

AXIAL AND CENTRIFUGAL COMPRESSORS AND EXPANDER-COMPRESSORS

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 non mandatory 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.

CONTEC

Comissão de Normalização
Técnica

SC - 11

Machines

1 Scope

1.1 This Standard is based on API Std 617 8th edition, published in September, 2014.

1.2 This Standard establishes the minimum requirements for Axial and Centrifugal Compressors, Expander-Compressors and their auxiliary equipment or systems, to be supplied in accordance with API Std 617 8th edition.

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

1.4 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 (including any amendments) applies.

API [Std 520](#) – Sizing, Selection, and Installation of Pressure-relieving Devices – Part I – Sizing and Selection

API [Std 614](#) – Lubrication, Shaft-Sealing, and Control-Oil Systems and Auxiliaries

API [Std 617](#) – Axial and Centrifugal Compressors and Expander-Compressors - Eighth Edition

API [Std 670](#) – Machinery Protection Systems

API [RP 686](#) – Recommended Practice for Machinery Installation and Installation Design

API [RP 687](#) – Rotor Repair

ASME [B1.20.1](#) – Pipe Threads, General Purpose

ASME [B16.1](#) – Gray Iron Pipe Flanges and Flanged Fittings - Classes 25, 125, and 250

ASME [B16.42](#) – Ductile Iron Pipe Flanges and Flanged Fittings - Classes 150 and 300

ASME [B16.47](#) – Large Diameter Steel Flanges - NPS 26 Through NPS 60

ASME [B16.5](#) – Pipe Flanges and Flanged Fittings - NPS ½ Through NPS 24

ASME [B31.3](#) – Process Piping

ASME [PTC-10](#) – Performance Test Code on Compressors and Exhausters

IEC [60079-10-1](#) – Electrical Apparatus for Explosive Gas Atmospheres – Part 10-1: Classification of Hazardous Areas – Explosive gas atmospheres

IEC [60529](#) – Degrees of Protection Provided by Enclosures (IP Code)

ISO [11342](#) – Mechanical Vibration - Methods and Criteria for the Mechanical Balancing of Flexible Rotors

ISO/IEC [17024](#) – Conformity assessment - General requirements for bodies operating certification of persons

ISO [1940-1](#) – Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances

ISO 8501 – Preparation of steel substrates before application of paints and related products
- Visual assessment of surface cleanliness

ISO 9712 – Non-destructive testing – Qualification and certification of NDT personnel

SSPC-SP 6 – Commercial Blast Cleaning

3 Basic Considerations

3.1 The requirements of this Standard are additions to, or modifications of the API Std 617 8th edition, which shall be considered as an integral part of this Standard.

3.2 Except for new clauses, item numbers used in this Standard are the same API Std 617 8th edition paragraph one.

3.3 All deviations from the requirements stated in this Standard and/or in API Std 617 8th edition shall be clearly identified in the proposal and submitted to PETROBRAS for approval. Any requirement exception or deviation from any of the listed documents not clearly mentioned in tender will be considered by PETROBRAS as full compliance with the material requisition.

3.4 All deviations from the contracted design or scope of supply made by vendor during time of drawings and documents review shall be clearly mentioned in the particular document to be approved.

3.5 Vendor's compliance with the requirements of these specifications does not exempt him from the responsibility of supplying equipment and accessories suitable for the specified service conditions.

3.6 Compressors and auxiliary equipment shall be in accordance with API Std 617 8th edition, plus the following changes, as noted in parenthesis for each clause, according to the definitions stated below. The information of each clause shall be read as follows, whenever starting with:

- addition - continuation of that particular API Std 617 8th edition paragraph;
- modification - replacement of part of that affected API Std 617 8th edition paragraph;
- substitution - replacement of that API Std 617 8th edition paragraph in its entirety;
- new - insertion of a requirement not found in API Std 617 8th edition;
- deletion - removal of that particular API Std 617 8th edition paragraph;
- comment - clarification or interpretation on that API Std 617 8th edition paragraph.

3.7 Annex A contains the data sheet form to be used for axial and centrifugal compressors and expander-compressors, according to API Std 617 8th Edition.

3.8 Annex B contains the Vendor Drawing and Data Requirements (VDDR) form to be used for axial and centrifugal compressors and expander-compressors, according to API Std 617 8th Edition.

3.9 Annex C establishes the shop vibration equipment configuration to be used by the vendor during the shop tests.

4 General Requirements (Part 1 of API Std 617)

4.1 Normative References (Section 2 of API Std 617)

4.1.1 Substitution (2.2 of API Std 617)

In case of conflict between the inquiry documents, the hierarchy of documents shall be as follows:

- a) data sheets;
- b) supplementary job or technical specifications (if any);

- c) this PETROBRAS Standard and all other PETROBRAS standards specifically referenced in the inquiry;
- d) API [Std 617](#) 8th edition.

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

- a) formal correspondence regarding any changes in the scope of supply or technical specifications, mutually agreed upon by PETROBRAS and vendor;
- b) approved documentation;
- c) revised data sheets and other material requisition documents (applicable to purchase);
- d) this PETROBRAS Standard and all other PETROBRAS standards specifically referenced in the inquiry or order;
- e) API [Std 617](#) 8th edition;
- f) vendor's proposal.

4.2 Terms, Definitions and Abbreviations (Section 3 of API [Std 617](#))

4.2.1 Substitution (3.1.65 of API [Std 617](#))

unit responsibility

Obligation for coordinating the documentation, delivery, and technical aspects of the equipment and all auxiliary systems included in the machinery train package.

4.2.2 New (3.1.67)

hazardous service

when so stated on the data sheets, shall apply to all parts of compressor, seal system, piping, instruments and auxiliary equipment that are to (or may eventually) be in contact with the process gas, and refers to the following fluids and operational conditions:

- a) H₂S (Hydrogen Sulphide) concentrations above 500 ppm;
- b) hydrocarbons with hydrogen at a partial pressure above 7 bar a (101 psi a);
- c) hydrogen-rich services (more than 90 % molal concentration at any pressure);
- 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.

4.3 General (Section 4 of API [Std 617](#))

4.3.1 Unit Responsibility (4.3 of API [Std 617](#))

4.3.1.1 Substitution (4.3.1 of API [Std 617](#))

Unless otherwise specified, the compressor vendor shall assume unit responsibility and shall assure that all sub-vendors comply with the requirements of this standard and all reference standards.

4.3.2 Basic Design (4.4 of API [Std 617](#))

4.3.2.1 General (4.4.1 of API [Std 617](#))

4.3.2.1.1 Substitution (4.4.1.2 of API [Std 617](#))

The equipment (including auxiliaries) covered by this standard shall be designed and constructed for a minimum service life of 20 years and at least 5 years of uninterrupted continuous operation.

4.3.2.1.2 Substitution (4.4.1.4 of API Std 617)

A complete liquid injection system manifold and control devices shall be provided whenever such system is specified. Liquid injection system shall be, as a minimum, according to the following requirements:

- a) a fluid type and source: as specified on the data sheets, injection liquid may be either supplied by a process stream or suctioned from a reservoir;
- b) injection points: unless otherwise specified, there shall be an injection point at each stage/casing inlet and at each impeller entrance;
- c) distribution of flow: unless otherwise specified, 60% of required flow shall be assigned to stage/casing inlet(s) and 40% distributed to impeller entrances, considering respective pressure levels;
- d) required fluid flow: unless otherwise specified or, else, recommended by the vendor, injection liquid flow shall be continuous and within 1% - 3% of compressor rated mass flow;
- e) nozzles: unless otherwise specified, injection nozzles shall be of the full-cone atomizing type, with size 90 % less than 100 μm , maximum size of 120 μm . Whenever feasible, nozzles shall be replaceable while compressor is in operation;
- f) injection manifold and controls: liquid injection manifold shall include a throttle valve, an armored flow meter, a check valve, a pressure indicator, and a block valve for each injection point. As specified on the data sheets, injection system may also require pressurization, filtration, cooling (or heating), piping, reservoir and other accessories needed for proper operation;
- g) construction materials: in accordance with compressor requirements or, unless otherwise specified, in 300 series stainless steel, as a minimum;
- h) liquid injection supply line(s) shall be provided with automatic blockage and interlock in case of compressor shutdown.

4.3.2.1.3 Addition (4.4.1.7 of API Std 617)

Compressor components that are very similar among each other (such as impellers, shafts, seals and seal glands, sleeves, diffusers and casings) shall be indelibly identified with the order of assembly and to which sub-set they belong to (e.g.: stage number, suction side, coupling end, etc). Lifting lugs or eyebolts shall be provided for any equipment or component that weighs more than 30 kg (66 lb). Precision assembly components (such as bearing housings, bearings, seals, diffusers, diaphragms, couplings, etc.), regardless of weight, shall always be fitted with suitable provisions to facilitate assembly / disassembly activities or any other maintenance task.

4.3.2.1.4 Substitution (4.4.1.10 of API Std 617)

Unless otherwise specified, the whole train furnished by the vendor (compressor, driver, gear unit and auxiliary equipment) shall conform to the maximum allowable sound pressure level of 85 dBA, slow-response, measured at 1 m (3.28 ft) from the equipment surfaces. Unless otherwise specifically stated on the data sheets, noise level tests need not to be performed. On the other hand, bidder/vendor shall guarantee that equipment actual sound pressure level will remain within allowable limits, informing in his proposal the expected (or guaranteed) maximum sound pressure level per octave band for the quoted equipment and including copies of noise level test certificates performed on similar equipment.

4.3.2.1.5 New (4.4.1.13)

All supplied equipment shall be new. Refurbished equipment or parts are not acceptable.

4.3.2.1.6 New (4.4.1.14)

New models or prototypes are not acceptable. A minimum of 25 000 hours continuous operation under similar operating conditions shall be demonstrated for, at least, 15 machines of the same model and 10 machines of the same size as the one offered.

The following parameters shall be considered to indicate similar operating conditions and shall be plotted in an experience plot:

Type of equipment/component	Most common set of parameters
Shaft seals	Peripheral speed and sealing pressure
Blades	Power per stage and peripheral speed
Impellers	Tip speed, head coefficient, hardness, gas composition and flow coefficient
Couplings	RPM and power
Gears Units	RPM and power
Compressors	Power, RPM, head & pressures, capacity, gas composition and density, critical speed ratio

4.3.2.2 Modification (4.4.4 of API Std 617)

Replace the third sentence by:

The vendor's representative shall witness:

- a check of the piping alignment performed by unfastening the main process connections of the equipment;
- the initial shaft alignment check at ambient conditions (cold alignment);
- check shaft alignment at the operating temperature (hot alignment).

4.3.2.3 Substitution (4.4.5 of API Std 617)

Motors, generators, instrumentation, electrical components, and electrical installations shall be suitable for the area classification (class, group, and division or zone) specified by the purchaser and shall meet the requirements of IEC 60079-10-1, as well as local codes specified and furnished by the purchaser.

4.3.2.4 Substitution (4.4.7 of API Std 617)

Compressors shall be suitable for field run on air. Performance parameters, including any required precautions, shall be indicated by vendor in the proposal and are subject to PETROBRAS approval. If a test run on air is not feasible, vendor shall indicate alternative procedure. Additional equipment required for the field test run shall be quoted separately.

4.3.3 Materials (4.5 of API Std 617)

4.3.3.1 General (4.5.1 of API Std 617)

4.3.3.1.1 Substitution (4.5.1.15 of API Std 617)

O-ring materials shall be compatible with all specified services. Unless otherwise specified, the maximum allowable depressurizing rate shall be in accordance with the design criterion established in API Std 520. Special consideration shall be given to the selection of O-rings for high-pressure services to ensure that they are not being damaged upon rapid depressurization (explosive decompression), where the use of redundant O-ring arrangements or other approved design countermeasure might be necessary. For vertically split case designs, the vendor shall state the maximum allowable depressurizing rate of the compressor casing required to prevent explosive decompression of the O-ring material supplied.

4.3.3.1.2 Low Temperature Service (4.5.1.19 of API Std 617)**4.3.3.1.2.1 Substitution (4.5.1.19.2 of API Std 617)**

Other components of the machinery train shall also be evaluated for the prevention of brittle fracture due to materials exhibiting change from ductile to brittle fracture as temperatures are reduced.

4.3.4 Casings (4.6 of API Std 617)**4.3.4.1 Material Inspection of Pressure-containing parts (4.6.3 of API Std 617)****4.3.4.1.1 Addition (4.6.3.2 of API Std 617)**

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

4.3.4.2 Pressure Casing Connections (4.6.4 of API Std 617)**4.3.4.2.1 General (4.6.4.1 of API Std 617)****4.3.4.2.1.1 Substitution (4.6.4.1.7 of API Std 617)**

Valved drains shall be provided on all casings. For multistage equipment, individual stage casing drains (including a drain for the balance piston cavity) shall be provided if the vendor cannot demonstrate, during bid stage (with drawings), that complete drainage of all inner parts is attainable with the vendor's standard casing drain arrangement.

4.3.4.2.2 Main Process Connections (4.6.4.2 of API Std 617)**4.3.4.2.2.1 Addition (4.6.4.2.11 of API Std 617)**

The vendor shall also supply blind flanges for hydrostatic testing of piping connected to the machine with nonstandard connections.

4.3.4.2.3 Auxiliary Connections (4.6.4.3 of API Std 617)**4.3.4.2.3.1 Substitution (4.6.4.3.5 of API Std 617)**

Pipe nipples screwed or welded to the casing, preferably not more than 150 mm (6 in.) long, shall be a minimum of Schedule 160 seamless for sizes DN 40 (NPS 1 1/2) and smaller.

4.3.4.2.3.3 Requirements for Threaded Connections (4.6.4.3.8 of API Std 617)**4.3.4.2.3.3.1 Substitution (4.6.4.3.8.1 of API Std 617)**

Threaded connections are only acceptable for air, inert gas or water. Threaded openings for tapered pipe threads shall conform to ASME B1.20.1. Bosses for pipe threads shall conform to ASME B16.5.

4.3.4.2.3.3.2 Substitution (4.6.4.3.8.2 of API Std 617)

Pipe threads shall be taper thread conforming to ASME B1.20.1.

4.3.5 Dynamics (4.8 of API Std 617)**4.3.5.1 General (4.8.1 of API Std 617)****4.3.5.1.1 Modification (4.8.1.3 of API Std 617)**

Replace the first sentence by:

The vendor with unit responsibility shall communicate the existence of any undesirable running speeds in the range from zero to trip speed.

4.3.5.1.2 Substitution (4.8.1.4.2 of API Std 617)

Unless otherwise specified, the reporting requirements identified as required for independent audit of the results shall be provided.

4.3.5.1.3 Substitution (4.8.1.4.3 of API Std 617)

Provisions shall be made to provide the purchaser with access to drawings to develop independent models of the rotor, bearings, and seals. This data shall be made available in electronic format.

4.3.5.1.4 Substitution (4.8.1.5.2 of API Std 617)

Unless otherwise specified, the reporting requirements identified as required for independent audit of the results shall be provided.

4.3.5.1.5 Substitution (4.8.1.5.3 of API Std 617)

Provisions shall be made to provide the purchaser with access to drawings to develop independent models of the rotors. This data shall be made available in electronic format.

4.3.5.2 Lateral Analysis (4.8.2 of API Std 617)

4.3.5.2.1 Substitution (4.8.2.2 of API Std 617)

The location of all critical speeds below the trip speed shall be confirmed on the test stand during the mechanical running test (see 4.8.3.1). The accuracy of the analytical model shall be demonstrated (see 4.8.3).

4.3.5.2.2 Substitution (4.8.2.3 of API Std 617)

The supplier shall conduct an undamped analysis to identify the undamped critical speeds and determine their mode shapes. The analysis shall identify the first four undamped critical speeds and cover as a minimum the stiffness range from free-free to rigid support rotor modes.

4.3.5.2.3 Addition (4.8.2.4 b of API Std 617)

The clearance ranges to be used in the analysis shall be:

minimum bearing clearance and maximum preload, calculated using maximum pad, minimum bearing and maximum shaft radius;
average bearing clearance and preload, calculated using mean pad, bearing and shaft radius;
maximum bearing clearance and minimum preload, calculated using minimum pad, maximum bearing and minimum shaft radius;
these calculated coefficients for the speed range, shall be presented in the damped unbalance response analysis report. Bearing circumferential temperature profile shall also be included.

4.3.5.2.4 Addition (4.8.2.4 c of API Std 617)

The pad inertia and thermal effects, convection and pad conduction shall also be considered.

4.3.5.2.5 New (4.8.2.4 k)

The influence over the operating range of the damper seals stiffness and damping, considering also the tolerance on the component clearance.

4.3.5.2.6 Modification (4.8.2.7 of API Std 617)

Replace the first sentence by:

A separate damped unbalance response analysis shall be conducted for each critical speed in the range from ZERO to trip speed, as well as the next mode occurring above the trip speed.

4.3.5.2.7 Substitution (4.8.2.8 of API Std 617)

As required by 4.8.3.1, additional analyses shall be made for use with the verification test specified in 4.8.3. The location of the unbalance shall be determined by the supplier. The unbalance shall not be less than 2 times or greater than 8 times the value from Equation (3) or Equation (4) or as specified in 4.8.2.8.1. Any test stand parameters that influence the results of the analysis shall be included, such as actual bearing clearances used during the test and pedestal stiffness. If the chosen location of the unbalance does not excite the critical(s) of concern, the unbalance shall be placed in the plane(s) that would excite the critical most adversely.

4.3.5.2.8 Substitution (4.8.2.9 a of API Std 617)

If the AF at a particular critical speed outside the operating speed range is less than 2.5, the response is considered critically damped and no separation margin is required ($SM_r = 0$). However, even though amplification factor calculations for a given rotor may indicate critically damped response and then no separation margin would be required, critical speeds within the operating speed range will only be accepted if the vendor can demonstrate that all efforts to remove the critical speed from the operating speed range have been exhausted.

4.3.5.2.9 Modification (4.8.2.11 of API Std 617)

Replace Equation (9) by:

$$S_{cc} = A_{vl} / A_{max}$$

4.3.5.2.9.1 Addition (4.8.2.11.2 of API Std 617)

For machines with abradable seals, the rotor response amplitudes, corrected in accordance with 4.8.2.11 at any speed from zero to trip speed shall not exceed 100 % of the minimum design diametral running clearances throughout the machine.

4.3.5.3 Unbalanced Rotor Response Verification Test (4.8.3 of API Std 617)

4.3.5.3.1 Substitution (4.8.3.1 of API Std 617)

An unbalanced rotor response test (URT) shall be performed as part of the mechanical running test (see 6.3.5 of Part 1, 6.3.1 of Parts 2 and 3, and 6.3.3 of Part 4, whichever is applicable), and the results shall be used to verify the analytical model. The actual response of the rotor on the test stand to the same arrangement of unbalance and bearing loads as was used in the analysis specified in 4.8.2.8 shall be used for determining the validity of the damped unbalanced response analysis. To accomplish this, the requirements of 4.8.3.1.1 through 4.8.3.1.6 shall be followed.

NOTE This test may be performed on an on-speed balancing machine if previously approved by PETROBRAS.

4.3.5.3.1.2 Substitution (4.8.3.1.3 of API Std 617)

The machine shall then be brought up to trip speed after being held at maximum continuous speed until bearing temperature and vibration have been stabilized, and the indicated vibration amplitudes and phase shall be recorded during the coastdown using the same procedure as 4.8.3.1.1.

4.3.5.3.1.3 Substitution (4.8.3.1.4 of API Std 617)

The location of critical speeds below the trip speed shall be clearly identified during the test.

NOTE This may be accomplished on an on-speed balancing machine if previously approved by PETROBRAS.

4.3.5.3.1.4 Addition (4.8.3.1.5 of API Std 617)

If, after vectorial subtraction, the unbalance mass does not change the vibration at critical speed in more than 2.5 μm (0.1 mil), then the unbalance weight shall be increased and the test shall be repeated.

4.3.5.4 Level 1 Stability Analysis (4.8.5 of API Std 617)

4.3.5.4.1 Addition (4.8.5.2 of API Std 617)

All components shall be analyzed using the extremes of the operating limits for clearance and oil inlet temperature and pressure, to produce the minimum log decrement.

4.3.5.4.2 Substitution (4.8.5.3 of API Std 617)

When tilt pad journal bearings are used, the analysis shall be performed with full pad dynamic coefficients.

4.3.5.4.3 Modification (4.8.5.8 of API Std 617)

Replace item a.2) by:

2) $\delta_a < 0.2$

Replace item b. by:

b. For axial flow rotors:

If $\delta_a < 0.2$, a Level II stability analysis shall be performed. Otherwise, the stability is acceptable and no further analyses are required.

4.3.5.5 Level II Stability Analysis (4.8.6 of API Std 617)

4.3.5.5.1 Substitution (4.8.6.4 of API Std 617)

All the operating conditions defined for the complete operational range (including surge and choke conditions) shall be extrapolated to both N_{ma} and N_{mc} .

NOTE Extrapolated conditions are expected to fall within the operating limits of the equipment train (the defined operating map).

4.3.5.5.2 Substitution (4.8.6.9 of API Std 617)

The Level II stability analysis shall indicate that the machine, as calculated in 4.8.6.1 through 4.8.6.8, shall have a final log decrement, δ_f , greater than 0.2.

4.3.5.5.3 Substitution (4.8.6.10 of API Std 617)

A stability test, to measure damping ratio (and to determine the corresponding log decrement), shall be performed in accordance with item 6.3.8 if one of the following conditions is satisfied:

- a) the machine fails to meet the criteria specified in item 4.8.6.9;
- b) the test has been specified in compressor data sheet.

NOTE Some particular applications which have not proven rotordynamic design may require special consideration in determining the actual compressor damping ratio (thus demanding stability test to be performed), such as CO₂ injection, high-pressure and high-density gases, etc.

4.3.5.6 Torsional Analysis (4.8.7 of API Std 617)

4.3.5.6.1 Substitution (4.8.7.2 of API Std 617)

For direct driven turbine trains, the vendor shall perform a torsional vibration analysis of the complete coupled train and shall be responsible for directing any modifications necessary to meet the requirements of 4.8.7.3 through 4.8.7.7.

4.3.5.6.2 Substitution (4.8.7.6 of API Std 617)

All other torsional natural frequencies (including blade pass frequencies) shall preferably be at least 10% above or 10% below any possible excitation frequency within the specified operating speed range (from minimum to MCS).

4.3.5.7 Vibration and Balancing (4.8.8 of API Std 617)

4.3.5.7.1 New (4.8.8.2.3)

After completion of final balancing, all major elements of the assembled rotor shall be match marked. Balance quality data (as designed / as final) for all rotating equipment and components shall be provided in the installation, operation and maintenance manuals and other applicable documents.

4.3.5.7.2 Substitution (4.8.8.3.1 of API Std 617)

Unless otherwise specified, after low speed sequential balancing, flexible rotors as defined per ISO 11342 shall be operating speed balanced in accordance with 4.8.8.4.

4.3.5.7.3 Substitution (4.8.8.4.4 of API Std 617)

The high speed drive assembly shall be shown to have an effect less than 25% of the balance tolerance. Job-coupling half moment shall be simulated either by means of the facility drive coupling and adapter or by means of the job-coupling hub with moment simulator.

4.3.5.7.4 Modification (4.8.8.11 of API Std 617)

Replace the first sentence by:

If the supplier can demonstrate that electrical or mechanical runout is present, a maximum of the level from Equation (13) or 6.35 μm (0.25 mil), whichever is greater, may be vectorially subtracted from the vibration signal measured during the factory acceptance test.

4.3.5.7.5 Substitution (4.8.8.8.1 of API Std 617)

At any speed greater than the MCS, up to and including the trip speed of the driver, the vibration level shall not exceed 12.7 μm (0.5 mil) above the value recorded at the maximum continuous speed for each probe or half of the value from Equation (12), whichever is less.

4.3.6 Shaft End Seals (4.10 of API Std 617)

4.3.6.1 General (4.10.1 of API Std 617)

4.3.6.1.1 Modification (4.10.1.5 of API Std 617)

Replace the first sentence by:

Unless otherwise specified, gas compressors shall be provided with dry gas seals.

4.3.6.1.2 Substitution (4.10.1.9 of API Std 617)

Unless otherwise specified, the method of control (flow control or pressure control) and system configuration shall be mutually determined.

4.3.7 Nameplates and Rotation Arrows (4.12 of API Std 617)

4.3.7.1 Substitution (4.12.4 of API Std 617)

SI units shall be used on the nameplates, except for pressure units (which shall be indicated in kgf/cm², unless otherwise specified).

4.4 Accessories (Section 5 of API Std 617)

4.4.1 Couplings and Guards (5.2 of API Std 617)

4.4.1.1 Modification (5.2.2 of API Std 617)

Replace the last sentence by:

Unless otherwise specified, couplings shall be of non-lubricated, flexible stainless steel diaphragm or disk type.

4.4.1.2 New (5.2.7)

For turbine driven units, couplings shall incorporate a feature that allows transmission of load for a limited period, in the event of a complete flexible element failure.

4.4.2 Mounting Plates (5.4 of API Std 617)

4.4.2.1 General (5.4.1 of API Std 617)

4.4.2.1.1 Substitution (5.4.1.2.13 of API Std 617)

The supplier shall define the specific type of grout to be used for field installation.

4.4.2.1.2 Substitution (5.4.1.2.14 of API Std 617)

Unless otherwise specified, the equipment supplier shall prepare the mounting plates by commercially abrasive blasting all grout contacting surfaces in accordance with [SSPC-SP 6](#) (ISO 8501, Grade Sa2) and shall precoat these surfaces with a primer compatible with the type of grout defined by the supplier.

4.4.2.2 Baseplates (5.4.2 of API Std 617)

4.4.2.2.1 Modification (5.4.2.1 of API Std 617)

Replace the first sentence by:

Unless otherwise specified, the driver and the driven equipment (including any gear unit) shall be furnished mounted on a baseplate.

4.4.2.2.1.1 Modification (5.4.2.1.1 of API Std 617)

Replace the first sentence by:

Baseplates shall be equipped with a drip rim (see Figure 6) or drip pan.

4.4.2.2.2 Substitution (5.4.2.4 of API Std 617)

Unless otherwise specified, nonskid decking covering all walk and work areas shall be provided on the top of the baseplate.

4.4.2.2.2.1 Substitution (5.4.2.4.1 of API Std 617)

Horizontal solid decked surfaces shall be sloped to avoid collection of liquid.

4.4.2.2.3 Modification (5.4.2.6 of API Std 617)

Replace the first sentence by:

The baseplate shall be designed to facilitate the use of optical, laser or other instruments for field leveling during installation.

4.4.3 Controls and Instrumentation (5.5 of API Std 617)

4.4.3.1 General (5.5.1 of API Std 617)

4.4.3.1.1 Substitution (5.5.1.6 of API Std 617)

Unless otherwise specified, controls that are installed outside shall have a minimum ingress protection level as follows:

IP 65 (as per IEC 60529) for on-shore installations;

IP 56 (as per IEC 60529) for off-shore installations.

The controls and instrumentation, equipment and wiring shall comply with the construction requirements of IEC 60079.

4.4.3.1.2 Substitution (5.5.1.7 of API Std 617)

Unless otherwise specified, terminal boxes shall have a minimum ingress protection level as follows:

IP 65 (as per IEC 60529) for on-shore installations;

IP 56 (as per IEC 60529) for off-shore installations.

4.4.3.2 Control Systems (5.5.2 of API Std 617)

4.4.3.2.1 Substitution (5.5.2.2 of API Std 617)

Unless otherwise specified, an anti-surge system shall be provided by the supplier.

4.4.3.2.2 Modification (5.5.2.3 of API Std 617)

Replace first sentence by:

Unless otherwise specified, the supplier shall supply the anti-surge valve.

4.4.3.2.3 Substitution (5.5.2.4 of API Std 617)

The supplier shall supply the results of an anti-surge system transient response simulation.

4.5 Inspection, Testing, and Preparation for Shipment (Section 6 of API Std 617)**4.5.1 General (6.1 of API Std 617)****4.5.1.1 Substitution (6.1.4 of API Std 617)**

Unless otherwise specified, all shop tests to be carried out shall be witnessed by the purchaser or the purchaser's representative.

4.5.2 Testing (6.3 of API Std 617)**4.5.2.1 Hydrostatic Test (6.3.2 of API Std 617)****4.5.2.1.1 New (6.3.2.4)**

The liquid used for the hydrostatic test shall be at a temperature higher than the nil-ductility transition temperature of the material being tested.

4.5.2.2 Mechanical Running Test (6.3.5 of API Std 617)**4.5.2.2.1 Substitution (6.3.5.2 of API Std 617)**

Shop test facilities shall include the capability of continuously monitoring, displaying, recording, and printing vibration displacement and phase, vibration spectra, Bode plots, shaft orbits, bearing metal temperatures and oil pressures and temperatures. Shop test facilities shall also include a dedicated station fully available for PETROBRAS use, and capable of handling and analyzing all real time data collected during all tests.

4.5.2.2.2 New (6.3.5.2.3)

The shop vibration equipment used during the tests shall be configured in accordance with Annex C of this standard. All cables shall be identified. ADRE system is preferred for data collecting and monitoring. If vendor uses another system, then visualization (or translation into ADRE files) software shall be included as well.

4.5.2.2.3 Substitution (6.3.5.3 of API Std 617)

At least 12 weeks prior to the first scheduled running test, the supplier shall submit to the purchaser detailed procedures for the Mechanical Running Test (MRT) and all specified running optional tests including acceptance criteria.

4.5.2.2.4 Substitution (6.3.5.9.3 of API Std 617)

Synchronous vibration amplitude and phase angle versus speed during acceleration and deceleration shall be plotted before and after the 4-hour run. Both the synchronous (one per revolution) and overall vibration levels shall be plotted. The speed range covered by these plots shall be from 400 rpm to trip speed and from trip speed to 400 rpm.

4.5.2.2.5 Substitution (6.3.5.9.3.1 of API Std 617)

These data shall also be furnished in polar form. The speed range covered by these plots shall be from 400 rpm to trip speed and from trip speed to 400 rpm.

4.5.2.2.6 Substitution (6.3.5.9.4 of API Std 617)

All real-time data files (vibration, speeds, phase signals, etc.), regarding a successful test or not, shall be recorded and a CD copy shall be provided to PETROBRAS immediately after the test.

4.5.2.2.7 Substitution (6.3.5.9.5 of API Std 617)

The following seal flow data shall be taken during the compressor mechanical running test (MRT) and performance test (PT) to assure that the seals are installed and operating properly:

- a) For compressors with oil seals, inner oil leakage, pressure and temperature shall be measured at each seal;
- b) For single dry gas seals, flow, pressure and temperature in each vent line from each seal shall be measured. If a buffer gas seal is used, injection flow, pressure and temperature for each seal shall also be measured;
- c) For tandem dry gas seals, flow, pressure and temperature in the primary and secondary vent line from each seal shall be measured. If a buffer gas for primary and secondary seal is used, injection flow, pressure and temperature for each seal shall also be measured;
- d) For double dry gas seals, the pressure, temperature and total flow to each seal shall be measured.

4.5.2.2.7.1 New (6.3.5.9.5.1)

The guaranteed static seal leakage shall be checked during the assembled compressor gas leakage test.

4.5.2.2.8 Substitution (6.3.5.9.6 of API Std 617)

Lube-oil and seal-oil inlet pressures and temperatures shall be varied through the range permitted in the compressor operating manual. The following cases shall be verified during the 4-hour test:

- high lube oil pressure & high lube oil temperature;
- high lube oil pressure & low lube oil temperature;
- low lube oil pressure & high lube oil temperature;
- low lube oil pressure & low lube oil temperature.

Oil conditions change test shall be done during the four-hour mechanical running test, but not before all test parameters and variables are considered to be stable or steady enough to proceed. This test does

not constitute a waiver of the other specified test requirements. The oil conditions change shall be held for a minimum of five minutes after temperature stabilization.

4.5.2.2.9 New (6.3.5.9.6.1)

During MRT the highest bearing surface metal temperature shall not exceed 100 °C (212 °F) at maximum continuous speed.

4.5.2.2.9 Addition (6.3.5.9.7 of API Std 617)

The limit used for bearing metal temperature during the test shall be corrected accordingly.

4.5.2.2.10 Addition (6.3.5.10.1 of API Std 617)

Details of inspection techniques and acceptance criteria shall be prior agreed upon between the purchaser and supplier.

4.5.2.2.11 Substitution (6.3.5.11 of API Std 617)

Shaft end seals shall be removed for inspection following a successful running test. If required by initial visual inspection, up on purchaser's discretion, dry gas seals shall be returned to seal manufacturer's facility for complete disassembly inspection.

4.5.2.3 Substitution (Spare-parts Test - 6.3.7.9 of API Std 617)

Spare parts such as rotors, bearings, and seals shall be inspected and tested under the same requirements of main components. Equivalent reports shall be issued as well. Spare rotors need not be performance tested, except when complete spare bundles are purchased. Complete spare bundles shall be performance tested using the same procedure as the main bundle.

4.5.2.4 New (6.3.8 - Stability Test)

The purpose of this entire new item is to provide the minimum requirements for the execution of a Factory Stability Test (FST), in order to measure the actual stability margin of the machine, identifying the sister modes (forward and backward) and their respective log decrements. The log decrement shall be measured, at least, in two different operational conditions, in order to plot the measured actual applied cross-coupled stiffness vs. Log decrement and the extrapolated produced curve, to the minimum log decrement at worst design conditions (see item C.1.k Part 1).

The presentation of the results shall include a plot of applied cross-coupled stiffness vs. Log decrement, showing the measured values and the expected values for similar conditions.

Equipment shall be tested in accordance with 6.3.8.1 through 6.3.8.6.

4.5.2.4.1 New (6.3.8.1 - Methods & Procedures)

The manufacturer shall specify in the FST procedure which kind of excitation is intended to be applied, which measurement devices to be used during the FST and how the test execution sequence has been planned. The type and direction of the excitation shall be fully described as well, including whether it would be directional (horizontal or vertical) or circular (forward or backward). It is purchaser understanding that there are several methods to apply excitation and to measure the required data, as below.

4.5.2.4.1.1 New (6.3.8.1.1 - Excitation Methods)

Impact exciters such as a hammer, bearing casing exciter or an Active Magnetic Bearing (AMB) exciter shall be used to excite the rotor. The excitation using an AMB could also be an impact or a sine sweep (blocking type or conventional).

4.5.2.4.1.2 New (6.3.8.1.2 - Measurement Techniques)

The measurement techniques can be applied in the frequency domain or in time domain. In any of the methods, the approach to estimate the forward and backward modes and respective log decrements shall be using multiple degrees of freedom (MDOF). The method employed shall provide acceptable results even in case of the following difficulties or abnormalities (but not limited to):

- a) rotor system anisotropy;
- b) slightly damped systems (the method must render an acceptable damping ratio estimation);
- c) limitations on the number of input and output locations;
- d) noise and /or internal sources of excitations, such as rotor unbalance.

Due to the proximity of modes in the rotating systems, the Single-Degree of Freedom (SDOF) technique is not acceptable. The methods that lead to the best results are the PEM (Predicted Error Method) for frequency domain and MOBAR (Multiple Output Backward Auto Regression) for time domain.

Any other applicable methodology, rendering acceptable results even in case of above mentioned system characteristics, such methodology shall be fully described (type of load, application of load, measurement techniques, interpretation of results, definition of model order, etc.) and demonstrated (list of experience with similar designs, results and comparison with actual data). Methodologies shall be submitted to purchaser for review and approval.

4.5.2.4.2 New (6.3.8.2 - Definitions)

The stability of the machine shall be measured in two different operating conditions as defined in 6.3.8.2.1 and 6.3.8.2.2.

4.5.2.4.2.1 New (6.3.8.2.1 - Base Stability)

The Base Stability is defined as the measured stability with the machine running with zero internal cross-coupling. This can be most closely achieved with the rotor running on High Speed Balancing Machine or running during the Mechanical Running Test, preferably under vacuum, which may be done during HSB at HSBM, or at Test Bed during Mechanical Running Test (MRT) or Performance Test (PT).

The Base stability shall be measured at maximum continuous speed - MCS - and at Performance test speed (if Performance test speed is different than MCS). The procedure for applying the excitation shall be according to item 6.3.8.5.

4.5.2.4.2.2 New (6.3.8.2.2 - Measurement During Pressurized Test)

The stability measurement during the Pressurized Test is defined as the measurement of the log decrement of the machine for a specific cross-coupling, calculated taking in account the pressure and speed during the test, for one chosen point. The Pressurized Test may be a performance test according to ASME [PTC-10](#) or a full pressure test (if specified).

For an ASME [PTC-10](#) type II test, the procedure shall consider the following premises:

- a) after determination of the first surge point, the capacity flow rate shall be increased in order to remain in safe region;
- b) there shall be a delay, waiting for system stabilization (pressures, temperatures, flow rates, bearing temperatures and shaft centerline);
- c) the test conditions shall be chosen by manufacturer such that estimated cross-coupling be, at least, 20% of the cross-coupling calculated according to item 4.8.6.8 d. For boundary conditions where such margin cannot be accomplished, the test point shall be the highest feasible;
- d) the excitation shall be started as per item 6.3.8.5.

For an ASME [PTC-10](#) type I test or full pressure test, the procedure shall consider the following premises:

- a) maximum pressure shall be achieved. Purchaser and the manufacturer may agree and define other intermediate points;
- b) there shall be a delay, waiting for system stabilization (pressures, temperatures, flow rates, bearing temperatures and shaft centerline);
- c) the excitation shall be started as per item 6.3.8.5.

4.5.2.4.3 New (6.3.8.3 - Preparation for the Test)

4.5.2.4.3.1 New (6.3.8.3.1)

When an active magnetic bearing is used for the excitation, its assembly on the shaft shall not significantly change the rotor response characteristics. The manufacturer shall submit for purchaser approval the proposed device and the expected changes in the rotor response prior to the test.

The equipment measured unfiltered vibration, during the mechanical running and performance tests, with the assembled device, before applying any load, shall not exceed the limits of item 4.8.8.8.

The manufacturer shall send a procedure informing how the AMB will be adjusted/calibrated and how the applied force will be measured. Prior to the tests, the accuracy of input force measurements shall be verified. The manufacturer shall submit the AMB calibration report for purchaser review.

4.5.2.4.3.2 New (6.3.8.3.2)

The manufacturer shall present, prior to the test, the calculated log decrement for the forward and backward modes at actual test conditions (Q_f), such as bearing clearance, preload and test speed (for ASME [PTC-10](#) type II test, the test speed may be different from maximum continuous speed).

4.5.2.4.3.3 New (6.3.8.3.3)

The data collect system shall consist as a minimum of an Oscilloscope, a Real Time Analyzer and a Data Recorder (analog or digital) with capability of continuously collecting all probes data and input signals. The sampling rate of the system shall be enough to identify the excitation frequencies and the results.

4.5.2.4.3.4 New (6.3.8.3.4)

The manufacturer shall present in the lateral vibration report, the expected orbits for both modes (forward and backward) at MCS, from zero to the maximum expected cross-coupling (0 %, 50 %, 100 %) for the average clearance case. The definition of excitation direction shall be based in those orbits.

4.5.2.4.3.5 New (6.3.8.3.5)

If a sine sweep method is used to identify the actual forward and backward frequencies, the frequency interval of each sine sweep shall be less or equal to 0.25 Hz.

4.5.2.4.4 New (6.3.8.4 - Signal Quality)

4.5.2.4.4.1 New (6.3.8.4.1)

In order to have good response when applying the excitation, the Signal to Noise Ratio (SNR) shall be at least two. The amplitude of excitation shall be controlled in order to not exceed an agreed amount of bearing clearances for safety and linearity concerns.

4.5.2.4.4.2 New (6.3.8.4.2)

If the manufacturer decides to apply filtering to eliminate the synchronous response, the type of filter shall be informed to Purchaser. The design of the filter shall not influence the signal components of interest.

4.5.2.4.5 New (6.3.8.5)

Any measured point (forward and backward) shall be calculated from an average of at least five readings. These five readings shall be in the range of:

$$\delta_m - 0.03 \leq \delta_i \leq \delta_m + 0.03$$

Where:

$$\delta_m = \frac{\delta_1 + \delta_2 + \delta_3 + \delta_4 + \delta_5}{5}$$

If any value falls outside the above defined range, it shall be discarded and measured again.

The average value (δ_m) will be used to compare with the predicted values.

4.5.2.4.6 New (6.3.8.6 - Acceptance Criteria)

4.5.2.4.6.1 New (6.3.8.6.1 - Model Verification)

If the measured value is above the predicted one, no correction in the model is necessary.

The vendor shall correct the model if it fails to meet the following criteria:

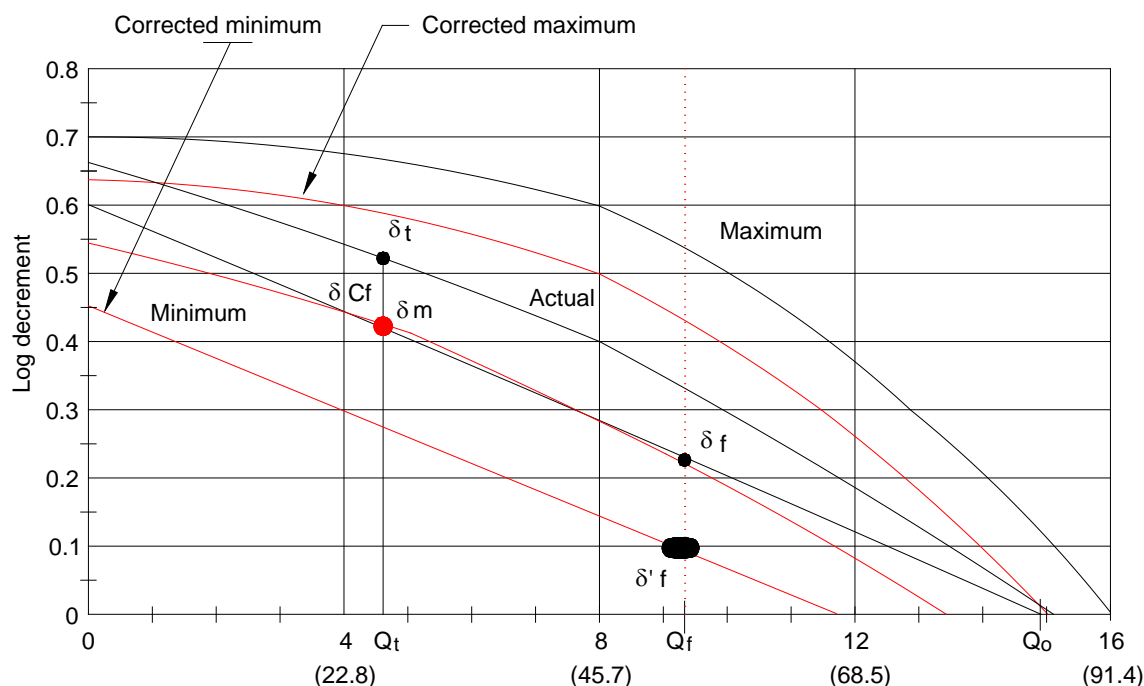
Any expected log decrement for the forward mode, for both cases (base stability and performance test conditions) calculated according 6.3.8.3.2, shall be inside the range of the measured log decrement ($\delta_m \pm 0.03$).

4.5.2.4.6.2 New (6.3.8.6.2 - Test Acceptance)

The highest difference between the expected value and the measured log decrement (δ_m) for each case (base stability and pressurized test conditions) will be the correction factor (δ_{cf}) to be applied to

the calculated log decrement (δ_f) for the worst condition (see item C.1.k Part 1) at maximum continuous speed and design pressure (see figure below).

The equipment acceptance criteria shall be that the final corrected log decrement (δ'_f), at worst condition (see item C.1.k Part 1), is greater than 0.1.



Where:

Q_t : calculated cross-coupled stiffness at test conditions (see 6.3.8.3.2);

Q_f : calculated cross-coupled stiffness at maximum continuous speed, design pressure and worst conditions (see item C.1.k Part 1).

NOTE The example in the curve above is only illustrative; no curve shape correction will be applied.

Figure 1 - Applied Cross-Coupled Stiffness, Q KN/mm (Klbf/in.)

4.5.3 Preparation for Shipment (6.4 of API Std 617)

4.5.3.1 Modification (6.4.1 of API Std 617)

Replace the third sentence by:

The preparation shall make the equipment suitable for 12 months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearing and seals.

4.5.3.2 Addition (6.4.3.9 of API Std 617)

Spare parts shall also be identified and tagged (or indelibly stamped with respective serial or part numbers) as applicable to each case.

4.5.3.3 Substitution (6.4.3.10.1 of API Std 617)

After testing and final inspections, spare rotors shall be wrapped, packed in steel export-type API Std 687 containers, sealed and pressurized / purged with Nitrogen gas. Containers shall be provided with N₂ pressure indication, vent, drain and refill connections and shall be equipped with a pressure safety valve and a Nitrogen cylinder and pressure control valve, to ensure adequate Nitrogen pressure inside the storage container. Container design shall be suitable for both horizontal and vertical storage.

4.6 Supplier's Data (Section 7 of API Std 617)

4.6.1 Proposals (7.2 of API Std 617)

4.6.1.1 Addition (7.2.3 q of API Std 617)

Compressor vendor and/or seal manufacturer shall note on the proposal data sheets the expected and guaranteed maximum leakage rates of the quoted seal, both at shop testing (with test gas) and at job site (with specified gas) under rated operating conditions.

4.6.2 Contract Data (7.3 of API Std 617)

4.6.2.1 Installation, Operation, Maintenance, and Technical Data Manuals (7.3.5 of API Std 617)

4.6.2.1.1 General (7.3.5.1 of API Std 617)

4.6.2.1.1.1 Addition (7.3.5.1.1 of API Std 617)

Manuals shall be provided by the compressor supplier in both Portuguese and English languages.

4.6.2.1.2 Substitution (7.3.5.2 of API Std 617)

All information required for the proper installation and commissioning of the equipment shall be compiled in a manual. It shall be separate from the operation and maintenance instructions. This manual shall contain all necessary information for performing the activities comprised from the time of equipment jobsite receiving up to the pre-operation, including at least, but not limited to, the following procedures:

- a) equipment receiving, storage and preservation (including auxiliaries, spare parts and shipped loose items);
- b) rigging;
- c) equipment leveling, shaft alignment and grouting;
- d) auxiliary systems installation;
- e) lube oil system flushing;
- f) piping cleanliness;
- g) equipment operational acceptance tests.

All drawings and data specified in 7.2.2 and 7.2.3 that are pertinent to proper installation shall be included as part of this manual. One extra manual, over and above the specified quantity, shall be included with the first equipment shipment.

NOTE Refer to API RP 686 and the VDDR for further installation requirements.

4.7 Requirements for Lateral Analysis Reports (Annex C of API Std 617)

4.7.1 Standard Lateral Analysis and Stability Report (C.1 of API Std 617)

4.7.1.1 Substitution (C.1.k.ii of API Std 617)

Figure C.2 plot of log decrement, δ , vs cross coupled stiffness for minimum and maximum bearing clearances, combined with the two extremes of oil temperature and pressure (minimum pressure with maximum oil temperature, and minimum temperature with maximum oil pressure);

NOTE The minimum and maximum bearing clearances to be used in the analysis shall be:

- Minimum bearing clearance and maximum preload, calculated using maximum pad, minimum bearing and maximum shaft radius;
- Maximum bearing clearance and minimum preload, calculated using minimum pad, maximum bearing and minimum shaft radius.

4.8 Dry Gas Seal Testing at Manufacturer's Shop (Annex F of API Std 617)

4.8.1 Static Test Procedure (F.2 of API Std 617)

4.8.1.1 New (F.2.c)

The average primary and secondary leakage shall be less than the maximum allowable leakage that was specified by the seal manufacturer.

5 Non-integrally Geared Centrifugal and Axial Compressors (Part 2 of API Std 617)

5.1 General (Section 4 of API Std 617)

5.1.1 Casings (4.6 of API Std 617)

5.1.1.1 Pressure-containing Casings (4.6.1 of API Std 617)

5.1.1.1.1 Substitution (4.6.1.7 of API Std 617)

Socket-head, slotted-nut or spanner-type bolting shall not be used externally.

5.1.2 Rotating Elements (4.7 of API Std 617)

5.1.2.1 Shafts (4.7.2 of API Std 617)

5.1.2.1.1 Addition (4.7.2.2 of API Std 617)

Unless otherwise specified, process compressors, either centrifugal or axial, shall be provided with non-through-bolt rotors and solid one-piece shafts, made of suitably machined heat treated steel. The use of modular (through-bolt) rotors for gas transportation centrifugal compressors is considered acceptable by Petrobras only for some particular applications. Therefore, such modular designs shall always be submitted for Petrobras approval during bid stage, on a case-by-case approach.

5.1.2.2 Thrust Balancing (4.7.3 of API Std 617)**5.1.2.2.1 Substitution (4.7.3.3 of API Std 617)**

A pressure tap connection shall be supplied by the vendor in the downstream end of the balance line to allow measurement of differential pressure in the balance line.

5.1.2.2.2 Substitution (4.7.3.3.1 of API Std 617)

Unless otherwise specified, a differential pressure indicator and transmitter (PDIT) shall be supplied by the vendor to monitor differential balance line pressure.

5.1.2.3 Axial Compressor Rotor Blading (4.7.5 of API Std 617)**5.1.2.3.1 Addition (4.7.5.1 of API Std 617)**

Blades shall be designed to withstand operation at resonant frequencies during normal warm-up. The vendor shall state in the proposal the speeds below the operation range corresponding to such blade resonances.

NOTE Excitation sources include fundamental and first harmonic passing frequencies of rotating and stationary blades upstream and downstream of each blade row, gas passage splitters, irregularities in vane and nozzle pitch at horizontal casing flanges, the first ten rotor speed harmonics, meshing frequencies in gear units.

5.1.2.3.2 New (4.7.5.6)

The tips of rotating blades and the labyrinths of shrouded rotating blades shall be designed to allow the unit to start up at any time in accordance with the vendor's requirements. When the design permits rubbing during normal start up, the component shall be designed to be rub tolerant and the vendor shall state in his proposal if rubbing is expected.

5.1.2.3.3 New (4.7.5.7)

All Campbell diagrams shall show the blade frequencies that have been corrected to reflect actual operating conditions. Where applicable, the diagrams for shrouded blades shall show frequencies above and below the blade lock-up speed and shall specify the speed at which blade lock-up occurs.

5.1.3 Shaft End Seals (4.10 of API Std 617)**5.1.3.1 Substitution (4.10.3 of API Std 617)**

Shaft seals and shaft sleeves shall be accessible for inspection and replacement without removing the top half of the casing of an axially split compressor or the heads of a radially split unit. Whenever feasible, this requirement shall apply to overhung designs as well.

5.2 Accessories (Section 5 of API Std 617)**5.2.1 Controls and Instrumentation (5.5 of API Std 617)**

5.2.1.1 Vibration, Position, and Bearing Temperature Detectors (5.5.7 of API Std 617)**5.2.1.1.1 Substitution (5.5.7.1 of API Std 617)**

Machinery protection and monitoring system (including, but not limited to: sensors, transducers and monitors for radial shaft vibration, axial position, bearing temperature and casing vibration) shall be supplied, installed and calibrated in accordance with API Std 670.

5.3 Inspection, Testing, and Preparation for Shipment (Section 6 of API Std 617)**5.3.1 Testing (6.3 of API Std 617)****5.3.1.1 Mechanical Running Test (6.3.1 of API Std 617)****5.3.1.1.1 Substitution (6.3.1.1.3 of API Std 617)**

Oil temperatures and supply pressures shall be varied over the allowable operating range during test in accordance with the requirements stated on item 4.5.2.2.8 of this standard.

5.3.1.1.2 Modification (6.3.1.1.8 of API Std 617)

Replace the first sentence by:

The contract coupling(s) shall be used during the mechanical running test.

5.3.1.1.3 Addition (6.3.1.1.10 of API Std 617)

Equipment specified to be driven at job site by constant speed drivers shall be tested at manufacturer's shop with variable speed drivers as well. Tests shall be conducted as if variable speeds were to be used at job site, for PETROBRAS reference and information only (not an acceptance criterion). PETROBRAS will use rated speed results for the acceptance of constant speed equipment.

5.3.1.1.4 Substitution (6.3.1.1.12 of API Std 617)

The amplitudes and phase angle of the shaft vibration shall be recorded during a coastdown from trip speed to slow roll. A check of slow roll run out shall be performed and recorded.

5.3.1.1.5 New (6.3.1.1.13)

After run out check, the amplitudes and phase angle of the shaft vibration shall be recorded during a ramp up from slow roll to trip speed.

5.3.1.1.6 New (6.3.1.1.14)

The speed shall be reduced to the MCS, and the equipment shall be run for 4 hours continuous operation.

5.3.1.1.7 New (6.3.1.1.15)

After the 4-hour run at MCS, the speed shall be momentarily increased to the trip speed, and the amplitudes and phase angle of the shaft vibration shall be recorded during coastdown.

5.3.1.1.8 Modification (Figure 4 of API Std 617)

Replace Figure 4 of API Std 617 Part 2 by the following figure:

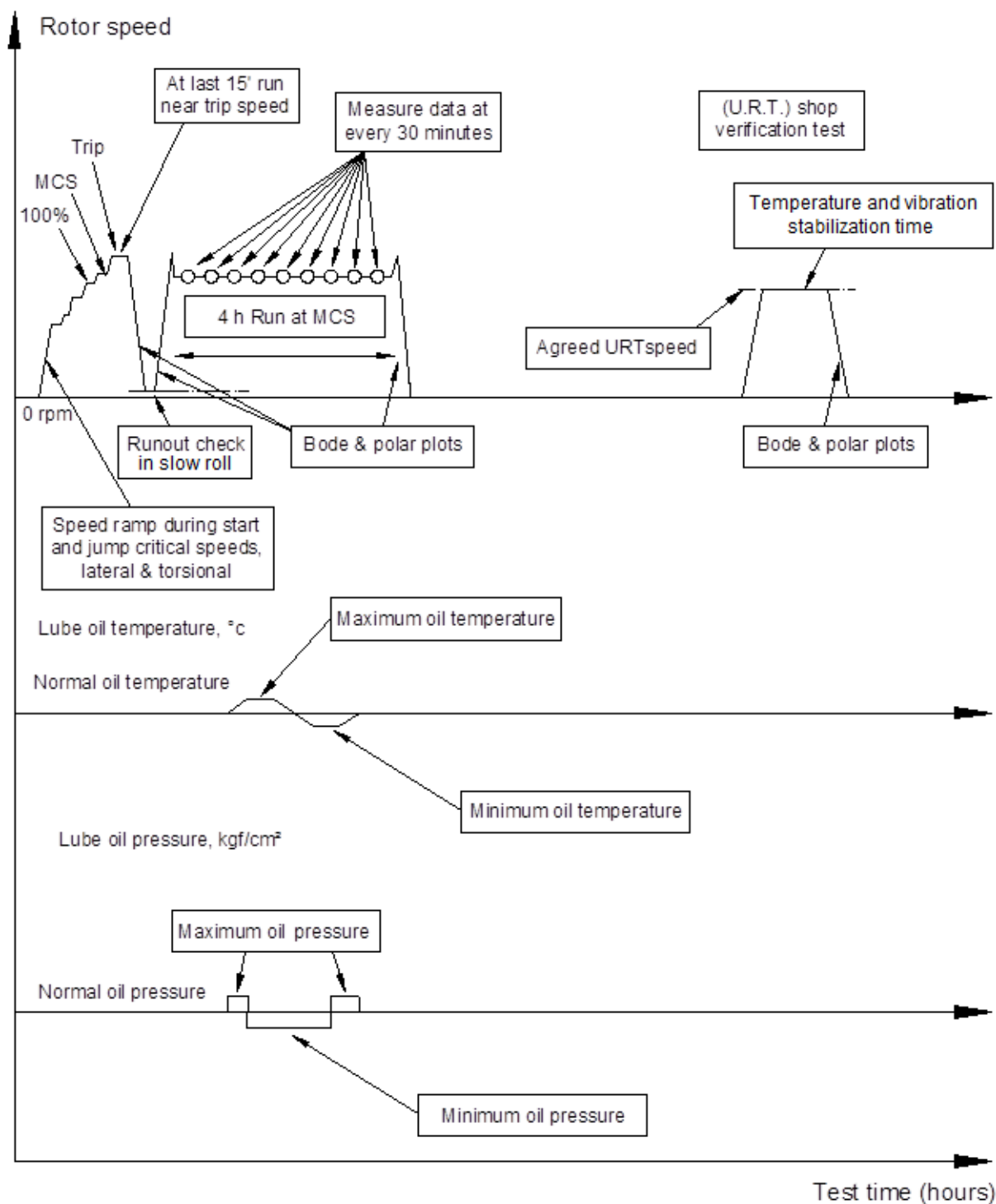


Figure 4 - Mechanical Running Test Sequence

5.3.1.2 Factory Performance Test (6.3.3.1 of API Std 617)

5.3.1.2.1 New (6.3.3.1.10)

During the performance test, the vibration and bearing temperatures limits used as acceptance criteria for mechanical running test shall also be applied, with exception of surge points measurement.

6 Integrally Geared Centrifugal Compressors (Part 3 of API Std 617)**6.1 General (Section 4 of API Std 617)****6.1.1 Casings (4.6 of API Std 617)****6.1.1.1 Pressure-containing Casings (4.6.1 of API Std 617)****6.1.1.1.1 Substitution (4.6.1.2 of API Std 617)**

Socket-head, slotted-nut or spanner-type bolting shall not be used externally. For limited space locations, integrally flanged fasteners may be required.

6.2 Accessories (Section 5 of API Std 617)**6.2.1 Controls and Instrumentation (5.5 of API Std 617)****6.2.1.1 Vibration, Position, and Bearing Temperature (5.5.7 of API Std 617)****6.2.1.1.1 Substitution (5.5.7.2 of API Std 617)**

Machinery protection and monitoring system (including, but not limited to: sensors, transducers and monitors for radial shaft vibration, axial position, bearing temperature and casing vibration) shall be supplied, installed and calibrated in accordance with API Std 670.

6.3 Inspection, Testing, and Preparation for Shipment (Section 6 of API Std 617)**6.3.1 Testing (6.3 of API Std 617)****6.3.1.1 Mechanical Running Test (6.3.1 of API Std 617)****6.3.1.1.1 Addition (6.3.1.1.3 of API Std 617)**

Oil temperatures and supply pressures shall be varied over the allowable operating range during test in accordance with the requirements stated on item 4.5.2.2.8 of this standard.

6.3.1.1.2 Addition (6.3.1.2 of API Std 617)

The contract coupling(s) shall be used during the mechanical running test.

6.3.1.1.3 Addition (6.3.1.1.10 of API Std 617)

Equipment specified to be driven at job site by constant speed drivers shall be tested at manufacturer's shop with variable speed drivers as well. Tests shall be conducted as if variable speeds were to be used at job site, for PETROBRAS reference and information only (not an acceptance criterion). PETROBRAS will use rated speed results for the acceptance of constant speed equipment.

6.3.1.1.4 Substitution (6.3.1.3.5 of API Std 617)

Shop verification of the unbalanced response analysis shall be performed in accordance with 4.8.3 of Part 1.

6.3.1.1.5 Substitution (6.3.1.3.6 of API Std 617)

All real-time data files (vibration, speeds, phase signals, etc.), regarding a successful test or not, shall be recorded and a CD copy shall be provided to PETROBRAS immediately after the test.

7 Expander-compressors (Part 4 of API Std 617)**7.1 General (Section 4 of API Std 617)****7.1.1 Casings (4.6 of API Std 617)****7.1.1.1 Pressure-containing Casings (4.6.1 of API Std 617)****7.1.1.1.1 New (4.6.1.5)**

Socket-head, slotted-nut or spanner-type bolting shall not be used externally.

7.1.2 Dynamics (4.8 of API Std 617)**7.1.2.1 Vibration Balancing (4.8.1 of API Std 617)****7.1.2.1.1 Modification (4.8.1.6 of API Std 617)**

Replace the first sentence by:

Rotors shall be assembled and the balance verified.

7.1.2.1.2 Modification (4.8.1.7 of API Std 617)

Replace the first sentence by:

A residual unbalance check shall be performed on assembled rotors.

7.2 Accessories (Section 5 of API Std 617)

7.2.1 Addition (5.5 of API Std 617)

Machinery protection and monitoring system (including, but not limited to: sensors, transducers and monitors for radial shaft vibration, axial position, bearing temperature and casing vibration) shall be supplied, installed and calibrated in accordance with API Std 670.

7.2.2 Substitution (5.5.4.1.2 of API Std 617)

An overspeed shutdown system based on two-out-of-three voting logic shall be furnished.

7.3 Inspection, Testing, and Preparation for Shipment (Section 6 of API Std 617)

7.3.1 Testing (6.3 of API Std 617)

7.3.1.1 Mechanical Running Test (6.3.3 of API Std 617)


7.3.1.1.1 Addition (6.3.3.1.3 of API Std 617)

Oil temperatures and supply pressures shall be varied over the allowable operating range during test in accordance with the requirements stated on item 4.5.2.2.8 of this standard.


7.3.1.1.2 Substitution (6.3.3.3.5 of API Std 617)


All real-time data files (vibration, speeds, phase signals, etc.), regarding a successful test or not, shall be recorded and a CD copy shall be provided to PETROBRAS immediately after the test.


[illegible]


	DATA SHEET		No.		REV.				
					SHEET				
	TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE				of				
1	APLICABLE TO: <input type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS BUILT								
2	FOR:			UNIT:					
3	SITE:			SERVICE:					
4	No REQ / TAG:			MANUFACTURER:					
5	MODEL:			VENDOR:					
6	SIZE / TYPE:			DRIVER:					
7	SERIAL No.			MANUFACTURER No:					
8	OPERATING CONDITIONS								
9	<div style="display: flex; flex-direction: column;"> <div>CASE</div> <div>STAGE</div> <div>(ALL DATA ON UNIT BASIS)</div> <div><input type="checkbox"/> GAS HANDLED (ALSO SEE PAGE)</div> <div><input type="checkbox"/> GAS PROPERTIES <input type="checkbox"/> HAZARDOUS SERVICE</div> <div><input type="checkbox"/> VOL. FLOW Nm³ / h (101.3 kPa) <input type="checkbox"/> DRY <input type="checkbox"/> WET</div> <div><input type="checkbox"/> WEIGHT FLOW, kg/h <input type="checkbox"/> DRY <input type="checkbox"/> WET</div> <div>INTELET CONDITIONS</div> <div><input type="checkbox"/> PRESSURE, kPa a</div> <div><input type="checkbox"/> TEMPERATURE, °C</div> <div><input type="checkbox"/> RELATIVE HUMIDITY, %</div> <div><input type="checkbox"/> MOLECULAR WEIGHT</div> <div><input type="checkbox"/> C_p/C_v <input type="checkbox"/> K₁</div> <div><input type="checkbox"/> COMPRESSIBILITY <input type="checkbox"/> Z₁</div> <div><input type="checkbox"/> INLET VOLUME, m³/h <input type="checkbox"/> DRY <input type="checkbox"/> WET</div> <div>DISCHARGE CONDITIONS</div> <div><input type="checkbox"/> PRESSURE, kPa a</div> <div><input type="checkbox"/> TEMPERATURE, °C</div> <div><input type="checkbox"/> C_p/C_v <input type="checkbox"/> K₂</div> <div><input type="checkbox"/> COMPRESSIBILITY <input type="checkbox"/> Z₂</div> <div><input type="checkbox"/> GAS POWER REQUIRED, kW</div> <div><input type="checkbox"/> COMPRESSOR MECHANICAL LOSSES, kW</div> <div><input type="checkbox"/> POWER REQUIRED AT DRIVER INCL. EXT. LOSSES (GEAR ETC.) kW</div> <div><input type="checkbox"/> SPEED, rpm</div> <div><input type="checkbox"/> ESTIMATED SURGE (@ SPEED ABOVE), kg/h & m³/h</div> <div><input type="checkbox"/> TURNDOWN, %</div> <div><input type="checkbox"/> POLYTROPIC HEAD, kJ/kg</div> <div><input type="checkbox"/> POLYTROPIC EFFICIENCY, %</div> <div><input type="checkbox"/> CERTIFIED POINT</div> <div><input type="checkbox"/> PERFORMANCE CURVE NUMBER</div> <div><input type="checkbox"/> BALANCE PISTON LEAKAGE, kg/h</div> <div> <div>PROCESS <input type="checkbox"/> SUCTION THROTTLING <input type="checkbox"/> VARIABLE INLET <input type="checkbox"/> SPEED VARIATION <input type="checkbox"/> DISCHARGE <input type="checkbox"/> COOLED BY-PASS</div> <div>CONTROL FROM kPa a GUIDE VANES / FROM % BLOWOFF FROM</div> <div>METHOD TO kPa a STATOR BLADES TO % TO TO</div> <div><input type="checkbox"/> SOURCE</div> <div>SIGNAL TYPE: <input type="checkbox"/> ELECTRONIC <input type="checkbox"/> PNEUMATIC <input type="checkbox"/> OTHER:</div> <div>RANGE: 4 - 20 mA kPa g</div> </div> <div><input type="checkbox"/> ANTI-SURGE SYSTEM: <input type="checkbox"/> MANUAL <input type="checkbox"/> AUTOMATIC <input type="checkbox"/> OTHER</div> </div>			NORMAL					
10				1 ST	2 ND	3 RD			
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
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39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49	REMARKS:								
50	<input type="checkbox"/> Nm ³ / h @ 0 °C								
51	<input type="checkbox"/> Nm ³ / h @ 15 °C								
52	<input type="checkbox"/> Nm ³ / h @ 20 °C								
53									
54									
55									
56									
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<div><div><div>BR</div><div>PETROBRAS</div></div></div>				DATA SHEET			No.		REV.		
				TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE						SHEET	
										of	
OPERATING CONDITIONS (CONT)											
2 GAS ANALYSIS				NORMAL							
3 <input type="checkbox"/> MOL % <input type="checkbox"/>				1 ST	2 ND	3 RD					
4		SYMBOL	MW								
5 AIR			28.966								
6 OXYGEN		O ₂	32.000								
7 NITROGEN		N ₂	28.016								
8 WATER VAPOR		H ₂ O	18.016								
9 CARBON MONOXIDE		CO	28.010								
10 CARBON DIOXIDE		CO ₂	44.010								
11 HYDROGEN SULFIDE		H ₂ S	34.076								
12 HYDROGEN		H ₂	2.016								
13 METHANE		CH ₄	16.042								
14 ETHANE		C ₂ H ₆	30.068								
15 ETHYLENE		C ₂ H ₄	28.052								
16 PROPANE		C ₃ H ₈	44.094								
17 PROPYLENE		C ₃ H ₆	42.078								
18 I-BUTANE		C ₄ H ₁₀	58.120								
19 N-BUTANE		C ₄ H ₁₀	58.120								
20 I-PENTANE		C ₅ H ₁₂	72.146								
21 N-PENTANE		C ₅ H ₁₂	72.146								
22 HEXANE PLUS											
23 CORROSIVE AGENTS											
24											
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36 TOTAL											
37 AVG. MOL. WT.											
38 LOCATION				NOISE ESPECIFICATIONS							
39 <input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input type="checkbox"/> GRADE				<input type="checkbox"/> APPLICABLE TO MACHINE:							
40 <input type="checkbox"/> HEATED <input type="checkbox"/> UNDER ROOF <input type="checkbox"/> MEZZANINE				SEE SPECIFICATION							
41 <input type="checkbox"/> UNHEATED <input type="checkbox"/> PARTIAL SLIDES <input type="checkbox"/> TROPICALIZATION				<input type="checkbox"/> APPLICABLE TO NEIGHBORHOOD:							
42 <input type="checkbox"/> ELEC. AREA CLASSIFICATION				SEE SPECIFICATION							
43 N Z GR CL				ACOUSTIC HOUSING: <input type="checkbox"/> YES <input type="checkbox"/> NO							
44 <input type="checkbox"/> SITE DATA:				APPLICABLE SPECIFICATIONS: API STD 617:2002							
45 <input type="checkbox"/> ELEVATION m BAROMETER kPa a				<input type="checkbox"/> VENDOR HAVING UNIT RESPONSIBILITY							
46 <input type="checkbox"/> RANGE OF AMBIENT TEMP, °C:				<input type="checkbox"/> GOVERNING SPECIFICATION (IF DIFFERENT)							
47 DRY BULB WET BULB											
48 NORMAL											
49 MAXIMUM											
50 MINIMUM											
51 <input type="checkbox"/> RELATIVE HUMIDITY, %:				PAINTING							
52 UNUSUAL CONDITIONS: <input type="checkbox"/> DUST <input type="checkbox"/> FUMES				<input type="checkbox"/> MANUFACTURER STD.							
53 <input type="checkbox"/> MARINE ENVIRONMENT <input type="checkbox"/> OTHER				<input type="checkbox"/> OTHER							
54 <input type="checkbox"/> COPPER AND COPPER ALLOYS PROHIBITED				NAMEPLATE <input type="checkbox"/> US CUSTOMARY <input type="checkbox"/> METRIC							
55 COATING:				SHIPMENT:							
56 <input type="checkbox"/> ROTATING COMPONENTS				<input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQ'D							
57 <input type="checkbox"/> STATIONARY COMPONENTS				<input type="checkbox"/> OUTDOOR STORAGE MORE THAN 12 MONTHS							
				SPARE ROTOR ASSEMBLY PACKAGE							
				<input type="checkbox"/> HORIZONTAL STORAGE <input type="checkbox"/> VERTICAL STORAGE							
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	DATA SHEET		No.	REV.
				SHEET
	TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE			of
CONSTRUCTION FEATURES				
1				
2	SPEEDS:		INTERMEDIATE MAIN PROCESS CONNECTIONS	
3	MAX. CONT	rpm	TRIP	rpm
4	MAX. TIP SPEEDS:	FPS @ 100% SPEED		DISCH. PRESSURE, kPa g : MAX MIN
5	FPS @ MAX. 100% CONT. SPEED		INLET PRESSURE, kPa g : MAX MIN	
6	LATERAL CRITICAL SPEEDS	<input type="checkbox"/> DAMPED	<input type="checkbox"/> UNDAMPED	GUIDE VANES
7	FIRST CRITICAL	rpm	MODE	MATERIAL
8	SECOND CRITICAL	rpm	MODE	NUMBER OF AXIAL BLADE ROWS
9	THIRD CRITICAL	rpm	MODE	NUMBER OF ADJUSTABLE ROWS
10	FOURTH CRITICAL	rpm	MODE	No. VANES GUIDE VANE
11	<input type="checkbox"/> LATERAL ANALYSIS ADDITIONAL REQUIREMENTS		IMPELLERS:	
12	<input type="checkbox"/> LATERAL CRITICAL SPEED BASIS		No. DIAMETERS	
13	<input type="checkbox"/> DAMPED UNBALANCED RESPONSE ANALYSIS		No. VANES EA. IMPELLER	
14	<input type="checkbox"/> SHOP VERIFICATION OF UNBALANCED RESPONSE ANALYSIS		TYPE (OPEN, ENCLOSED, ETC.) ENCLOSED	
15	<input type="checkbox"/> TRAIN LATERAL ANALYSIS REQUIRED		TYPE FABRICATION	
16	<input type="checkbox"/> TRAIN TORSIONAL ANALYSIS REQUIRED		MATERIAL	
17	TORSIONAL CRITICAL SPEEDS:		MIN. YIELD STRENGTH, kPa	
18	FIRST CRITICAL	rpm	HARDNESS, (BNH)(Rc): MAX MIN	
19	SECOND CRITICAL	rpm	SMALLEST TIP INTERNAL WIDTH, mm	
20	THIRD CRITICAL	rpm	MAX. MACH. No. @ IMPELLER EYE	
21	FOURTH CRITICAL	rpm	MAX. IMPELLER HEAD @ 100% SPD, m - kg	
22	<input checked="" type="checkbox"/> LIST OF TRAIN UNDESIRABLE SPEEDS		SHAFT: <input type="checkbox"/> ONE PIECE <input type="checkbox"/> BUILT UP	
23	<input checked="" type="checkbox"/> STABILITY ANALYSIS		MATERIAL	
24	VIBRATION:		DIA @ IMPELLERS, mm DIA @ COUPLING, mm	
25	ALLOWABLE TEST / FIELD LEVEL/ μm (PK-TO-PK)		DIA @ BEARINGS, mm DIA @ SEAL, mm	
26			SHAFT END: <input checked="" type="checkbox"/> TAPERED <input type="checkbox"/> CYLINDRICAL	
27	<input type="checkbox"/> ROTATION, VIEWED FROM DRIVEN END <input type="checkbox"/> CW <input type="checkbox"/> CCW		<input type="checkbox"/> SPLINED <input type="checkbox"/> INTEGRAL FLANGE	
28	<input type="checkbox"/> MATERIALS INSPECTIONS REQUIREMENTS		MIN. YIELD STRENGTH, kPa	
29	<input type="checkbox"/> RADIOGRAPHY REQUIRED FOR		SHAFT HARDNESS, (BNH)(Rc)	
30	<input type="checkbox"/> ULTRASONIC REQUIRED FOR		MAX. TORQUE CAPABILITY, m - kg	
31	<input type="checkbox"/> MAGNETIC PARTICLE REQUIRED FOR		<input checked="" type="checkbox"/> BALANCE PISTON: INTEGRAL WITH SHAFT	
32	<input type="checkbox"/> LIQUID PENETRANT REQUIRED FOR		MATERIAL mm^2	
33	<input type="checkbox"/> LOW TEMPERATURE		FIXATION METHOD	
34	MIN. DESIGN METAL TEMPERATURE, °C		NORMAL CLEARANCE, mm	
35	AT CONCURRENT PRESSURE, kPa g		FLOW WITH NORMAL CLEARANCE, kg/min	
36	<input type="checkbox"/> OTHER TRAIN COMPONENTS		FLOW WITH 2 x NORMAL CLEARANCE, kg/min	
37	CASING:		<input checked="" type="checkbox"/> PRESS CONN. BAL LINE DOWNSTREAM	
38	MODEL	BARREL TYPE		SHAFT SLEEVES:
39	CASING SPLIT	RADIALLY		AT INTERSTG. CLOSE MATL
40	MATERIAL			CLEARANCE POINTS
41	THICKNESS, mm	CORR. ALLOW., mm		AT SHAFT SEALS MATL
42	TEST PRESS, kPa g:	HELIUM	HYDRO	<input type="checkbox"/> ACCESSIBLE ROTOR
43	MAX. ALLOWABLE PRESS	kPa g		<input type="checkbox"/> DISASSEMBLY AND REASSEMBLY
44	MAX. DESIGN PRESSURE	kPa g		<input checked="" type="checkbox"/> AT SPEED BALANCING
45	MAX. ALLOWABLE TEMPERATURE	°C		<input type="checkbox"/> SEQUENTIAL LOW SPEED BAL PREC. AT SPEED BAL
46	MAX. OPER TEMP	°C	MIN. OPER. TEMP	°C
47	MAX. No OF IMPELLERS FOR CASING			
48	MAX. CASING CAPACITY, m_n^3/h			
49	SYS. RELIEF VALVE SET PT., kPa g			
50	RADIOGRAPH QUALITY			
51	<input checked="" type="checkbox"/> Q.C. OF INACCESSIBLE WELDS			
52	DIAPHRAGMS:			
53	MATERIAL			
54	AXIALLY SPLIT	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
55	Max. ΔP (kgf/cm^2)			
56	REMARKS:			
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	DATA SHEET		No.		REV.
	TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE				SHEET
					of
CONSTRUCTION FEATURES (CONT.)					
1					
2	SHAFT SEALS <input type="checkbox"/> MFR: <input type="checkbox"/> SECONDARY / BARRIER SEAL GAS TYPE:				
3	<input checked="" type="checkbox"/> SEAL TYPE DRY GAS SEAL (CARTRIDGE) <input type="checkbox"/> PRESSURE kPa g				
4	<input type="checkbox"/> SETTLING OUT PRESSURE, kPa g <input type="checkbox"/> TEMPERATURE °C				
5	<input type="checkbox"/> MIN. SEALING PRESSURE, kPa g <input type="checkbox"/> FILTRATION				
6	API Std 617 FIGURE: <input type="checkbox"/> 1C-7 <input type="checkbox"/> 1C-8 <input type="checkbox"/> 1C-9 <input type="checkbox"/> OTHER <input type="checkbox"/> GAS SYSTEM REQUIRED				
7	<input checked="" type="checkbox"/> SUPPL'T'L DEVICE REQ'D FOR CONTACT SEALS TYPE <input type="checkbox"/> MANIFOLD				
8	<input checked="" type="checkbox"/> PRIMARY / BUFFER SEAL GAS TYPE: <input type="checkbox"/> METHOD OF CONTROL				
9	<input type="checkbox"/> PRESSURE kPa g <input type="checkbox"/> GAS CONTROL SYSTEM SCHEMATIC BY VENDOR				
10	<input type="checkbox"/> TEMPERATURE °C <input type="checkbox"/> PRESSURIZING GAS FOR SUBATMOSPHERIC SEALS				
11	<input type="checkbox"/> FILTRATION <input type="checkbox"/> EDUCTOR <input type="checkbox"/> INJECTION				
12	<input checked="" type="checkbox"/> GAS SYSTEM REQUIRED <input type="checkbox"/> TRACER LINE				
13	<input type="checkbox"/> MANIFOLD <input type="checkbox"/> LEAKAGE, m ³ / DAY / SEAL				
14	<input type="checkbox"/> METHOD OF CONTROL <input type="checkbox"/> GAS REQUIRED FOR:				
15	<input checked="" type="checkbox"/> GAS CONTROL SYSTEM SCHEMATIC BY VENDOR <input type="checkbox"/> AIR RUN-IN <input type="checkbox"/> OTHER				
16	<input type="checkbox"/> PRESSURIZING GAS FOR SUBATMOSPHERIC SEALS <input type="checkbox"/> FLOW (PER SEAL):				
17	<input type="checkbox"/> EDUCTOR <input type="checkbox"/> INJECTION NORM: kg/min @ kPa ΔP				
18	<input type="checkbox"/> TRACER LINE MAX: kg/min @ kPa ΔP				
19	<input type="checkbox"/> LEAKAGE TO PROCESS, m ³ / DAY / SEAL <input checked="" type="checkbox"/> SEPARATION GAS TYPE:				
20	<input checked="" type="checkbox"/> GAS REQUIRED FOR: <input type="checkbox"/> PRESS kPa g <input type="checkbox"/> TEMP °C				
21	<input checked="" type="checkbox"/> AIR RUN-IN <input checked="" type="checkbox"/> OTHER START / SET. OUT / SHTDWN <input type="checkbox"/> FLOW, kg/min (MAX / MIN PER SEAL): /				
22	<input type="checkbox"/> FLOW (PER SEAL): <input checked="" type="checkbox"/> ROTATION: <input type="checkbox"/> UNI <input checked="" type="checkbox"/> BI-DIRECTIONAL				
23	NORM: kg/min @ kPa ΔP BEARING HOUSING CONSTRUCTION				
24	MAX: kg/min @ kPa ΔP <input checked="" type="checkbox"/> SEPARATE <input type="checkbox"/> INTEGRAL <input checked="" type="checkbox"/> HORIZONTAL <input type="checkbox"/> VERTICAL SPLIT				
25	MATERIAL				
26	AXIAL COMPRESSOR^[a]				
27	STAGE				
28	ROTOR				
29	<input type="checkbox"/> BLADE MATERIAL				
30	<input type="checkbox"/> FABRICATION METHOD				
31	<input type="checkbox"/> BLADE QUANTITY				
32	<input type="checkbox"/> BLADE ROOT TYPE / FASTENING METHOD				
33	<input type="checkbox"/> CORD WIDTH, mm				
34	<input type="checkbox"/> OUTER DIAMETER, mm				
35	<input type="checkbox"/> BLADE HEIGHT, mm				
36	<input type="checkbox"/> REACTION DEGREE				
37	<input type="checkbox"/> MACH NUMBER DESIGN / ALLOWABLE				
38	<input type="checkbox"/> MAXIMUM YIELD STRENGTH, kgf/cm ²				
39	<input type="checkbox"/> STRESS @ RATED / TRIP RPM, kgf/cm ²				
40					
41	STATOR				
42	<input type="checkbox"/> BLADE MATERIAL				
43	<input type="checkbox"/> FABRICATION METHOD				
44	<input type="checkbox"/> BLADE QUANTITY				
45	<input type="checkbox"/> BLADE ROOT TYPE / FASTENING METHOD				
46	<input type="checkbox"/> CORD WIDTH, mm				
47	<input type="checkbox"/> OUTER DIAMETER, mm				
48	<input type="checkbox"/> BLADE HEIGHT, mm				
49	<input type="checkbox"/> REACTION DEGREE				
50	<input type="checkbox"/> MACH NUMBER DESIGN / ALLOWABLE				
51	<input type="checkbox"/> MAXIMUM YIELD STRENGTH, kgf/cm ²				
52	<input type="checkbox"/> STRESS @ RATED / TRIP RPM, kgf/cm ²				
53					
54					
55	REMARKS:				
56	[a] CONTRACTOR shall fill in this table for all stages of axial compressor. If necessary, CONTRACTOR shall repeat this page in your proposal.				
57					
58					
59					
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		DATA SHEET			No.		REV.			
		TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE						SHEET		
								of		
1 CONSTRUCTION FEATURES (CONT.)										
2 BEARINGS AND BEARING HOUSINGS										
3 MAGNETIC BEARINGS <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO										
4 RADIAL		THRUST		NON-THRUST		THRUST		ACTIVE	INACTIVE	
5 <input type="checkbox"/> TYPE						<input type="checkbox"/> TYPE				
6 <input type="checkbox"/> MANUFACTURER						<input type="checkbox"/> MANUFACTURER				
7 <input type="checkbox"/> LENGTH, mm						<input type="checkbox"/> UNIT LOADING (MAX), kPa				
8 <input type="checkbox"/> SHAFT DIA, mm						<input type="checkbox"/> UNIT LOADING (ULT.), kPa				
9 <input type="checkbox"/> UNIT LOAD (ACT/ALLOW)						<input type="checkbox"/> AREA, mm ²				
10 <input type="checkbox"/> BASE MATERIAL						<input type="checkbox"/> No. PADS				
11 <input type="checkbox"/> BABBIT THICKNESS, mm						<input type="checkbox"/> PIVOT: CENTER / OFFSET, %				
12 <input type="checkbox"/> No. PADS						<input type="checkbox"/> PAD BASE MATL				
13 <input type="checkbox"/> LOAD: B'TWN / ON PAD						<input type="checkbox"/> BABBIT THICKNESS, mm				
14 <input type="checkbox"/> PIVOT: CENTER / OFFSET, %						<input type="checkbox"/> COPPER BACKED				
15 <input type="checkbox"/> BEARING SPAN						LUBRICATION: <input type="checkbox"/> FLOODED <input checked="" type="checkbox"/> DIRECTED				
16 <input type="checkbox"/> PAD MATERIAL						THRUST COLLAR <input type="checkbox"/> INTEGRAL <input checked="" type="checkbox"/> REPLACEABLE				
17						MATERIAL				
18						<input type="checkbox"/> SIZING CRITERION				
19 BEARING TEMPERATURE DETECTORS					VIBRATION DETECTORS <input checked="" type="checkbox"/> SEE MACHIN. PROT. SYS. DATA SHEET					
20 <input checked="" type="checkbox"/> SEE MACHINERY PROTECTION SYSTEM DATA SHEET					<input type="checkbox"/> TYPE <input type="checkbox"/> MODEL					
21 <input type="checkbox"/> THERMOCOUPLES TYPE					<input type="checkbox"/> MFR					
22 <input type="checkbox"/> RESISTANCE TEMP DETECTORS					<input type="checkbox"/> No. AT EA SHAFT BEARING TOTAL No.					
23 <input type="checkbox"/> RESISTANCE MAT'L <input type="checkbox"/> OHMS					<input type="checkbox"/> OSCILLATOR-DETECTORS SUPPLIED BY					
24 <input type="checkbox"/> ALARM TEMPERATURE, °C					<input type="checkbox"/> MFR <input type="checkbox"/> MODEL					
25 <input type="checkbox"/> SHUTDOWN TEMPERATURE, °C					<input type="checkbox"/> MONITOR SUPPLIED BY					
26 <input type="checkbox"/> PROVISION FOR LOCAL DISCONNECT					<input type="checkbox"/> LOCATION ENCLOSURE					
27 <input type="checkbox"/> LOCATION-JOURNAL BRG					<input type="checkbox"/> MFR <input type="checkbox"/> MODEL					
28 No EA. PAD EVERY OTH PAD PER BRG					<input type="checkbox"/> SCALE RGE ALARM <input type="checkbox"/> SET@ μm					
29 OTHER					<input type="checkbox"/> SHTDWN: <input type="checkbox"/> SET@ μm <input type="checkbox"/> TIME DELAY s					
30 <input type="checkbox"/> LOCATION-THRUST BRG <input type="checkbox"/> ACT. <input type="checkbox"/> INACT					<input type="checkbox"/> CASING VIBRATION TRANSDUCERS					
31 No EA. PAD EVERY OTH PAD PER BRG					<input type="checkbox"/> CASING VIBRATION MONITORS					
32 OTHER					AXIAL POSITION DETECTOR <input checked="" type="checkbox"/> SEE MACHIN. PROT. SYS. DATA SHEET					
33 <input type="checkbox"/> LOCATION-THRUST BRG <input type="checkbox"/> ACT. <input type="checkbox"/> INACT					<input type="checkbox"/> TYPE <input type="checkbox"/> MODEL					
34 No EA. PAD EVERY OTH PAD PER BRG					<input type="checkbox"/> MFR <input type="checkbox"/> No. REQUIRED					
35 OTHER					<input type="checkbox"/> OSCILLATOR-DEMODULATOR SUPPLIED BY					
36 <input type="checkbox"/> LOCAL DISCONNECTION					<input type="checkbox"/> MFR <input type="checkbox"/> MODEL					
37 <input type="checkbox"/> MONITOR SUPPLIED BY					<input type="checkbox"/> MONITOR SUPPLIED BY					
38 <input type="checkbox"/> LOCATION ENCLOSURE					<input type="checkbox"/> LOCATION ENCLOSURE					
39 <input type="checkbox"/> MFR. <input type="checkbox"/> MODEL					<input type="checkbox"/> MFR <input type="checkbox"/> MODEL					
40 <input type="checkbox"/> SCALE RGE ALARM <input type="checkbox"/> SET@ °C					<input type="checkbox"/> SCALE RGE ALARM <input type="checkbox"/> SET@ μm					
41 <input type="checkbox"/> SHTDWN <input type="checkbox"/> SET@ °C <input type="checkbox"/> TIME DELAY s					<input type="checkbox"/> SHTDWN: <input type="checkbox"/> SET@ μm <input type="checkbox"/> TIME DELAY s					
42 KEY PHASOR REQUIRED										
43 <input type="checkbox"/> COMPRESSOR <input type="checkbox"/> GEAR H.S. <input type="checkbox"/> GEAR L.S. <input type="checkbox"/> DRIVER										
44 CASING CONNECTIONS										
45 CONNECTION (DESIGN APP. REQUIRED)		ANSI/ASME B16.1; B16.5; B16.42; B16.47 Series A, B; ISO 7005-1,-2; OTHER		SIZE FACING BORE RATING		ORIENTATION		FLANGED OR STUDDED	MATING FLG & GASKET BY VENDOR	GAS VELOCITY, m/s
46										
47										
48										
49										
50 INLET										
51 DISCHARGE										
52 INSTRUMENT AIR										
53 WATER										
54 DRAINS / VENTS										
55 <input checked="" type="checkbox"/> BOROSCOPIC INSPECTION PORTS										
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		DATA SHEET				No.		REV.	
		TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE						SHEET	
								of	

1	OTHER CONNECTIONS													
2	SERVICE		No.	SIZE	TYPE						No.	SIZE	TYPE	
3	LUBE OIL INLET					PRESSURE								
4	LUBE OIL OUTLET					TEMPERATURE								
5	SEAL OIL INLET					SOLVENT INJECTION								
6	SEAL OIL OUTLET					PURGE FOR								
7	SEAL GAS INLET					BRG. HOUSING								
8	SEAL GAS OUTLET					BTWN BRG & SEAL								
9	CASING DRAINS					BTWN SEAL & GAS								
10	STAGE DRAINS													
11	<input checked="" type="checkbox"/> INDIVIDUAL STAGE DRAINS REQUIRED													
12	<input type="checkbox"/> VALVE & BLINDED													
13	<input checked="" type="checkbox"/> VALVE & BLINDED & MANIFOLD													
14	ALLOWABLE PIPING FORCES AND MOMENTS													
15			INLET		DISCHARGE									
16			FORCE	MOMT.	FORCE	MOMT.							FORCE	MOMT.
17			N	N.m	N	N.m							N	N.m
18			AXIAL											
19			VERTICAL											
20	HORIZ. 90°													
21														
22			FORCE	MOMT.	FORCE	MOMT.	FORCE	MOMT.						
23			N	N.m	N	N.m	N	N.m						
24			AXIAL											
25			VERTICAL											
26			HORIZ. 90°											
27	LUBRICATION AND SEALING SYSTEMS													
28	<input checked="" type="checkbox"/> SEE OIL SYSTEM DATASHEET													
29	<input type="checkbox"/> SEPARATE <input type="checkbox"/> COMBINED													
30	<input type="checkbox"/> INTEGRAL OIL RESERVOIR													
31	<input type="checkbox"/> OIL TYPE:													
32	ACCESSORIES													
33	<input checked="" type="checkbox"/> COUPLING AND GUARDS <input checked="" type="checkbox"/> ACCORDING TO API Std 671													
34	<input type="checkbox"/> SEE ATTACHED API std 671:2002 DATA SHEET <input checked="" type="checkbox"/> KEYLESS HYDRAULIC <input type="checkbox"/> KEYED <input type="checkbox"/> FLANGED <input type="checkbox"/> OTHER													
35	<input checked="" type="checkbox"/> COUPLING FURNISHED BY VENDOR													
36	MANUFACTURER		TYPE				MODEL							
37	<input checked="" type="checkbox"/> COUPLING GUARD FURNISHED BY VENDOR													
38	TYPE:		<input checked="" type="checkbox"/> FULLY ENCLOSED				<input type="checkbox"/> SEMI-OPEN				<input checked="" type="checkbox"/> NON-SPARKING MATERIAL			
39	COUPLING DETAILS													
40	<input type="checkbox"/> MAX O. D.					mm	<input type="checkbox"/> IDLING ADAPTER / SOLO PLATE REQ.'D							
41	<input type="checkbox"/> HUB WEIGHT					kg	<input type="checkbox"/> PLUG AND RING GAUGES							
42	<input type="checkbox"/> SPACER LENGTH					mm	LUBRICATION REQUIREMENTS:							
43	<input type="checkbox"/> SPACER WEIGHT					kg	<input checked="" type="checkbox"/> NON-LUBE <input type="checkbox"/> CONT. OIL LUBE <input type="checkbox"/> OTHER							
44	<input checked="" type="checkbox"/> VENDOR MOUNT HALF COUPLING						QUANTITY PER HUB						m³/h	
45	<input checked="" type="checkbox"/> MOUNTING PLATES													
46	<input checked="" type="checkbox"/> BASEPLATES FURNISHED BY					CONTRACTOR		<input type="checkbox"/> SOLEPLATES FURNISHED BY						
47	<input checked="" type="checkbox"/> COMPRESSOR		<input checked="" type="checkbox"/> DRIVER		<input checked="" type="checkbox"/> GEAR		<input type="checkbox"/> THICKNESS					mm		
48	<input type="checkbox"/> OTHER													
49	<input checked="" type="checkbox"/> NONSKID DECKING		<input checked="" type="checkbox"/> SLOPED DECK		<input type="checkbox"/> SUBSOLE PLATES REQUIRED									
50	<input checked="" type="checkbox"/> LEVELING PADS OR TARGETS					<input type="checkbox"/> LEVELING BLOCKS REQ.'D								
51	<input checked="" type="checkbox"/> DRIP RIM					<input checked="" type="checkbox"/> STAINLESS STEEL SHIM THICKNESS							mm	
52	<input type="checkbox"/> COLUMN MOUNTING					<input checked="" type="checkbox"/> COMPRESSOR								
53	<input type="checkbox"/> SUB-SOLE PLATES REQUIRED					<input checked="" type="checkbox"/> GEAR								
54	<input checked="" type="checkbox"/> STAINLESS STEEL SHIM THICKNESS					mm	<input checked="" type="checkbox"/> DRIVER							
55	<input checked="" type="checkbox"/> MACHINED MOUNTING PADS REQUIRED					<input type="checkbox"/> COUNTER BORE ANCHOR BOLT HOLES								
56	<input type="checkbox"/> BASEPLATE WILL BE ON CONCRETE FOUNDATION													
57	<input type="checkbox"/> TRI-POINT SKID													
58														


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<div><div></div><div>PETROBRAS</div></div>		DATA SHEET			No.			REV.
TITLE: <div>CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE</div>						SHEET		of
1	SHOP INSPECTION AND TESTS				MANUALS			
2		REQ'D	WIT	OBS	<input checked="" type="checkbox"/> DRAFT MANUAL FOR REVIEW			
3	HYDROSTATIC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TECHNICAL DATA MANUAL			
4	IMPELLER OVERSPEED	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	MISCELLANEOUS			
5	MECHANICAL RUN	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION			
6	<input checked="" type="checkbox"/> CONTRACT COUPLING	<input type="checkbox"/> IDLING ADAPTOR(S)			<input checked="" type="checkbox"/> COMPRESSOR TO BE SUITABLE FOR FIELD RUN-IN ON AIR			
7	<input checked="" type="checkbox"/> CONTRACT PROBES	<input type="checkbox"/> SHOP PROBES			<input checked="" type="checkbox"/> VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION			
8	<input checked="" type="checkbox"/> PURCHASER VIBRATION EQUIPMENT				<input type="checkbox"/> COMPLETE <input type="checkbox"/> PROVISION FOR LIQUID INJECTION SYSTEM			
9	VARY LUBE & SEAL OIL PRESSURES				<input type="checkbox"/> VENDOR'S ANTI-SURGE SYSTEMS			
10	AND TEMPERATURES ^[a]	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/> EXTENT OF PROCESS PIPING BY VENDOR			
11	POLAR FORM VIBRATION DATA	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/> AUXILIARY EQUIP. MOTORS SUITABLE FOR AREA CLASSIFICATION			
12	CD RECORD VIBRATION DATA	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/> OPTICAL ALIGNMENT FLATS REQ. ON COMP. / DRIVER			
13	SHAFT END SEAL INSPECTION	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> VENDOR'S REVIEW & COMMENTS ON PURCHASER'S CONTROL SYSTEMS			
14	GAS LEAK TEST AT DISCHARGE PRESS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> SHOP FIT UP OF VENDOR PROCESS PIPING			
15	POST TEST INTERNAL INSPECTION				<input checked="" type="checkbox"/> WELDING HARDNESS TESTING			
16	<input type="checkbox"/> BEFORE GAS LEAKAGE TEST				<input type="checkbox"/> DESIGN AUDIT			
17	<input checked="" type="checkbox"/> AFTER GAS LEAKAGE TEST				<input checked="" type="checkbox"/> BALANCE PISTON ΔP			
18	PERFORMANCE TEST W/ <input checked="" type="checkbox"/> GAS <input type="checkbox"/> AIR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> PROVIDE TAIL END SCHEDULES			
19	COMPLETE UNIT TEST (A)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	VENDOR'S REPRESENTATIVE SHALL:			
20	TANDEM TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> OBSERVE FLANGE PARTING			
21	GEAR TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> CHECK ALIGNMENT AT TEMPERATURE			
22	HELIUM LEAK TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> BE PRESENT AT INITIAL ALIGNMENT			
23	SOUND LEVEL TEST	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
24	AUX. EQUIPMENT TEST	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
25	FULL LOAD / SPEED / PRESS TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
26	HYDRAULIC COUPLING INSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
27	SPARE PARTS TEST	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	WEIGHTS, kg			
28	INSPECTOR'S CHECKLIST COMPLIANCE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COMPR. GEAR			
29	GAS SEAL TEST VENDOR SHOP	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	DRIVER BASE			
30	TORSIONAL VIBRATION MEASUREMENT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ROTORS COMP. DRIVER GEAR			
31	RESIDUAL ELECTRIC / MECH. RUNOUT	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	COMPRESSOR UPPER CASE			
32	DISAS./REASSEMB. COMP. AFTER TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MAX. FOR MAINTENANCE (IDENTIFY)			
33	FIELD EVALUATION TEST	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	L.O. CONSOLE			
34	CERTIFIED COPIES OF ALL TEST DATA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TOTAL SHIPPING WEIGHT			
35	STABILITY TEST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPACE REQUIREMENTS, m & mm			
36					COMPLET UNIT: L W H			
37					COMPRESSOR GEAR L W H			
38					DRIVER L W H			
39					L.O. CONSOLE L W H			
40								
41								
42								
43								
44								
45								
46	REMARKS:							
47	[a] ONE COMPLETE UNIT TEST PER UNIT TYPE							
48								
49								
50								
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		DATA SHEET				No.		REV.	
		TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE						SHEET	
								of	
1	UTILITIES CONDITIONS								
2	STEAM (DRIVERS)					COOLING WATER			
3	INLET	MIN	kPa g	°C	SOURCE	<input type="checkbox"/> OPEN		<input type="checkbox"/> CLOSED	
4		NORM	kPa g	°C	WATER TYPE				
5		MAX.	kPa g	°C	INLET				
6	EXHAUST.	MIN	kPa g	°C	PRESS., kPa	MAX	NORM.	MIN.	
7		NORM.	kPa g	°C	TEMP., °C	MAX	NORM.	MIN.	
8		MAX.	kPa g	°C	RETURN				
9	TOTAL CONSUMPTION				kg/h	PRESS., kPa	MAX	NORM.	MIN.
10	STEAM (HEATERS)					TEMP., °C MAX NORM. MIN.			
11	INLET	MIN	kPa g	°C	FOULING FACTOR, m ² °C / W				
12		NORM	kPa g	°C	TOTAL CONSUMPTION, m ³ /h				
13		MAX.	kPa g	°C	NITROGEN				
14	EXHAUST.	MIN	kPa g	°C	SOURCE	<input type="checkbox"/> DRY		<input type="checkbox"/> WET	
15		NORM.	kPa g	°C	PRESS., kPa	MAX	NORM.	MIN.	
16		MAX.	kPa g	°C	TEMP., °C	MAX	NORM.	MIN.	
17	TOTAL CONSUMPTION				kg/h	TOTAL CONSUMPTION, m ³ /h			
18	ELECTRICITY					OTHER GAS			
19		DRIVERS	CONTROL	SHUTDOWN	SOURCE	<input type="checkbox"/> DRY		<input type="checkbox"/> WET	
20	VOLTAGE				PRESS., kPa	MAX	NORM.	MIN.	
21	HERTZ				TEMP., °C	MAX	NORM.	MIN.	
22	PHASE				INSTRUMENT AIR				
23	TOTAL CONSUMPTION				kW/h	PRESS., kPa	MAX	NORM.	MIN.
24	ELECTRICITY					TEMP., °C MAX NORM. MIN.			
25		DRIVERS	CONTROL	SHUTDOWN	DEOILED:	<input type="checkbox"/> YES		<input type="checkbox"/> NO	
26	VOLTAGE				DEW POINT	°C @		kPa	
27	HERTZ				TOTAL CONSUMPTION, m ³ /h				
28	PHASE				SERVICE AIR				
29	TOTAL CONSUMPTION				kW/h	PRESS., kPa	MAX	NORM.	MIN.
30	<input type="checkbox"/> REDUCED VOLTAGE START				TEMP., °C MAX NORM. MIN.				
31	<input type="checkbox"/> NUMBER OF STARTS				DEOILED: <input type="checkbox"/> YES <input type="checkbox"/> NO				
32					DEW POINT °C @ kPa				
33					TOTAL CONSUMPTION, m ³ /h				
34									
35									
36	REMARKS:								
37									
38									
39									
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	DATA SHEET		No.		REV.				
					SHEET				
	TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE				of				
1	INSTRUMENTATION^[g]								
2	<input checked="" type="checkbox"/> PER API Std 614 AND API Std 670 <input type="checkbox"/> OTHER								
3	LOCAL CONTROL PANEL (LCP)								
4	FURNISHED BY: <input type="checkbox"/> VENDOR <input type="checkbox"/> PURCHASER <input type="checkbox"/> OTHERS								
5	<input type="checkbox"/> BASE MOUNTED <input type="checkbox"/> FREE STANDING <input type="checkbox"/> WEATHERPROOF <input type="checkbox"/> TOTALLY ENCLOSED <input type="checkbox"/> EXTRA CUTOUTS								
6	<input type="checkbox"/> VIBRATION ISOLATORS <input type="checkbox"/> STRIP HEATERS <input type="checkbox"/> PURGE CONNECTIONS <input type="checkbox"/> WITH DOORS								
7	<input type="checkbox"/> ANNUNCIATOR WITH FIRST OUT INDICATION LOCATED UNIT CONTROL PANEL								
8	<input type="checkbox"/> CUSTOMER CONNECTIONS BROUGHT OUT TO TERMINAL BOXES BY VENDOR								
9	REMARKS:								
10									
11	INSTRUMENT SUPPLIERS								
12	PRESSURE GAGES	MFR.			SIZE & TYPE				
13	TEMPERATURE GAGES	MFR			SIZE & TYPE				
14	LEVEL GAGES	MFR			SIZE & TYPE				
15	DIFF. PRESSURE GAGES	MFR			SIZE & TYPE				
16	PRESURE TRANSMITTERS	MFR			SIZE & TYPE				
17	DIFF. PRESSURE TRANSMITTERS	MFR			SIZE & TYPE				
18	TEMPERATURE TRANSMITTERS	MFR			SIZE & TYPE				
19	LEVEL TRANSMITTERS	MFR			SIZE & TYPE				
20	CONTROL VALVES	MFR			SIZE & TYPE				
21	PRESSURE RELIEF VALVES	MFR			SIZE & TYPE				
22	SIGHT FLOW INDICATORS	MFR			SIZE & TYPE				
23	VIBRATION EQUIPMENT	MFR			SIZE & TYPE				
24	TACHOMETER	MFR			RANGE & TYPE				
25	SOLENOID VALVES	MFR			SIZE & TYPE				
26	ANNUNCIATOR	MFR			MODEL & No. POINTS				
27	DAMPER/VANE ACTUATOR	MFR			MODEL				
28	FURNISHED BY	TYPE			MAX. TORQUE, N-m				
29	PRESSURE GAUGE REQUIREMENTS		LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL	FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL
30	FUNCTION								
31	COMPRESSOR SUCTION ^[a]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PROCESS GAS COOLER ^[a,c]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32	COMPRESSOR DISCHARGE ^[a]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LIQUID INJECTION SYSTEM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33	COMPRESSOR SUCTION FILTER ΔP'		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL PUMP DISCHARGE ^[f]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34	JOURNAL OIL BEARING INLET ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL COOLER ^[d]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35	THRUST OIL BEARING INLET ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL MANIFOLD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36	BALANCE PISTON CHAMBER		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37	BALANCE PISTON ΔP		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL PUMP DISCHARGE ^[f]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38	SEAL GAS FILTER ΔP ^[a,b]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL COOLER ^[d]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39	SEAL GAS INLET / OUTLET ^[a,b]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL MANIFOLD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40	SEAL GAS ΔP ^[a,b]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41	SEAL CHAMBER ^[a,b]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42	TEMPERATURE GAUGE REQUIREMENTS		LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL	FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL
43	FUNCTION								
44	COMPRESSOR SUCTION ^[a]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL PUMP DISCHARGE ^[f]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45	COMPRESSOR DISCHARGE ^[a]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL RESERVOIR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46	JOURNAL OIL BEARING OUTLET ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL COOLER ^[d]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47	THRUST OIL BEARING OUTLET ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL PUMP DISCHARGE ^[f]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48	JOURNAL METAL BEARING ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL RESERVOIR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49	THRUST METAL BEARING ^[a,e]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL COOLER ^[d]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50	PROCESS GAS COOLER ^[a,c]		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51	ELECTRIC MOTOR WINDING		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52	REMARKS:								
53	[a] Each stage / casing								
54	[b] Primary / buffer, secondary / barrier and separation gas, where applicable.								
55	[c] Gas & water side, inlet & outlet								
56	[d] Oil & water side, inlet & outlet								
57	[e] Compressor, transmission and drive								
58	[f] Each pump								
59	[g] For oil system instruments, alarms and shutdown signals see Oil System Data Sheet.								
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		DATA SHEET			No.		REV.		
							SHEET		
		TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE					of		
1	LEVEL GAUGE REQUIREMENTS			LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL	LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL
2	FUNCTION								
3	SUCTION SCRUBBER ^[a]			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	OVERHEAD TANK	<input type="checkbox"/>	<input type="checkbox"/>
4	LIQUID INJECTION SYSTEM			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RUNDOWN TANK	<input type="checkbox"/>	<input type="checkbox"/>
5	LUBE OIL RESERVOIR			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL RESERVOIR	<input type="checkbox"/>	<input type="checkbox"/>
6	CONTAMINATED LUBE OIL RECOV. TANK			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONT. CTRL OIL RECOV. TANK	<input type="checkbox"/>	<input type="checkbox"/>
7	LUBE OIL ACCUMULATOR			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL ACCUMULATOR	<input type="checkbox"/>	<input type="checkbox"/>
8				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
9				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
10				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
11	DISPLACEMENT AND VIBRATION GAUGE REQUIREMENTS								
12				LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL			
13	FUNCTION						LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL
14	AXIAL DISPLACEMENT			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PHASE ANGLE	<input type="checkbox"/>	<input type="checkbox"/>
15	VIBRATION INDICATORS			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPEED INDICATOR	<input type="checkbox"/>	<input type="checkbox"/>
16				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
17	GENERAL INDICATORS			LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL			
18	FUNCTION						LOCALLY MOUNTED	LOCAL PANEL	CONTROL PANEL
19	SERVICE HOURMETER			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	RECYCLE VALVE OPENING	<input type="checkbox"/>	<input type="checkbox"/>
20	ELECTRIC MOTOR AMPERIMETER			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PERCENTAGE ^[a]		
21	COMPRESSOR SUCTION VOLUMETRIC			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COMPRESSOR RECYCLE	<input type="checkbox"/>	<input type="checkbox"/>
22	AND MASS FLOW ^[a]						MASSIC FLOW ^[a]		
23	THROTTLE VALVE OPENING PERCENTAGE			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
24				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
25	SIGHT FLOW INDICATORS								
26	<input type="checkbox"/> OIL OUTLET COMPRESSOR BEARING			<input type="checkbox"/> COOLING WATER OUTLET					
27	<input type="checkbox"/> OIL OUTLET DRIVER BEARINGS			<input type="checkbox"/> LIQUID INJECTION MANIFOLD					
28	<input type="checkbox"/> OIL OUTLET GEAR BEARINGS			<input type="checkbox"/> SEAL FLOW (EACH)					
29	<input type="checkbox"/> OIL OUTLET OVERHEAD TANK								
30	<input type="checkbox"/> ALL RETURN OIL LINES TO RESERVOIR								
31	PUSH BUTTON & ALARMS^[b]								
32	<input type="checkbox"/> LAMP TEST			<input type="checkbox"/> MAIN OIL PUMP RUNNING					
33	<input type="checkbox"/> RESET SYSTEM			<input type="checkbox"/> AUXILIARY OIL PUMP RUNNING					
34	<input type="checkbox"/> TURNING GEAR OPERATION			<input type="checkbox"/> SIGNALING OF ALL ALARMS AND TRIPS					
35	<input type="checkbox"/> RECYCLE OPENING ^[a]			<input type="checkbox"/> ALL WASH OIL SYSTEM SIGNALING					
36	<input type="checkbox"/> DRIVER RUNNING			<input checked="" type="checkbox"/> NORMAL STOP					
37				<input checked="" type="checkbox"/> EMERGENCY STOP					
38	SWITCH CLOSURES								
39	ALARM CONTACTS SHALL			<input type="checkbox"/> OPEN	<input type="checkbox"/> CLOSE TO SOUND ALARM AND BE NORMALLY	<input type="checkbox"/> ENERGIZED	<input type="checkbox"/> DE-ENERGIZED		
40	SHUTDOWN CONTACTS SHALL			<input type="checkbox"/> OPEN	<input type="checkbox"/> CLOSE TO TRIP AND BE NORMALLY	<input type="checkbox"/> ENERGIZED	<input type="checkbox"/> DE-ENERGIZED		
41	REMARKS:								
42	[a] Each stage / casing								
43	[b] CONTRACTOR shall inform standard configuration.								
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									


	DATA SHEET		No.		REV.
					SHEET
					of
	TITLE: CENTRIFUGAL COMPRESSOR FOR MAIN COMPRESSOR PACKAGE				
INSTRUMENTATION (CONT.)					
1	ALARM & TRIPS				
2	FUNCTION	ALARM	TRIP	FUNCTION	ALARM TRIP
3	HIGH COMPRESSOR SUCTION PRESSURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL RESERVOIR LEVEL	<input type="checkbox"/>
4	LOW COMPRESSOR SUCTION PRESSURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	LOW LUBE OIL PRESSURE	<input type="checkbox"/>
5	HIGH COMPRESSOR SUCTION TEMPERATURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	LUBE OIL AUX. PUMP RUNNING	<input type="checkbox"/>
6	HIGH COMPRESSOR DISCHARGE PRESSURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	HIGH TEMP. AFTER LUBE OIL COOLERS	<input type="checkbox"/>
7	LOW COMPRESSOR DISCHARGE PRESSURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	LOW OIL TEMP. IN LUBE OIL RESERVOIR	<input type="checkbox"/>
8	HIGH COMPRESSOR DISCHARGE TEMPERATURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>	HIGH LUBE OIL FILTER ΔP	<input type="checkbox"/>
9	HIGH THRUST BEARING METAL TEMPERATURE ^[c]	<input type="checkbox"/>	<input type="checkbox"/>	LOW ACCUMULATOR LEVEL	<input type="checkbox"/>
10	HIGH JOURNAL BEARING METAL TEMPERATURE ^[c]	<input type="checkbox"/>	<input type="checkbox"/>	LOW RUNDOWN TANK LEVEL	<input type="checkbox"/>
11	LOW BALANCE PISTON ΔP	<input type="checkbox"/>	<input type="checkbox"/>	LOW OVERHEAD TANK LEVEL	<input type="checkbox"/>
12	HIGH AND LOW SEAL GAS ΔP ^[b]	<input type="checkbox"/>	<input type="checkbox"/>	LOW CONTROL OIL RESERVOIR LEVEL	<input type="checkbox"/>
13	HIGH AND LOW SEAL GAS FLOW ^[b]	<input type="checkbox"/>	<input type="checkbox"/>	LOW CONTROL OIL PRESSURE	<input type="checkbox"/>
14	HIGH AND LOW SEAL GAS PRESSURE INLET ^[b]	<input type="checkbox"/>	<input type="checkbox"/>	CONTROL OIL AUX. PUMP RUNNING	<input type="checkbox"/>
15	HIGH AND LOW SEAL CHAMBER PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>	HIGH TEMP. AFTER CONTROL OIL COOLERS	<input type="checkbox"/>
16	HIGH SEAL GAS FILTER ΔP ^[b]	<input type="checkbox"/>	<input type="checkbox"/>	LOW OIL TEMP. IN CONTROL OIL RESERVOIR	<input type="checkbox"/>
17	INBOARD AND OUTBOARD SEAL FAILURE	<input type="checkbox"/>	<input type="checkbox"/>	HIGH CONTROL OIL FILTER ΔP	<input type="checkbox"/>
18	HIGH COOLER GAS OUTLET TEMPERATURE ^[a]	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
19	HIGH SUCTION DRUM LEVEL ^[a]	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
20	EXCESSIVE AXIAL DISPLACEMENT ^[d]	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
21	EXCESSIVE VIBRATION ^[d]	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
22	COMPRESSOR IN SURGE	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
23	ELECTRIC MOTOR WINDING TEMPERATURE	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
24	CONTACTS:				
25	<input type="checkbox"/> LUBE & CONTROL OIL AUX. PUMP START UP			<input type="checkbox"/> REMOTE AND LOCAL SHUTDOWN / START UP	
26	<input type="checkbox"/> LUBE & CONTROL OIL MAIN PUMP START UP			<input type="checkbox"/> LIQUID INJECTION PUMP	
27	<input type="checkbox"/> SEAL OIL AUX. PUMP START UP				
28	<input type="checkbox"/> AUTOMATIC HEATER SWITCHING – ON				
29	MISCELLANEOUS:				
30	<input checked="" type="checkbox"/> ALARM AND SHUTDOWN SHALL BE SEPARATE				
31	<input checked="" type="checkbox"/> ELECTRICAL AND INSTRUMENT CONNECTIONS WITHIN THE BOUNDARIES OF THE BASE SHALL BE BROUGHT OUT TO TERMINAL BOXES				
32	COMMENTS REGARDING INSTRUMENTATION				
33					
34					
35					
36	REMARKS:				
37	[a] Each stage / casing				
38	[b] Primary / buffer, secondary / barrier and separation gas				
39	[c] Compressor and driver				
40	[d] Compressor, transmission and drive				
41					
42					
43					
44					
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57					
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 PETROBRAS	DATA SHEET				No.				
	CLIENT:							SHEET	
								of	
	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									
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	DATA SHEET		No.		REV.													
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS				SHEET													
					of													
THE DOCUMENTS STATED BELOW SHALL BE SUPPLIED IN ENGLISH OR BRAZILIAN PORTUGUESE ^[d,e] [NOTES 1, 2, 9, 10]																		
<table border="0"> <tr> <td>PROPOSAL ^[a]</td> <td>BIDDER SHALL FURNISH</td> <td>COPIES OF DATA FOR ALL ITEMS INDICATED BY AN X</td> </tr> <tr> <td>REVIEW ^[b] [3]</td> <td>VENDOR SHALL FURNISH</td> <td>COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED</td> </tr> <tr> <td>FINAL ^[c]</td> <td>VENDOR SHALL FURNISH</td> <td>COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED</td> </tr> <tr> <td></td> <td>VENDOR SHALL FURNISH</td> <td>COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED</td> </tr> </table>							PROPOSAL ^[a]	BIDDER SHALL FURNISH	COPIES OF DATA FOR ALL ITEMS INDICATED BY AN X	REVIEW ^[b] [3]	VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED	FINAL ^[c]	VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED		VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED
PROPOSAL ^[a]	BIDDER SHALL FURNISH	COPIES OF DATA FOR ALL ITEMS INDICATED BY AN X																
REVIEW ^[b] [3]	VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED																
FINAL ^[c]	VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED																
	VENDOR SHALL FURNISH	COPIES AND TRANSPARENCES OF DRAWINGS AND DATA INDICATED																
DISTRIBUTION RECORD		FINAL - RECEIVED FROM VENDOR _____ FINAL - DUE FROM VENDOR ^[c] _____ REVIEW - RETURNED TO VENDOR _____ REVIEW - RECEIVED FROM VENDOR _____ REVIEW - DUE FROM VENDOR ^[c] _____																
CENTRIFUGAL COMPRESSOR																		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1	CERTIFIED DIMENSIONAL OUTLINE DRAWING AND LIST OF CONNECTIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2	CROSS-SECTIONAL DRAWING, PART LIST AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3	ROTOR ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4	THRUST-BEARING ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4a	THRUST BEARING DATA SHEET AND SIZING CALCULATIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5	JOURNAL-BEARING ASSEMBLY DRAWING, PART LIST AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5a	JOURNAL BEARING DATA SHEET AND SIZING CALCULATIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	COUPLING ASSEMBLY DRAWING AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7	LUBE-OIL SYSTEM SCHEMATIC AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8	LUBE-OIL SYSTEM ASSEMBLY & ARRANGEMENT DRAWING AND LIST OF CONNECTIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9	LUBE-OIL SYSTEM COMPONENT DRAWINGS AND DATA														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10	DRY GAS SEAL ASSEMBLY DRAWING AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11	ELECTRICAL AND INSTRUMENTATION SCHEMATICS AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12	ELECTRICAL AND INSTRUMENTATION ARRANGEMENT DRAWINGS AND LIST OF CONNECTIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13	BUFFER GAS SEAL SYSTEM SCHEMATIC AND BILL OF MATERIALS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14	BUFFER GAS SEAL SYSTEM ARRANGEMENT DRAWING AND LIST OF CONNECTIONS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15	BUFFER GAS SEAL SYSTEM COMPONENT DRAWINGS AND DATA														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16	DATA SHEETS (PROPOSAL / AS-BUILT) [NOTE 9]														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16a	GAS FLOW SCHEME (INCLUDING ALL EQUIPMENT)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16b	DESIGN LIMITATIONS FOR ALL EQUIPMENT QUOTED														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17	PREDICTED NOISE SOUND LEVEL (IN PROPOSAL)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18	METALLURGY OF MAJOR COMPONENTS (IN PROPOSAL)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19	LATERAL ANALYSIS REPORT (INCLUDING TRANSIENT CONDITIONS)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20	TORSIONAL ANALYSIS REPORT (INCLUDING TRANSIENT CONDITIONS)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21	VIBRATION ANALYSIS REPORT [NOTE 8]														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22	PERFORMANCE CURVES FOR EACH COMPRESSOR SECTION (PROPOSAL / AS-BUILT)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22a	POLYTROPIC HEAD AND EFFICIENCY VERSUS INLET VOLUME FLOW														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22b	DISCHARGE PRESSURE AND POWER VERSUS INLET VOLUME FLOW														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22c	SPEED VERSUS STARTING TORQUE														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23	IMPELLER OVERSPEED PROCEDURES, REPORT AND DATA (MAIN AND SPARE)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24	MECHANICAL RUNNING TEST PROCEDURES, REPORT AND DATA (MAIN AND SPARE/SHOP AND FIELD TESTS)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25	COUPLING SELECTION AND RATING														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	26	LIST OF RECOMMENDED SPARE PARTS WITH PART NUMBERS AND LIST OF INTERCHANGEABLE PARTS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	27	LIST OF SPECIAL TOOLS														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28	PREPARATION FOR STORAGE AT JOB SITE BEFORE INSTALLATION														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29	WEATHER PROTECTION (WHEN APPLICABLE) AND TROPICALIZATION REQUIRED AT JOB SITE														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30	TABULATION OF ALL UTILITIES (CONSUMPTION LIST)														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31	LIST OF SIMILAR MACHINES														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	32	OPERATING RESTRICTIONS TO PROTECT EQUIPMENT DURING START-UP OPERATION AND SHUTDOWN														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	33	LIST OF COMPONENTS REQUIRING PURCHASER'S APPROVAL														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	34	SUMMARY OF MATERIALS AND HARDNESS OF MATERIALS EXPOSED TO H ₂ S														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	35	SEAL LEAKAGE RATES														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	36	INTERSTAGE COOLER SYSTEM DATA														
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37	DRAWINGS, DETAILS AND DESCRIPTION OF INSTRUMENTATION AND CONTROLS														
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	DATA SHEET		No.		REV.	
					SHEET	
	TITLE:				of	
VENDOR DRAWING AND DATA REQUIREMENTS						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	38	MINIMUM LENGTH OF STRAIGHT PIPE REQUIRED AT MACHINE INLET OR SIDE INLETS		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	39	MAXIMUM AND MINIMUM ALLOWABLE SEAL PRESSURE FOR EACH COMPRESSOR		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	40	STATEMENT OF MANUFACTURER'S TESTING CAPABILITIES		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	41	PERFORMANCE TEST PROCEDURES, DATA, REPORT AND CURVES (SHOP AND FIELD)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	42	BACK-TO-BACK IMPELLER MACHINE VENDOR TO PROVIDE THRUST BEARING LOADS VERSUS DIFFERENTIAL PRESSURE CURVE		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	43	BALANCE PISTON LEAKAGE RATES		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	44	CURVES OF BALANCE PISTON LINE DIFFERENTIAL PRESSURE VERSUS THRUST LOAD		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	45	ENGINEERING, FABRICATION AND DELIVERY SCHEDULE		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	46	TESTING PROCEDURES		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	47	PROGRES REPORTS		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	48	INSTALLATION MANUAL		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	49	OPERATING AND MAINTENANCE MANUALS		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	50	TECHNICAL DATA MANUAL		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	51	TECHNICAL REQUIREMENTS / INFORMATION FOR ANTI-SURGE CONTROL		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	52	MATERIAL SAFETY DATA SHEETS		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	53	ASME PRESSURE VESSEL CERTIFICATION DATA		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	54	SHIPPING LIST		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	55	WELDING PROCEDURES, REPORTS AND DATA		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	56	LIST OF DRAWINGS AND DOCUMENTS INDEX (STATUS AND DELIVERY SCHEDULE)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	57	PAINTING SPECIFICATION (FOR WHOLE COMPRESSOR PACKAGE)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	58	LIST OF SUB-SUPPLIERS (FOR WHOLE COMPRESSOR PACKAGE)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	59	NAMEPLATES DRAWING FOR EACH PIECE OR PART, INCLUDING APPLICABLE CODE STAMP (FOR WHOLE COMPRESSOR PACKAGE)		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	60	LIST OF EXCEPTIONS TO THE SPECIFICATIONS AND APPLICABLE STANDARDS (FOR WHOLE COMPRESSOR PACKAGE) [NOTES 6, 7]		
REMARKS: [a] - Proposal drawings and data do not have to be certified or as-built. [b] - Purchaser will inform in contract, official documentation or indicate in this column the desired time frame for submission of materials using the API nomenclature. [c] - Bidder shall complete this column to reflect his actual distribution schedule and shall include this form with his proposal. [d] - All documents and drawings shall also be provided in magnetic media (CD) and shall be issued by vendor. Files shall be in accordance with contract and PETROBRAS requirements.						
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	DATA SHEET		No.	REV.
	TITLE: VENDOR DRAWING AND DATA REQUIREMENTS			SHEET
				of
<p>NOTE 1 Drawings, instruction books and other commercial or engineering data shall be in English or Brazilian Portuguese language, except for those from the Brazilian market, which shall be in Brazilian Portuguese language. All data, drawings, hardware and equipment supplied to this specification shall use the SI system of measurements, except for ordinary piping, flanges, accessories and appurtenances, which shall be in inches.</p> <p>NOTE 2 All drawings and documents (sub-suppliers documents included) shall be identified, as a minimum, with the following:</p> <ul style="list-style-type: none"> • Client's name; • Client's station; • Job location; • Purchaser's requisition number; • Purchaser's order number; • Tag number; • Service. <p>NOTE 3 Revision boxes shall be provided to describe the latest revisions in full detail and an indication of revisions shall be made at revised information by such means as circled revision number.</p> <p>NOTE 4 Installation, operation and maintenance manuals must be issued by equipment vendor in both Brazilian Portuguese and English.</p> <ul style="list-style-type: none"> • In case of conflicts between IOM instructions, Portuguese version shall prevail; • Both languages shall be used in all Human - Machine Interfaces (HMI) computer screens installed on control panels. Language selection shall be performed at any time, without requiring computer reset or disturbing any monitoring / control process being run by computer plc; • All warnings, such as caution, danger, hazardous signs and other basic safety instructions to be applied on equipment / component external surfaces, enclosures, doors, handles, levers, emergency stop buttons etc. shall be supplied by vendor and shall be written in Brazilian Portuguese (primary text, in capital letters) and english (secondary text, with smaller fonts); • Ordinary / standard documentation of foreign items (main and auxiliary equipment) may be supplied in English. Whenever documents are written in languages other than English, then translations shall be provided as well. <p>NOTE 5 The manuals shall be divided in three sections and shall included the topics below (minimum):</p> <p>Section I:</p> <ul style="list-style-type: none"> • All certified drawings; • Certified and illustrated part list (exploded views of internal parts); • Catalogues; • Technical specifications; • Performance curves for driven and driver equipment; • Calculation sheets; • Data sheets; • Dynamic loads for all operations conditions. <p>Section II:</p> <ul style="list-style-type: none"> • Instructions for storage and transportation; • Commissioning procedure; • Instructions for installation and operation (including auxiliaries); • Instructions for maintenance; • Maintenance procedures, including: disassembly, special tools, cleaning, inspection, repair and assembly of main equipment and auxiliaries. <p>Section III:</p> <ul style="list-style-type: none"> • Material certificates; • Test certificates; • Welding procedures; • Quality plans; • Electrical and electronic instrument certificates for area classification. 				
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	DATA SHEET		No.	REV.
				SHEET
	TITLE:			of
	VENDOR DRAWING AND DATA REQUIREMENTS			
<p>NOTE 6 Purchaser approval of vendor's drawings shall not be considered as relieving the vendor of any responsibility for detailed design, dimension and construction of equipment or deviations from specifications.</p> <p>NOTE 7 All deviations from the requirements in the material requisition (data sheets and technical specifications) and/or API standards must be clearly identified in the proposal and submitted to PETROBRAS for approval. Any requirement exception or deviation from any of the listed documents not clearly mentioned in tender will be considered by petrobras as full compliance with the material requisition.</p> <p>NOTE 8 The vibration analysis data and lateral critical analysis report shall include: rotor analytical model, bearing data, seal clearance x amplitude, critical speed map, undamped rotor mode shapes, unbalance response plots, damped rotor mode shapes, rotor stability analysis. Vendor shall provide to PETROBRAS a recorded CD with vibration data (including vibration amplitude sweeping and vibration signature) and phase angle recorded during mechanical running test, including also signature and sweep diagram for all bearings (horizontal and vertical axis). A Goodman Diagram shall be provided for the highest stressed location of the rotor blade at the rated (guarantee) point. A Campbell Diagram shall be provided for the rotor blade including the blade natural frequencies operating range and potential exciting frequencies. All natural frequencies shall be at least 10 % away from exciting frequency.</p> <p>NOTE 9 Manufacturer shall fill in PETROBRAS data sheets when it's furnished. Vendor data sheets will be not acceptable in this case. For others equipment, manufacturer shall use API data sheets.</p> <p>NOTE 10 All tests reports, data and curves shall be certified.</p>				
<p>THE INFORMATION CONTAINED IN THIS DOCUMENT IS PETROBRAS PROPERTY AND MAY NOT BE USED FOR PURPOSES OTHER THAN THOSE SPECIFICALLY INDICATED HEREIN.</p> <p>THIS FORM IS PART OF PETROBRAS N-2626 REV. D ANNEX B - SHEET 05/05.</p>				

ANNEX C (Normative)

The shop vibration equipment shall use the following minimum configuration during the tests. This configuration shall be stated in the test procedure and shall be checked before starting the test. SI units shall be used in the configuration.

1. Each channel shall be configured according to the contracted vibration probes, considering the following:
 - Transducer type;
 - Full scale range;
 - Scale factor considering the probes sensing area material.
2. Each channel shall be configured according to the probe mounting position and its tag number. Regarding the orientation, API 670 shall be followed.
3. A bandpass filter shall be configured considering high – 1 Hz and low – 1500 Hz.
4. Data shall cover a frequency range from 0.05 to 8 times the MCS. Spectra shall be displayed with 1 Hz/line or less.
5. Data shall be recorded considering a speed variation of 10 RPM or less.
6. Data shall be recorded considering a time variation of 5 seconds or less.
7. Data shall be recorded considering a minimum of 10 static samples per waveform.

The recording instrumentation resolution shall be at least 1.25 μm (0.05 mils).

INDEX OF REVISIONS	
REV. A	
Affected Parts	Description of Alteration
4.1	Included
4.2	Included
4.7	Included
4.8.1	
1.4.25	Revised
4.8.2	
2.1.5	Revised
2.1.19	Revised
2.4.2.1	Revised
2.6.11	Revised
2.6.18	Included
4.8.3	
3.2.2	Revised
3.4.3.1	Revised
3.5.1.5	Revised
4.8.4	
4.3.1.1	Revised
4.3.2.1	Revised
4.3.3	Revised
4.3.4.2.1	Included
4.8.5	
5.2.1	Revised
APPENDIX K	Included
REV. B	
Affected Parts	Description of Alteration
All	General Revision
REV. C	
Affected Parts	Description of Alteration
All	Revision without technical changes to alignment the versions Portuguese / English.

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