied for all pumps. The drain manifold shall be inside the drain pan limits.

8.19 Deletion (7.5.2.6 of ISO 13709:2009)

Removed from ISO 13709:2009.

8.20 New (7.5.2.11)

Flanges are required for balance lines, whatever the pumped liquid is, in order to facilitate removal and inspection.

9 Inspection, Testing, and Preparation for Shipment (Section 8 of ISO 13709:2009)**9.1 Addition (8.1.1 of ISO 13709:2009)**

- d) The vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser has specified to be witnessed or observed.
- e) The purchaser will specify the extent of his participation in the inspection and testing and the amount of advance notification required.
- f) When shop inspection and testing have been specified the purchaser and the vendor shall coordinate manufacturing hold points and inspector's visits.

9.2 Substitution (8.1.3 of ISO 13709:2009)

After advance notification to the purchaser by the vendor, the purchaser's representative shall have entry to all vendor and sub-vendor plants where manufacturing, testing, or inspection of the equipment is in progress.

9.3 Addition (8.1.4 of ISO 13709:2009)

Calibration schedules of the instruments to be used for inspection and testing shall be duly recorded for PETROBRAS review. The accuracy and/or resolution of these instruments shall be finer than the tolerance of what is to be measured. Test reports shall inform the type and serial number of instruments used during the test / inspection.

9.4 Modification (8.2.1.1 of ISO 13709:2009)

Replace the item "c" by:

- c) details of all repairs and records of all heat-treatment performed as part of a repair procedure;

9.5 Addition (8.2.2.3 of ISO 13709:2009)

- d) VI/MT/PT shall be performed after final machining, except for austenitic stainless and duplex / super-duplex steels.

- e) Inspections required by Table 1 of this Standard shall be performed again after any repair.

9.6 Addition (8.2.2.7 of ISO 13709:2009)

Except for austenitic stainless steels, the hardness test of parts, welds, and heat-affected zones, when they are to be exposed to H₂S, shall be performed in order to verify if the hardness is within the allowable values.

9.7 Addition (8.3.1.1 of ISO 13709:2009)

Regardless specification, if requested by the inspector, vendor shall present the test procedures only for information.

9.8 Modification (8.3.2.10 of ISO 13709:2009)

Replace the first sentence by: Austenitic or duplex stainless steel pressure casing components shall be hydrostatically tested at the final machined condition.

9.9 New (8.3.2.17)

Vises or any other devices for clamp pressing of nozzle flanges shall not be used during hydrostatic test.

9.10 New (8.3.2.18)

PTFE tape or any threaded compounds shall not be used in order to help prevent leakage of threaded plugs and connections during hydrostatic tests.

9.11 Addition (8.3.3.1 of ISO 13709:2009)

NOTE When assembled spare multistage rotors are supplied, they shall be tested according to the same procedures and tolerances as the main rotor.

9.12 Modification (8.3.3.2 of ISO 13709:2009)

Replace the item "d" by:

- d) Seal leakage during test shall require the assembled pump and seal to be rerun to demonstrate satisfactory seal performance.

9.13 Modification (8.3.3.3 of ISO 13709:2009)

Replace the item "a" by:

- a) The vendor shall take test data, including head, flow, power, and vibration at a minimum of five points. These points shall be:
- 1) shutoff (no vibration data required).
 - 2) minimum continuous stable flow.
 - 3) midway between minimum and rated flow.
 - 4) rated flow.
 - 5) end of allowable operating region.

Replace the item “c” by:

- c) Unless otherwise specified, the test speed shall be within 3 % of the rated speed shown on the pump data sheet. Test results shall be corrected to rated speed.

NOTE When the specified driver is an electric motor without variable speed drive, test results shall be corrected to actual driver speed.

9.14 Substitution (8.3.3.4 of ISO 13709:2009)

For higher power pumps (drivers ≥ 1 MW), pump efficiency at rated flow shall be quoted to the tolerance -0 % and shall be included in the pump's rated performance.

NOTE The vendor shall include any cost and delivery impact during the proposal.

9.15 Modification (8.3.3.5 of ISO 13709:2009)

Replace the items “a” and “b” by:

- a) Vibration values shall be recorded at each test point except shutoff during the test in accordance with 6.9.3.2 of ISO 13709:2009. Vibration shall be measured at each point test flow ± 5 %. Vibration values shall not exceed those given in 6.9.3.6 of ISO 13709:2009.
- b) For ring and splash oil systems, oil temperatures (at oil sump) and bearing temperatures shall be measured and recorded each 15 minutes up to temperature stabilization during the test. For pressurized systems, inlet and outlet oil temperatures (for each bearing) and bearing metal temperatures shall be measured and recorded each 15 minutes during the test.

Table 1 - Pressure casing material inspection requirements (Substitution of Table 14 of ISO 13709:2009)

Type of component	Requirements by inspection class ^a		
	I	II	III
-	Minimum	$P_{d_{max}} > 80\%$ of MAWP and $T_{max} > 200\text{ °C}$	$SG_{min} < 0,5$ or $T_{max} > 200\text{ °C}$ and $SG_{min} < 0,7$ or $T_{max} > 260\text{ °C}$ or Hazardous services ^e
Casing ^b : cast	VI	VI and 100 % MT or PT after final machining	VI and 100 % MT or PT after final machining and RT or UT of critical areas
Casing ^b : wrought ^c	VI	VI and MT or PT of critical areas	VI and MT or PT of critical areas and UT of critical areas
Nozzle weld: casing	VI and 100 % MT or PT	VI and 100 % MT or PT and 10 % RT or UT	VI and 100 % MT or PT and 100 % RT or UT
Auxiliary connection welds ^d	VI and 100 % MT or PT	VI and 100 % MT or PT	VI and 100 % MT or PT
Internals	VI	VI	VI and 100 % UT in the shaft (raw material) ^f and 100 % MT or PT on the impellers
Auxiliary process piping ^g : socket-welded	VI	VI and 100 % MT or PT	VI and 100 % MT or PT
Auxiliary process piping ^g : butt-welded	VI and 5 % RT	VI and 100 % MT or PT and 5 % RT	VI and 100 % MT or PT and 10 % RT

a Definition of abbreviations:

VI: Visual inspection
 MT: Magnetic particle inspection
 PT: Liquid penetrant inspection
 RT: Radiographic inspection
 UT: Ultrasonic examination

$P_{d_{max}}$: Maximum discharge pressure (shutoff condition)

T_{max} : Maximum operation temperature

SG_{min} : Minimum operation specific gravity

b Casing includes all items of the pressure boundary of the finished pump casing (e.g. the casing itself and other parts, such as nozzles, flanges etc. attached to the casing). "Critical areas" are inlet nozzle locations, outlet nozzle locations and casing wall thickness changes. The manufacturer shall submit details of the critical areas proposed to receive MT/PT/RT/UT inspection for purchaser's approval.

c Wrought materials include forgings, plate and tubular products.

d Due to complex geometry and thickness variations, it is not practical to RT butt-welded auxiliary casing connections.

e Hazardous services, as specified in 3.1 of this Standard.

f Shafts with diameters of 100 mm (4 in) or greater shall be inspected with UT according to ASTM E 388.

g As per defined on item 7.5.2.1 of ISO 13709:2009.

Table 2 - Materials Inspection Standards^a (Substitution of Table 15 of ISO 13709:2009)

Type of inspection	Methods	Acceptance criteria	
		For fabrications	For castings
Radiography	ASME BPVC, Section V, Articles 2 and 22	ASME BPVC, Section VIII, Division 1, UW-51 (for 100 % radiography) and UW-52 (for spot radiography)	ASME BPVC, Section VIII, Division 1, Appendix 7
Ultrasonic inspection	ASME BPVC, Section V, Articles 5 and 23	ASME BPVC, Section VIII, Division 1, Appendix 12	ASME BPVC, Section VIII, Division 1, Appendix 7
Liquid penetrant inspection	ASME BPVC, Section V, Articles 6 and 24	ASME BPVC, Section VIII, Division 1, Appendix 8	ASME BPVC, Section VIII, Division 1, Appendix 7
Magnetic particle inspection	ASME BPVC, Section V, Articles 7 and 25	ASME BPVC, Section VIII, Division 1, Appendix 6	ASME BPVC, Section VIII, Division 1, Appendix 7
Visual Inspection (all surfaces)	ASME BPVC, Section V, Article 9 ^(a)	In accordance with the material specification and the manufacturer's documented procedures	MSS SP-55

NOTE The method applied for casting shall be according to vendor's procedures.

a **Inspectors for non-destructive testing** – in order to perform visual, liquid penetrant, magnetic particle, radiographic and ultrasonic testing in Brazil, qualification and certification shall be according to the National System of Personnel Qualification and Certification in NDT – SNCQ/END, ABENDI, Brazil –, in conformity with ISO 9712. For services rendered abroad, qualification and certification shall be according to that established above or by independent international entities that meet requirements in ISO/IEC 17024 and that operate in conformity with ISO 9712.

9.16 Modification (8.3.3.7 of ISO 13709:2009)

Replace the items “a”, “b” and “c” by:

- a) If it is necessary to dismantle a pump after the performance test for the sole purpose of machining impellers to meet the tolerances for head, no retest is required unless the reduction in diameter exceeds 5 % of the original diameter. The diameter of the impeller at the time of shop test, as well as the final diameter of the impeller, shall be recorded on a certified shop test curve that shows the operating characteristics after the diameter of the impeller has been reduced. A dynamic balance check of impellers machined shall be performed and recorded.

If the head adjustment requires reduction more than 5 % of the original impeller diameter, a dynamic balance check, mechanical test, performance test and NPSHr test shall be performed and duly recorded.

NOTE NPSHr test shall be retest when it is applicable.

- b) Disassembly of multistage pumps for any head adjustment (including less than 5 % diameter change) after test, shall be cause for retest.
- c) If it is necessary to dismantle a pump for any other correction (including any seal correction), such as hydraulic performance or mechanical operation, all initial tests shall not be acceptable, and all tests shall be run after the correction is made.

9.17 Substitution (8.3.3.8 of ISO 13709:2009)

Pumps shall not be disassembled after final performance testing. The pump, including the seal chamber, shall be drained to the extent practical, filled with a water-displacing inhibitor within 4 h of testing and redrained.

9.18 New (8.3.3.9)

Hydrodynamic bearings shall be removed, inspected by the purchaser or his representative, and reassembled after the mechanical and performance tests are completed. An inspection report shall be included in the documentation. Antifriction bearings shall be partially disassembled for inspection and/or substitution only in case of any relevant abnormality is noticed during tests.

9.19 Substitution (8.3.4.1 of ISO 13709:2009)

Unless otherwise specified, the mechanical run test described in 8.3.4.2 of ISO 13709:2009 shall be performed. If specified, the shop tests described in 8.3.4.3 through 8.3.4.7 of ISO 13709:2009 shall be performed. Test details and required data (such as vibration and temperature data) shall be agreed upon by the purchaser and the vendor prior to conducting the tests.

9.20 Substitution (8.3.4.2.1 of ISO 13709:2009)

The pump shall be run on the test stand at the rated flow until oil and bearing temperature stabilization (6.10.2.4 of ISO 13709:2009) has been achieved.

NOTE 1 Before taking test data, at least a one-hour warm-up period shall be awaited in order to such parameters stabilize or else, be considered steady enough to proceed.

NOTE 2 Stabilized temperature for oil and bearing shall be considered if there is no temperature rise more than 2 K during 30 minutes.

9.21 Substitution (8.3.4.2.2 of ISO 13709:2009)

The pump shall be mechanically run at the rated flow for 4 h if, at least, one of the criteria below is met:

- a) nd_m factor $\geq 350\,000$;
- b) Energy density $> 4,0 \times 10^6$ kW/min.

9.22 Addition (8.3.4.3.1 of ISO 13709:2009)

NOTE If at rated flow the NPSH margin ($NPSH_a - NPSH_r$) is less than 1 m or NPSH ratio ($NPSH_a / NPSH_r$) is less than 1,20, $NPSH_r$ shall be determined at each test point identified in 9.13 of this Standard except shutoff.

9.23 Addition (8.3.4.4 of ISO 13709:2009)

All real-time data (vibration, speed, phase signals etc.) shall be recorded during the whole test.

9.24 New (8.3.4.8)

The following data shall be available, recorded and printed (or plotted):

- a) unfiltered and filtered vibration amplitude (FFT each 15 minutes during the test and unfiltered and filtered synchronous speed vibration amplitude trends);

- b) bearing temperature trend;
- c) oil temperature and pressure trends.

9.25 Substitution (8.4.2.6 of ISO 13709:2009)

Besides the use of bolted wooden closures for protection during shipment, all flanged openings shall be provided with thin closures – e.g., paddle blinds – at least 5 mm thick, properly sealed in order to prevent entrance of foreign materials. As those closures will only be removed at the stage of mounting of definitive gaskets or joints, they shall neither obstruct nor restrain any work related to the installation of suction, discharge and auxiliary piping.

9.26 Addition (8.4.5 of ISO 13709:2009)

Spare parts also shall be identified and tagged, as applicable to each case. When an assembled spare rotor is purchased, both main and spare rotors shall be identified (and indelibly stamped) with different serial numbers. Purchaser will state in the inquiry and/or purchase order the additional numbers and identification codes to be used in equipment and equipment data.

9.27 Addition (8.4.7 of ISO 13709:2009)

The vendor shall specify the products to be used in preparation of the pump components, the methods of removal and reapplication, and inform the date of application. Such data shall be summarized in two tags to be securely affixed to the equipment and on the outside of the crate.

9.28 New (8.4.13)

When a spare rotor is purchased, the rotor shall be prepared for unheated indoor storage for a period of at least 3 years. The rotor shall be treated with a rust preventive and shall be housed in a vapor-barrier envelope with a slow vapor inhibitor. The rotor shall be suitably crated for the type of shipment specified. Suitable lead sheeting, at least 3,2 mm thick, shall be used between the rotor and the cradle at the support areas. The rotor shall not be supported at journals.

9.29 New (8.4.14)

Components (both individual pieces and packaged sets) shipped with mounted preassembled piping, tubing, or wiring shall comply with the requirements of safety and health.

9.30 New (8.4.15)

Vendor shall provide a pre-alignment report about complete pump train.

10 Specific Pump Types (Section 9 of ISO 13709:2009)**10.1 Substitution (9.2.1.5 of ISO 13709:2009)**

Refer to 7.16 of this Standard.

10.2 Modification (9.2.5.2.4 of ISO 13709:2009)

Replace the item “c” by:

- c) maximum calculated babbitt surface temperature of 100 °C.

10.3 Addition (9.2.7.1 of ISO 13709:2009)

Test-stand oil filtration shall be 25 microns nominal or better with beta factor more than 200.

10.4 Substitution (9.2.7.5 of ISO 13709:2009)

See 9.18 of this Standard.

10.5 Substitution (9.3.10.7 of ISO 13709:2009)

Vertical pumps shall have their column and bowl assembly joints flanged.

10.6 Substitution (9.3.13.2 of ISO 13709:2009)


Bowls and column pipe shall be hydrostatically tested with liquid at a minimum of 1,5 times the maximum differential pressure developed by the bowl assembly. Hydrostatic testing shall be conducted in accordance with the requirements of 8.3.2 of ISO 13709:2009.


11 Vendor's data (Section 10 of ISO 13709:2009)**11.1 Modification (10.2.1.1 of ISO 13709:2009)**


Replace "this International Standard" in the second sentence by: "this Standard and all technical documents listed in RM".


12 Annexes

- Annex A - OH and BB Centrifugal Pump Data Sheet;
- Annex B - VS Centrifugal Pump Data Sheet;
- Annex C - Mechanical Seal Data Sheet;
- Annex D - OH2 Pumps Seal Chambers Dimensions;
- Annex E - Materials Class Selection Guidance (Modification of Annex G of ISO 13709:2009);
- Annex F - Materials and Material Specifications for Centrifugal Pump Parts (Addition / Modification of Annex H of ISO 13709:2009);
- Annex G - Vendor Drawing and Data Requirements (Substitution of Figure L.1 of ISO 13709:2009);

DATA SHEET		No.	REV.
 PETROBRAS		SHEET	3 of 6
TITLE:		CENTRIFUGAL PUMP (OH / BB)	
1	CONSTRUCTION		
2	ROTATION (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW		
3	PUMP ISO 13709 DESIGNATION: _____		
4	CASING MOUNTING:		
5	<input type="checkbox"/> CENTERLINE <input type="checkbox"/> FOOT <input type="checkbox"/> IN-LINE		
6	<input type="checkbox"/> OTHER _____		
7	CASING SPLIT:		
8	<input type="checkbox"/> AXIAL <input type="checkbox"/> RADIAL		
9	CASING TYPE:		
10	<input type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> DOUBLE VOLUTE <input type="checkbox"/> DIFFUSER		
11	<input type="checkbox"/> SINGLE CASING <input type="checkbox"/> BARREL <input type="checkbox"/> OTHER _____		
12	CASE PRESSURE RATING:		
13	<input type="checkbox"/> MAWP _____ kgf/cm ² g @ _____ °C		
14	NOZZLE CONNECTIONS:		
15	SIZE	RATING	FACING
16	POSITION		
17	SUCTION		
18	DISCHARGE		
19	PRESSURE CASING AUX. CONNECTIONS:		
20	<input type="checkbox"/> SOCKET WELD		
21	<input type="checkbox"/> BUTT WELD		
22	N°	SIZE	TYPE
23	FAC.	RAT.	POS.
24	<input type="checkbox"/> DRAIN		
25	<input type="checkbox"/> VENT		
26	<input type="checkbox"/> PRESS. INSTRUM.		
27	<input type="checkbox"/> TEMP. INSTRUM.		
28	<input type="checkbox"/> WARM UP		
29	<input type="checkbox"/> BALANCE/LEAK-OFF		
30	<input type="checkbox"/> _____		
31	<input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS		
32	<input type="checkbox"/> CYLINDRICAL THREADS REQUIRED		
33	<input type="checkbox"/> GUSSET SUPPORT REQUIRED		
34	<input type="checkbox"/> SPECIAL FITTINGS FOR TRANSITIONING		
35	ROTOR:		
36	<input type="checkbox"/> COMPONENT BALANCE TO ISO 1940 G. 1.0		
37	<input type="checkbox"/> SHRINK FIT-LIMITED MOVEMENT IMPELLERS		
38	<input type="checkbox"/> 1 ST CRITICAL SPEED WET (MULTISTAGE PUMP ONLY) _____ rpm		
39	COUPLINGS:		
40	<input type="checkbox"/> MANUF. _____ <input type="checkbox"/> MODEL _____		
41	<input type="checkbox"/> TYPE _____ <input type="checkbox"/> SIZE _____		
42	<input type="checkbox"/> RATING (kW PER 100 rpm) _____		
43	<input type="checkbox"/> SPACER LENGTH (mm) _____ <input type="checkbox"/> S.F. _____		
44	<input type="checkbox"/> DRIVER HALF COUPLING MOUNTED BY _____		
45	<input type="checkbox"/> PUMP MFR <input type="checkbox"/> DRIVER MFR <input type="checkbox"/> PURCHASER		
46	<input type="checkbox"/> COUPLING WITH HYDRAULIC FIT		
47	<input type="checkbox"/> COUPLING WITH PROPRIETARY CLAMPING DEVICE		
48	<input type="checkbox"/> COUPLING IN COMPLIANCE WITH _____		
49	<input type="checkbox"/> COUPLING GUARD STANDARD PER _____		
50	BASEPLATE:		
51	<input type="checkbox"/> ISO BASEPLATE N°. _____		
52	<input type="checkbox"/> MATERIAL _____		
53	<input type="checkbox"/> NON-GROUT CONSTRUCTION		
54	<input type="checkbox"/> OPEN DECK DESIGN		
55	<input type="checkbox"/> OTHER _____		
56	MECHANICAL SEAL: _____		
57	PACKING: _____		
58	REMARKS:		
59			
60			
CONSTRUCTION (CONT.)			
SHAFT:			
MAX. / MIN. DIAMETER _____ / _____ mm L3/D4 _____			
DIAMETER AT SLEEVE _____ mm			
DIAMETER AT COUPLING _____ mm			
DIAMETER BETWEEN BRGS _____ mm			
SPAN BETWEEN BRGS _____ mm			
SPAN BETWEEN BRG. / IMP. _____ mm			
TOTAL DEFLECTION AT SEAL CHAMBER _____ µm			
TOTAL DEFLECTION AT IMPELLER END _____ µm			
TOTAL DEFLECTION AT COUPLING END _____ µm			
MATERIAL			
<input type="checkbox"/> MATERIAL CLASS _____			
<input type="checkbox"/> MIN DESIGN METAL TEMP _____ °C			
<input type="checkbox"/> REDUCED HARDNESS MATERIALS			
<input type="checkbox"/> BARREL / CASE _____			
<input type="checkbox"/> DIFFUSERS _____			
<input type="checkbox"/> IMPELLER (S) _____			
<input type="checkbox"/> CASE WEAR RINGS _____			
<input type="checkbox"/> IMPELLER WEAR RINGS _____			
<input type="checkbox"/> SHAFT _____			
SURFACE PREPARATION AND PAINT			
<input type="checkbox"/> MANUFACTURER'S STANDARD <input type="checkbox"/> OTHER _____			
<input type="checkbox"/> SPECIFICATION _____			
PUMP:			
<input type="checkbox"/> PUMP SURFACE PREPARATION _____			
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____			
BASEPLATE:			
<input type="checkbox"/> BASEPLATE SURFACE PREPARATION _____			
<input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____			
<input type="checkbox"/> DETAILS OF LIFTING DEVICES _____			
SHIPMENT			
<input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQUIRED			
<input type="checkbox"/> OUTDOOR STORAGE FOR AT LEAST _____ MONTHS			
SPARE ROTOR ASSEMBLY PACKAGED FOR:			
<input type="checkbox"/> SHIPPING CONTAINER <input type="checkbox"/> N ₂ PURGE			
STORAGE <input type="checkbox"/> VERTICAL <input type="checkbox"/> HORIZONTAL			
<input type="checkbox"/> TYPE OF SHIPPING PREPARATION _____			
HEATING AND COOLING			
<input type="checkbox"/> HEATING JACKET REQ'D <input type="checkbox"/> COOLING REQ'D			
<input type="checkbox"/> COOLING WATER PIPING PLAN _____			
C. W. PIPING:			
<input type="checkbox"/> PIPE <input type="checkbox"/> TUBING <input type="checkbox"/> FITTINGS _____			
C.W. PIPING MATERIALS:			
<			

DATA SHEET		No.	REV.
 PETROBRAS		SHEET 4 of 6	
TITLE:		CENTRIFUGAL PUMP (OH / BB)	
1 BEARINGS AND LUBRICATION (CONT.)		WEIGHTS AND DIMENSIONS	
2 <input type="checkbox"/> CONSTANT LEVEL OILER PREFERENCE _____ 3 <input type="checkbox"/> PRESSURE L.O.S. <input type="checkbox"/> ISO 10438-3 <input type="checkbox"/> ISO 10438-2 4 <input type="checkbox"/> L.O.S. DATA SHEET _____ 5 <input type="checkbox"/> L.O.S. MOUNTED ON PUMP BASEPLATE 6 <input type="checkbox"/> INTERCONNECTING PIPING PROVIDED BY _____ 7 <input type="checkbox"/> OIL VISC. ISO GRADE _____ 8 <input type="checkbox"/> OIL PRESS TO BE GREATER THAN COOLANT PRESSURE 9 <input type="checkbox"/> OIL HEATER REQ'D <input type="checkbox"/> STEAM <input type="checkbox"/> ELECTRIC		WEIGHTS, kgf: PUMP _____ GEAR _____ BASE _____ DRIVER _____ COUP. _____ TOTAL _____ L.O.S. _____ (SEPARATE BASEPLATE) DIMENSIONS, mm: COMPLETE UNIT L _____ W _____ H _____ L.O.S. L _____ W _____ H _____	
10 INSTRUMENTATION			
11 FUNCTION 12 SUCTION PRESSURE TRANSMITTER 13 DISCHARGE PRESSURE TRANSMITTER 14 SUCTION TEMPERATURE TRANSMITTER 15 SUCTION FILTER ΔP TRANSMITTER 16 BALANCE PISTON ΔP TRANSMITTER 17 LUBE OIL PRESSURE TRANSMITTER 18 LUBE OIL TEMP. TRANSMITTER 19 LUBE OIL FILTER ΔP TRANSMITTER 20 LUBE OIL RESERVOIR LEVEL 21 TRANSMITTER		BEARING / CASING VIBRATION AND TEMPERATURE <input type="checkbox"/> SEE ATTACHED MONITORING SYSTEM DATA SHEET <input type="checkbox"/> ACCELEROMETER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY QTY _____ MOUNTING LOCATION _____ <input type="checkbox"/> VIBRATION PROBES. <input type="checkbox"/> PROVISION FOR MOUNTING ONLY RADIAL _____ PER. BRG. AXIAL _____ PER. BRG. <input type="checkbox"/> FLAT SURFACE REQUIRED <input type="checkbox"/> TEMP. TRANSMITTER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY _____ PER RADIAL BRG. _____ PER THRUST BRG. <input type="checkbox"/> TEMP. TRANSMITTERS WITH THERMOWELLS <input type="checkbox"/> MONITORS AND CABLES SUPPLIED BY _____ <input type="checkbox"/> INTERCONNECTIONS AND WIRING TO JUNCTION BOXES	
22			
23 ALARM AND TRIP			
24 LOW SUCTION / DISCHARGE PRESSURE 25 HIGH DISCHARGE PRESSURE 26 HIGH SUCTION FILTER ΔP 27 EXCESSIVE VIBRATION 28 EXCESSIVE AXIAL DISPLACEMENT 29 HIGH BEARING TEMPERATURE		30 LOW / HIGH BALANCE PISTON ΔP 31 LOW LUBE OIL PRESSURE 32 HIGH LUBE OIL FILTER ΔP 33 LOW LUBE OIL RESERVOIR TEMPERATURE 34 LOW LUBE OIL RESERVOIR LEVEL 35 AUX. LUBE OIL PUMP FAILURE	
36 PRESSURE VESSEL DESIGN CODE REFERENCES			
37 <input type="checkbox"/> THESE REFERENCES MUST BE LISTED BY THE MANUFACTURER 38 CASTING FACTORS USED IN DESIGN <input type="checkbox"/> _____ 39 SOURCE OF MATERIAL PROPERTIES <input type="checkbox"/> _____			
40 WELDING AND REPAIRS			
41 THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO ISO 13709 TABLE 11 IF NO PURCHASER PREFERENCE IS 42 <input type="checkbox"/> ALTERNATIVE WELDING CODES AND STANDARDS 43 WELDING REQUIREMENT (APPLICABLE CODE OR STANDARD) 44 WELDER / OPERATOR QUALIFICATION 45 WELDING PROCEDURE QUALIFICATION 46 NON PRESS. RETAINING STRUC. WELDING SUCH AS BASEPLATES OR SUPPORTS 47 M.P. OR LIQUID PENETRANT EXAMINATION OF THE PLATE EDGES 48 POST WELD HEAT TREATMENT 49 POST WELD HEAT TREATMENT OF CASING FABRICATION WELDS			
50 INSPEÇÃO DE MATERIAL			
51 THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO PETROBRAS N-553 TABLE 2 IF NO PURCHASER PREFERENCE IS STATED 52 <input type="checkbox"/> ALTERNATIVE MATERIAL INSPECTIONS AND ACCEPTANCE CRITERIA 53 TYPE OF INSPECTION METHODS FOR FABRICATIONS FOR CASTINGS 54 RADIOGRAPHY <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____ 55 ULTRASONIC <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____ 56 MAGNETIC PARTICLE <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____ 57 LIQUID PENETRANT <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____			
58 REMARKS:			
59			
60			

DATA SHEET		No.	REV.																																																												
		SHEET 3 of 7																																																													
TITLE: CENTRIFUGAL PUMP (VS)																																																															
CONSTRUCTION 2 ROTATION (VIEWED FROM COUPLING END) <input type="checkbox"/> CW <input type="checkbox"/> CCW 3 PUMP ISO 13709 DESIGNATION: _____ 4 CASING MOUNTING: 5 <input type="checkbox"/> CENTERLINE <input type="checkbox"/> FOOT <input type="checkbox"/> IN-LINE 6 <input type="checkbox"/> OTHER _____ 7 CASING SPLIT: 8 <input type="checkbox"/> AXIAL <input type="checkbox"/> RADIAL 9 CASING TYPE: 10 <input type="checkbox"/> SINGLE VOLUTE <input type="checkbox"/> DOUBLE VOLUTE <input type="checkbox"/> DIFFUSER 11 <input type="checkbox"/> SINGLE CASING <input type="checkbox"/> BARREL <input type="checkbox"/> OTHER _____ 12 CASE PRESSURE RATING: 13 <input type="checkbox"/> MAWP _____ kgf/cm ² g @ _____ °C 14 NOZZLE CONNECTIONS: 15 <table border="1"> <thead> <tr> <th>SIZE</th> <th>RATING</th> <th>FACING</th> <th>POSITION</th> </tr> </thead> <tbody> <tr> <td>16 SUCTION</td> <td></td> <td></td> <td></td> </tr> <tr> <td>17 DISCHARGE</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 18 PRESSURE CASING AUX. CONNECTIONS: 19 <input type="checkbox"/> SOCKET WELD 20 <input type="checkbox"/> BUTT WELD 21 <table border="1"> <thead> <tr> <th>Nº</th> <th>SIZE</th> <th>TYPE</th> <th>FAC.</th> <th>RAT.</th> <th>POS.</th> </tr> </thead> <tbody> <tr> <td>22 <input type="checkbox"/> DRAIN</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>23 <input type="checkbox"/> VENT</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>24 <input type="checkbox"/> PRESS. INSTRUM.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>25 <input type="checkbox"/> TEMP. INSTRUM.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>26 <input type="checkbox"/> WARM UP</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>27 <input type="checkbox"/> BALANCE/LEAK-OFF</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>28 <input type="checkbox"/> _____</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> 29 <input type="checkbox"/> MACHINED AND STUDDED CONNECTIONS 30 <input type="checkbox"/> CYLINDRICAL THREADS REQUIRED 31 <input type="checkbox"/> GUSSET SUPPORT REQUIRED 32 <input type="checkbox"/> SPECIAL FITTINGS FOR TRANSITIONING 33 ROTOR: 34 <input type="checkbox"/> COMPONENT BALANCE TO ISO 1940 G. 1.0 35 <input type="checkbox"/> SHRINK FIT-LIMITED MOVEMENT IMPELLERS 36 <input type="checkbox"/> 1 ST CRITICAL SPEED WET (MULTISTAGE PUMP ONLY) _____ rpm 37 COUPLINGS: 38 <input type="checkbox"/> MANUF. _____ <input type="checkbox"/> MODEL _____ 39 <input type="checkbox"/> TYPE _____ <input type="checkbox"/> SIZE _____ 40 <input type="checkbox"/> RATING (kW PER 100 rpm) _____ 41 <input type="checkbox"/> SPACER LENGTH (mm) _____ <input type="checkbox"/> S.F. _____ 42 <input type="checkbox"/> DRIVER HALF COUPLING MOUNTED BY _____ 43 <input type="checkbox"/> PUMP MFR <input type="checkbox"/> DRIVER MFR <input type="checkbox"/> PURCHASER 44 <input type="checkbox"/> COUPLING WITH HYDRAULIC FIT 45 <input type="checkbox"/> COUPLING WITH PROPRIETARY CLAMPING DEVICE 46 <input type="checkbox"/> COUPLING IN COMPLIANCE WITH _____ 47 <input type="checkbox"/> COUPLING GUARD STANDARD PER _____ 48 BASEPLATE: 49 <input type="checkbox"/> ISO BASEPLATE Nº. _____ 50 <input type="checkbox"/> MATERIAL _____ 51 <input type="checkbox"/> NON-GROUT CONSTRUCTION 52 <input type="checkbox"/> OPEN DECK DESIGN 53 <input type="checkbox"/> OTHER _____ 54 MECHANICAL SEAL: _____ 55 PACKING: _____ 56 REMARKS: 57 _____ 58 _____ 59 _____ 60 _____		SIZE	RATING	FACING	POSITION	16 SUCTION				17 DISCHARGE				Nº	SIZE	TYPE	FAC.	RAT.	POS.	22 <input type="checkbox"/> DRAIN						23 <input type="checkbox"/> VENT						24 <input type="checkbox"/> PRESS. INSTRUM.						25 <input type="checkbox"/> TEMP. INSTRUM.						26 <input type="checkbox"/> WARM UP						27 <input type="checkbox"/> BALANCE/LEAK-OFF						28 <input type="checkbox"/> _____						CONSTRUCTION (CONT.) SHAFT: MAX./MIN. DIAMETER _____ / _____ mm L3/D4 _____ DIAMETER AT SLEEVE _____ mm DIAMETER AT COUPLING _____ mm DIAMETER BETWEEN BRGS _____ mm SPAN BETWEEN BRGS _____ mm SPAN BETWEEN BRG. / IMP. _____ mm TOTAL DEFLECTION AT SEAL CHAMBER _____ µm TOTAL DEFLECTION AT IMPELLER END _____ µm TOTAL DEFLECTION AT COUPLING END _____ µm MATERIAL <input type="checkbox"/> MATERIAL CLASS _____ <input type="checkbox"/> MIN DESIGN METAL TEMP _____ °C <input type="checkbox"/> REDUCED HARDNESS MATERIALS <input type="checkbox"/> BARREL / CASE _____ <input type="checkbox"/> DIFFUSERS _____ <input type="checkbox"/> IMPELLER (S) _____ <input type="checkbox"/> CASE WEAR RINGS _____ <input type="checkbox"/> IMPELLER WEAR RINGS _____ <input type="checkbox"/> SHAFT _____ SURFACE PREPARATION AND PAINT <input type="checkbox"/> MANUFACTURER'S STANDARD <input type="checkbox"/> OTHER _____ <input type="checkbox"/> SPECIFICATION _____ PUMP: <input type="checkbox"/> PUMP SURFACE PREPARATION _____ <input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____ BASEPLATE: <input type="checkbox"/> BASEPLATE SURFACE PREPARATION _____ <input type="checkbox"/> PRIMER _____ <input type="checkbox"/> FINISH COAT _____ <input type="checkbox"/> DETAILS OF LIFTING DEVICES _____ SHIPMENT <input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQUIRED <input type="checkbox"/> OUTDOOR STORAGE FOR AT LEAST _____ MONTHS SPARE ROTOR ASSEMBLY PACKAGED FOR: <input type="checkbox"/> SHIPPING CONTAINER <input type="checkbox"/> N ₂ PURGE STORAGE <input type="checkbox"/> VERTICAL <input type="checkbox"/> HORIZONTAL <input type="checkbox"/> TYPE OF SHIPPING PREPARATION _____ HEATING AND COOLING <input type="checkbox"/> HEATING JACKET REQ'D <input type="checkbox"/> COOLING REQ'D <input type="checkbox"/> COOLING WATER PIPING PLAN _____ C. W. PIPING: <input type="checkbox"/> PIPE <input type="checkbox"/> TUBING FITTINGS _____ C.W. PIPING MATERIALS: <input type="checkbox"/> S. STEEL <input type="checkbox"/> C. STEEL <input type="checkbox"/> OTHER _____ COOLING WATER REQUIREMENTS: BEARING HOUSING _____ m ³ /h HEAT EXCHANGER _____ m ³ /h TOTAL COOLING WATER _____ m ³ /h HEATING MEDIUM <input type="checkbox"/> STEAM <input type="checkbox"/> OTHER _____ HEATING PIPING <input type="checkbox"/> TUBING <input type="checkbox"/> PIPE _____ BEARINGS AND LUBRICATION BEARING (TYPE / NUMBER): <input type="checkbox"/> RADIAL _____ / _____ <input type="checkbox"/> THRUST _____ / _____ L ₁₀ @ RATED _____ / _____ @ MAX LOAD _____ / _____ <input type="checkbox"/> REVIEW AND APPROVE THRUST/RADIAL BRG SIZE LUBRICATION: <input type="checkbox"/> GREASE <input type="checkbox"/> HYDRODYNAMIC. <input type="checkbox"/> RING OIL <input type="checkbox"/> PURGE OIL MIST <input type="checkbox"/> PURE OIL MIST	
SIZE	RATING	FACING	POSITION																																																												
16 SUCTION																																																															
17 DISCHARGE																																																															
Nº	SIZE	TYPE	FAC.	RAT.	POS.																																																										
22 <input type="checkbox"/> DRAIN																																																															
23 <input type="checkbox"/> VENT																																																															
24 <input type="checkbox"/> PRESS. INSTRUM.																																																															
25 <input type="checkbox"/> TEMP. INSTRUM.																																																															
26 <input type="checkbox"/> WARM UP																																																															
27 <input type="checkbox"/> BALANCE/LEAK-OFF																																																															
28 <input type="checkbox"/> _____																																																															

 PETROBRAS	DATA SHEET		No.	REV.	
				SHEET	4 of 7
	TITLE: CENTRIFUGAL PUMP (VS)				

BEARINGS AND LUBRICATION (CONT.)	WEIGHTS AND DIMENSIONS
<input type="checkbox"/> CONSTANT LEVEL OILER PREFERENCE _____ <input type="checkbox"/> PRESSURE L.O.S. <input type="checkbox"/> ISO 10438-3 <input type="checkbox"/> ISO 10438-2 <input type="checkbox"/> L.O.S. DATA SHEET _____ <input type="checkbox"/> L.O.S. MOUNTED ON PUMP BASEPLATE <input type="checkbox"/> INTERCONNECTING PIPING PROVIDED BY _____ <input type="checkbox"/> OIL VISC. ISO GRADE _____ <input type="checkbox"/> OIL PRESS TO BE GREATER THAN COOLANT PRESSURE <input type="checkbox"/> OIL HEATER REQ'D <input type="checkbox"/> STEAM <input type="checkbox"/> ELECTRIC	WEIGHTS, kgf: PUMP _____ GEAR _____ BASE _____ DRIVER _____ COUP. _____ TOTAL _____ L.O.S. _____ (SEPARATE BASEPLATE) DIMENSIONS, mm: COMPLETE UNIT L _____ W _____ H _____ L.O.S. L _____ W _____ H _____

INSTRUMENTATION				
FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	CONTROL ROOM	BEARING / CASING VIBRATION AND TEMPERATURE
SUCTION PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> SEE ATTACHED MONITORING SYSTEM DATA SHEET
DISCHARGE PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> ACCELEROMETER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY
SUCTION TEMPERATURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	QTY _____ MOUNTING LOCATION _____
SUCTION FILTER ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> VIBRATION PROBES <input type="checkbox"/> PROVISION FOR MOUNTING ONLY
BALANCE PISTON ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RADIAL _____ PER BRG. AXIAL _____ PER BRG.
LUBE OIL PRESSURE TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> FLAT SURFACE REQUIRED
LUBE OIL TEMP. TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> TEMP. TRANSMITTER <input type="checkbox"/> PROVISION FOR MOUNTING ONLY
LUBE OIL FILTER ΔP TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ PER RADIAL BRG. _____ PER THRUST BRG.
LUBE OIL RESERVOIR LEVEL TRANSMITTER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> TEMP. TRANSMITTERS WITH THERMOWELLS
				<input type="checkbox"/> MONITORS AND CABLES SUPPLIED BY _____
				<input type="checkbox"/> INTERCONNECTIONS AND WIRING TO JUNCTION BOXES

ALARM AND TRIP			
	ALARM	TRIP	
LOW SUCTION / DISCHARGE PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>	LOW / HIGH BALANCE PISTON ΔP
HIGH DISCHARGE PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL PRESSURE
HIGH SUCTION FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	HIGH LUBE OIL FILTER ΔP
EXCESSIVE VIBRATION	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL RESERVOIR TEMPERATURE
EXCESSIVE AXIAL DISPLACEMENT	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL RESERVOIR LEVEL
HIGH BEARING TEMPERATURE	<input type="checkbox"/>	<input type="checkbox"/>	AUX. LUBE OIL PUMP FAILURE

PRESSURE VESSEL DESIGN CODE REFERENCES	
<input type="checkbox"/> THESE REFERENCES MUST BE LISTED BY THE MANUFACTURER	
CASTING FACTORS USED IN DESIGN	<input type="checkbox"/> _____
SOURCE OF MATERIAL PROPERTIES	<input type="checkbox"/> _____

WELDING AND REPAIRS		
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO ISO 13709 TABLE 11 IF NO PURCHASER PREFERENCE IS STATED)		
<input type="checkbox"/> ALTERNATIVE WELDING CODES AND STANDARDS		
WELDING REQUIREMENT (APPLICABLE CODE OR STANDARD)	PURCHASER DEFINED	PER TABLE 11
WELDER / OPERATOR QUALIFICATION	<input type="checkbox"/> _____	<input type="checkbox"/> _____
WELDING PROCEDURE QUALIFICATION	<input type="checkbox"/> _____	<input type="checkbox"/> _____
NON PRESS. RETAINING STRUC. WELDING SUCH AS BASEPLATES OR SUPPORTS	<input type="checkbox"/> _____	<input type="checkbox"/> _____
M.P. OR LIQUID PENETRANT EXAMINATION OF THE PLATE EDGES	<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT	<input type="checkbox"/> _____	<input type="checkbox"/> _____
POST WELD HEAT TREATMENT OF CASING FABRICATION WELDS	<input type="checkbox"/> _____	<input type="checkbox"/> _____

INSPEÇÃO DE MATERIAL			
THESE REFERENCES MUST BE LISTED BY THE PURCHASER (DEFAULT TO PETROBRAS N-553 TABLE 2 IF NO PURCHASER PREFERENCE IS STATED)			
<input type="checkbox"/> ALTERNATIVE MATERIAL INSPECTIONS AND ACCEPTANCE CRITERIA			
TYPE OF INSPECTION	METHODS	FOR FABRICATIONS	FOR CASTINGS
RADIOGRAPHY	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
ULTRASONIC	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
MAGNETIC PARTICLE	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____
LIQUID PENETRANT	<input type="checkbox"/> _____	<input type="checkbox"/> _____	<input type="checkbox"/> _____

REMARKS:

BR PETROBRAS		DATA SHEET		No.		REV.	
				SHEET 2 of 5			
TITLE:		MECHANICAL SEAL					
1	APPLICABLE TO	<input type="checkbox"/> PROPOSAL		<input type="checkbox"/> PURCHASE		<input type="checkbox"/> AS BUILT	
2	FOR	_____		UNIT		_____	
3	SITE	_____		SERVICE		_____	
4	MANUFACTURER	_____		No. REQUIRED		_____	
5	VENDOR	_____		SERIAL No.		_____	
6	MODEL	_____		MAIN EQUIPMENT		_____ / _____	
7	SIZE / TYPE	_____ / _____					
SEAL SPECIFICATION							
9	CATEGORY	<input type="checkbox"/> SEAL CATEGORY 1		<input type="checkbox"/> SEAL CATEGORY 2		<input type="checkbox"/> SEAL CATEGORY 3	
10	TYPE	<input type="checkbox"/> TYPE A		<input type="checkbox"/> TYPE B		<input type="checkbox"/> ALTERNATIVE STATIONARY (TYPE A & B)	
11	(CODE-CW)	<input type="checkbox"/> TYPE C		<input type="checkbox"/> ALTERNATIVE ROTATING (TYPE C)		<input type="checkbox"/> SINGLE SPRING (TYPE A)	
12	ARR'G'T	DEFAULT CONFIG.		ALTERNATIVE DESIGN		FLUSH PLANS	
13	1	(CAT. 1 & 2)	<input type="checkbox"/> 1CW-FX	<input type="checkbox"/> 1 CW-FL (CAT. 1 & 2)		<input type="checkbox"/> 01 <input type="checkbox"/> 11 <input type="checkbox"/> 14 <input type="checkbox"/> 23 <input type="checkbox"/> 32 <input type="checkbox"/> 51 <input type="checkbox"/> 62	
14		(CAT. 3)	<input type="checkbox"/> 1CW-FL	<input type="checkbox"/> DIST. FLUSH (CAT. 1 & 2)		<input type="checkbox"/> 02 <input type="checkbox"/> 13 <input type="checkbox"/> 21 <input type="checkbox"/> 31 <input type="checkbox"/> 41 <input type="checkbox"/> 61 <input type="checkbox"/> 65	
15				<input type="checkbox"/> ALTERNATIVE BUSH			
16	2	LIQUID	<input type="checkbox"/> 2CW-CW	<input type="checkbox"/> TANGENTIAL LBO		<input type="checkbox"/> 01 <input type="checkbox"/> 13 <input type="checkbox"/> 23 <input type="checkbox"/> 41 <input type="checkbox"/> 62 <input type="checkbox"/> 75	
17	BUFFER			<input type="checkbox"/> CONN'N (CAT. 1 & 2)		<input type="checkbox"/> 02 <input type="checkbox"/> 14 <input type="checkbox"/> 31 <input type="checkbox"/> 52 <input type="checkbox"/> 71 <input type="checkbox"/> 76	
18		GAS	<input type="checkbox"/> 2CW-CS	<input type="checkbox"/> 2NC-CS		<input type="checkbox"/> 11 <input type="checkbox"/> 21 <input type="checkbox"/> 32 <input type="checkbox"/> 61 <input type="checkbox"/> 72	
19	3	LIQUID	<input type="checkbox"/> 3CW-FB	<input type="checkbox"/> 3CW-BB		<input type="checkbox"/> 01 <input type="checkbox"/> 13 <input type="checkbox"/> 53A <input type="checkbox"/> 54 <input type="checkbox"/> 74	
20	BARRIER			<input type="checkbox"/> 3CW-FF		<input type="checkbox"/> 02 <input type="checkbox"/> 14 <input type="checkbox"/> 53B <input type="checkbox"/> 61	
21		GAS	<input type="checkbox"/> 3NC-BB	<input type="checkbox"/> 3NC-FF		<input type="checkbox"/> 11 <input type="checkbox"/> 32 <input type="checkbox"/> 53C <input type="checkbox"/> 62	
22	SLEEVE-SHAFT DRIVE	<input type="checkbox"/> SET-SCREW ONTO SHAFT <input type="checkbox"/> ALTERNATIVE - SPECIFY _____					
MATERIALS							
24	SECONDARY SEALS	SEALS FACES		METAL BELLOWS		SPRINGS	
25	<input type="checkbox"/> FKM <input type="checkbox"/> FFKM	<input type="checkbox"/> CARBON VS SIC		<input type="checkbox"/> UNS N10276 (TYPE B)		<input type="checkbox"/> UNS N10276 OR N06455	
26	<input type="checkbox"/> SPIRAL-W GASKET	<input type="checkbox"/> SIC VS SIC		<input type="checkbox"/> UNS N07718 (TYPE C)		<input type="checkbox"/> UNS S31600/S31635	
27	<input type="checkbox"/> FLEXIBLE GRAPHITE	<input type="checkbox"/> SS-SIC <input type="checkbox"/> RB-SIC		<input type="checkbox"/> UNS N08020		<input type="checkbox"/> UNS N10276	
28	<input type="checkbox"/> NBR	<input type="checkbox"/> _____ VS _____		<input type="checkbox"/> OTHER _____		<input type="checkbox"/> UNS N08020	
29	<input type="checkbox"/> OTHER _____					<input type="checkbox"/> UNS S31600 OR S31635	
30						<input type="checkbox"/> OTHER _____	
MECHANICAL SEAL DATA							
32	<input type="checkbox"/> SEAL VENDOR _____			<input type="checkbox"/> DYNAMIC SEALING PRESSURE RAT./MAX. _____ / _____		kgf/cm ² g	
33	<input type="checkbox"/> CÓDIGO _____			<input type="checkbox"/> STATIC SEALING PRESS. RAT./MAX. _____ / _____		kgf/cm ² g	
34	<input type="checkbox"/> SIZE / TYPE _____			<input type="checkbox"/> MAXIMUM ALLOWABLE TEMPERATURE _____		°C	
35	<input type="checkbox"/> SEAL DRAWING NUMBER _____			<input type="checkbox"/> MINIMUM DESIGN METAL TEMPERATURE _____		°C	
36	<input type="checkbox"/> VENDOR'S SEAL CODE _____			<input type="checkbox"/> GENERATED HEAT @ NORMAL CONDITIONS _____		kW	
37	<input type="checkbox"/> MODIFIED FACES FOR PUMP PERFORMANCE TEST			<input type="checkbox"/> HEAT SOAK @ NORMAL CONDITIONS _____		kW	
38	<input type="checkbox"/> ALTERNATIVE SEAL FOR PUMP PERFORMANCE TEST			<input type="checkbox"/> TOTAL SEAL AXIAL THRUST ON SHAFT _____		kgf	
39				<input type="checkbox"/> ALLOWABLE LEAKAGE RAT./MAX. _____ / _____		ml/h	
40							
SEAL CHAMBER DATA							
42	<input type="checkbox"/> ASME B73.1 & 2	<input type="checkbox"/> CYLINDRICAL	<input type="checkbox"/> TAPERED	<input type="checkbox"/> ISO 13709	<input type="checkbox"/> ISO 3069-C	<input type="checkbox"/> OTHER _____	
43	<input type="checkbox"/> BOLT-ON CHAMBER	<input type="checkbox"/> SEAL CHAMBER FLUSH PORT REQ'D		<input type="checkbox"/> SEAL CHAMBER VENT REQ'D			
44	<input type="checkbox"/> FLOATING THROAT BUSH	<input type="checkbox"/> FIXED THROAT BUSH		<input type="checkbox"/> CHAMBER HEATING REQ'D			
PUMP DATA							
46	<input type="checkbox"/> SEE PUMP DATA SHEET _____						
47	PUMP DESIGN	<input type="checkbox"/> MANUFAC. _____	<input type="checkbox"/> MODEL _____	<input type="checkbox"/> SIZE/TYPE _____	<input type="checkbox"/> CASE MAT. _____		
48	PUMP OPERATING PRESSURE	<input type="checkbox"/> SUCTION PRESS. (RATED) _____ kgf/cm ² g		<input type="checkbox"/> DISCHARGE PRESSURE _____ kgf/cm ² g			
49	SEAL CHAMBER	<input type="checkbox"/> NORMAL _____ kgf/cm ² g	<input type="checkbox"/> MIN./MAX. _____ / _____ kgf/cm ² g		<input type="checkbox"/> MSSP _____ kgf/cm ² g		
50	SHAFT	<input type="checkbox"/> HORIZONTAL	<input type="checkbox"/> VERTICAL	SHAFT ROTATION DIRECTION (FROM DRIVER) <input type="checkbox"/> CW <input type="checkbox"/> CCW			
51		<input type="checkbox"/> DIA _____ mm	<input type="checkbox"/> SPEED _____ rpm				
52							
53	REMARKS:						
54							
55							
56							
57							
58							

Annex E - Materials Class Selection Guidance (Modification of Annex G of ISO 13709:2009)

Table E.1 is intended to provide general guidance for on-plot process plants and off-plot transfer and loading services. It should not be used without a knowledgeable review of the specific services involved.

Table E.1 - Materials Class Selection Guidance

Service	Temperature (°C)	Pressure range	Materials class	Ref. Note
Fresh water, condensate, cooling tower water	< 100	All	I-1 or I-2	—
Boiling water and process water	< 120	All	I-1 or I-2	a
	120 to 175	All	S-5	a
	> 175	All	S-6, C-6	a
Boiler feed water Axially split Double-casing (barrel)	> 95	All	C-6	—
	> 95	All	S-6	—
Boiler circulator water	> 95	All	C-6	—
Foul water, reflux drum water, water draw, and hydrocarbons containing these waters, including reflux streams	up to 175	All	S-6	b
	> 175	All	C-6	—
Propane, butane, liquefied petroleum gas, ammonia, ethylene, low temperature services (minimum metal temperature)	-196 to -100	All	A-8	h,i
	> -100 to -73	All	S-5(LC3)	h,i
	> -73 to -46	All	S-5(LC2)	h
	> -46 to -29	All	S-5(LCB)	h
	> -29 to 230	All	S-5	—
Diesel oil; gasoline; naphtha; kerosene; gas oils; light, medium and heavy lubricating oils; fuel oil; residuum; crude oil; asphalt; synthetic crude bottoms	< 230	All	S-5	—
	230 to 370	All	S-6	b,c
	> 370	All	C-6	b
Hydrocarbons with Total Acid Number (TAN) equal or greater than 0,5 mg KOH/g	220 to 400	All	A-7	j
Non-corrosive hydrocarbons, e.g. catalytic reformat, isomaxate, desulfurized oils	230 to 370	All	S-5	c
Xylene, toluene, acetone, benzene, furfural, MEK, cumene	< 230	All	S-5	—
Sodium carbonate	< 175	All	I-1	—
Caustic (sodium hydroxide), concentration < 20 %	up to 100	All	S-5	d
	> 100	All	—	e
Seawater	< 95	All	—	f
Sour water without chloride with chloride with chloride	< 260	All	A-7	k
	up to 60	All	A-7	k
	> 60	All	D-1	—
Produced water, formation water and brine	All	All	D-1 or D-2	f
Sulfur (liquid state)	All	All	S-5	—
FCC slurry	< 370	All	C-6	—
Potassium carbonate	< 175	All	C-6	—
	175 to 370	All	A-8	—
MEA, DEA, TEA stock solutions	< 120	All	S-5	—

Table E.1 - Materials Class Selection Guidance (Continuation)

Service	Temperature °C	Pressure range	Materials class	Ref. Note
DEA, TEA-lean solutions	< 120	All	S-5 or S-8	d,g
MEA-lean solution (CO ₂ only)	80 to 150	All	S-9	d
MEA-lean solution (CO ₂ and H ₂ S)	80 to 150	All	S-8	d,g
MEA-, DEA-, TEA-rich solutions	< 80	All	S-5 or S-8	d
Sulfuric acid concentration > 85 %	< 38	All	S-5	b
85 % to < 1 %	< 230	All	A-8	b
Hydrofluoric acid concentration > 96 %	< 38	All	S-9	b
<p>NOTE 1 The materials for pump parts for each material class are given in Annex H of ISO 13709:2009.</p> <p>NOTE 2 Specific materials recommendations should be obtained for services not clearly identified by the service descriptions listed in this table.</p> <p>NOTE 3 Cast iron casings (6.12.1.6 of ISO 13709:2009), if recommended for chemical services, are for non-hazardous locations only. Steel casings should be used for pumps in services located near process plants or in any location where released vapour from a failure can create a hazardous situation or where pumps can be subjected to hydraulic shock, for example in loading services.</p>				
<p>a Oxygen content and buffering of water should be considered in material selection.</p> <p>b The corrosiveness of foul waters, hydrocarbons over 230 °C, acids, and acid sludges can vary widely. Material recommendations should be obtained for each service. The materials class indicated above is satisfactory for many of these services, but shall be verified. The materials class S-8 may also be considered for operating temperatures below 95 °C.</p> <p>c If product corrosivity is low, materials class S-5 may be used for services at 230 °C to 370 °C. Specific material recommendations should be obtained in each instance.</p> <p>d All welds shall be stress-relieved.</p> <p>e UNS N08007 or Ni-Cu alloy pump material should be used.</p> <p>f For seawater, produced water, formation water and brine services, the purchaser and the vendor should agree on the construction materials that best suit the intended use.</p> <p>g The vendor shall consider the effects of differential material expansion between casing and rotor and confirm suitability if operating temperatures can exceed 95 °C.</p> <p>h Materials selected for low-temperature services shall meet the requirements of 6.12.1.6 and 6.12.4 of ISO 13709:2009. Casting alloy grades LCB, LC2 and LC3 are shown only for reference. Grades LCB, LC2 and LC3 refer to ISO 4991. C23-45BL, C43E2aL and C43L are equivalent to ASTM A352/A352M, grades LCB, LC2 and LC3. Use equivalent materials for wrought alloys.</p> <p>i Material alloys based on aluminium, bronze, aluminium bronze and nickel, may also be considered for temperatures as low as -196 °C.</p> <p>j A-7 construction in 317L austenitic stainless steel.</p> <p>k A-7 construction in 304 austenitic stainless steel. Materials class A-8 can also be applied.</p>				

Annex F - Materials and Material Specifications for Centrifugal Pump Parts (Addition / Modification of Annex H of ISO 13709:2009)**F.1 Modification (Table H.1 of ISO 13709:2009)**

Replace the remark "c" for:

c Austenitic stainless steels include AISI standard types 302, 303, 304, 316, 317, 321, and 347.

F.2 Addition (Table H.2 of ISO 13709:2009)

ASTM Specifications for 317L Austenitic Stainless Steel (main components):


Pressure castings - A351 Gr CG3M
General castings - A743 Gr CG3M
Wrought/Forgings - A182 Gr F 317L
Bar stock - A276 Gr 317

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Table F.1 - Piping Materials (Substitution of Table H.4 of ISO 13709:2009)

Component	Fluid					
	Auxiliary process liquid		Steam		Cooling water	
	Category		Gauge pressure kPa		Nominal size	
	Materials classes I-1 and I-2	All weldable materials	≤ 500	> 500	Standard ≤ DN 25 (NPS 1)	Optional ≥ DN 40 (NPS 1 1/2)
Pipe	Seamless ^a	Seamless ^a	Seamless ^a	Seamless ^a	-	Carbon steel (galvanized to ISO 10684 or ASTM A153/ A153M)
Tubing ^b	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	Stainless steel (Seamless type 316)	-
All valves	Class 800	Class 800	Class 800	Class 800	Class 200 Bronze	Class 200 Bronze
Gate and globe valve	Bolted bonnet and gland	Bolted bonnet and gland	Bolted bonnet and gland	Bolted bonnet and gland	-	-
Pipe fittings	Forged class 3 000	Forged class 3 000	Forged class 3 000	Forged class 3 000	Malleable iron (galvanized to ISO 10684 or ASTM A153/ A153M)	Malleable iron (galvanized to ISO 10684 or ASTM A153/ A153M)
Tubing fittings	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	Manufacturer's standard	-
Fabricated joints ≤ DN 25 (NPS 1)	Threaded	Socket-welded	Socket-welded	Socket-welded	Threaded	-
Fabricated joints ≥ DN 40 (NPS 1 1/2)	-	-	-	-	-	Purchaser to specify
Gaskets	Purchaser to specify	Austenitic stainless steel spiral-wound	-	Austenitic stainless steel spiral-wound	-	-
Flange bolting ^c	4140 alloy steel	4140 alloy steel	-	4140 alloy steel	-	-
<p>a Schedule 80 shall be used for pipe sizes from DN 15 to DN 50 (NPS 1/2 to NPS 2); schedule 40 shall be used for sizes larger than DN 50 (NPS 2);</p> <p>b Acceptable tubing sizes (in accordance with ISO 4200) are the following:</p> <ul style="list-style-type: none"> - 12,7 mm diameter, 1,66 mm wall (1/2 in diameter, 0,065 in wall); - 19 mm diameter, 2,6 mm wall (3/4 in diameter, 0,095 in wall); <p>c If the purchaser does not specify stainless steel fasteners, they shall be according to 7.9 of this PETROBRAS Standard.</p>						

Annex G – Vendor Drawing and Data Requirements (Substitution of Figure L.1 of ISO 13709:2009)

	DATA SHEET		No.						
	CLIENT:							SHEET 1 of 4	
	JOB:								
	AREA:								
TITLE:		VENDOR DRAWING AND DATA REQUIREMENTS							
INDEX OF REVISIONS									
REV.	DESCRIPTION AND/OR REVISED SHEETS								
<div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%) rotate(-30deg); opacity: 0.3; font-size: 100px; font-weight: bold;"> AMENDED SHEET IN 04/2015 DO NOT USE </div>									
	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-553 REV. E ANNEX G - SHEET 01/05.									

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