

Reciprocating 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 nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

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

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

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Introduction

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

CONTEC

 Comissão de Normalização
Técnica

SC - 11

Machines

Foreword

This Standard is the English version (issued in 12/2012) of PETROBRAS N-1854 REV. D 12/2012. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used. This Standard is based on API [STD 618:2007](#), 5th edition, december 2007.

1 Scope

1.1 The requirements of this Standard are additions to, or modifications of the API [STD 618:2007](#), which is an integral part of this Standard.

1.2 Compressors and auxiliary equipment covered of this Standard shall be in accordance with API [STD 618:2007](#), plus the following changes, as noted for each clause, according to the definitions stated below. The information of each clause shall be read as follows, whenever starting with:

- **Addition:** is the continuation of that particular API [STD 618:2007](#) paragraph;
- **Modification:** is the replacement of part of that affected API [STD 618:2007](#) paragraph;
- **Substitution:** is the replacement of that API [STD 618:2007](#) paragraph in its entirety;
- **New:** is the insertion of a requirement not found in API [STD 618:2007](#);
- **Deletion:** is the removal of that particular API [STD 618:2007](#) paragraph.

1.3 Except for new clauses, API item numbers, as noted in parenthesis in this Standard are the same API [STD 618:2007](#), paragraph ones.

1.4 All deviations from the requirements in this Standard and/or API [STD 618:2007](#), 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.

1.5 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.

1.6 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.

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

1.8 This Standard only contains Technical Requirements.

2 Normative References

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

IEC [60079-0](#) - Explosive Atmospheres - Part 0: Equipment - General Requirements;

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

ANSI/NACE [MR0175](#)/ISO 15156-1 - Petroleum and Natural Gas Industries - Materials for Use in H₂S-Containing Environments in Oil and Gas Production - Part 1: General Principles For Selection of Cracking-Resistant Materials;

API [STD 618:2007](#) - Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services;

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

ASME BPVC [Section VIII - Division I](#) - Boiler and Pressure Vessel Code - Section VIII - Division 1 - Rules for Construction of Pressure Vessels.

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

3 Terms and Definitions

For the purposes of this document, the following term and definition apply.

New (3.63)

hazardous service: 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 percent molal concentration at any pressure);
- d) other toxic and lethal substances, which shall result in death or permanent personal injury through inhalation, exposition, or contact, to be specified and defined in the inquiry documents;
- e) air compression services above 12 bar g (175 psi g).

4 Basic Considerations

4.1 The Annex A is the data sheet to be used to reciprocating compressors for SI units according to API [STD 618:2007](#).

4.2 The Annex B is the data sheet to be used to reciprocating compressors for SI units, except for pressure unit that will be in kgf/cm², according to API [STD 618:2007](#).

4.3 The Annex C is the Vendor Drawing and Data Requirements (VDDR) to be used to reciprocating compressors according to API [STD 618:2007](#).

5 Requirements - Substitution (5.3 of API [STD 618:2007](#)):

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

- a) data sheets;
- b) supplementary job or technical specifications (if any);
- c) this Standard and all other PETROBRAS standards specifically referenced in the inquiry;
- d) API [STD 618:2007](#).

Concerning any conflict after placement of order, the following priority 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 Standard and all other PETROBRAS standards specifically referenced in the inquiry or order;
- e) API [STD 618:2007](#);
- f) vendor's proposal.

6 Basic Design

6.1 Substitution (6.1.5 of API [STD 618:2007](#))

Unless otherwise agreed upon by the purchaser, the pressure design code shall be ASME BPVC [Section VIII - Division I](#).

6.2 Modification (6.1.6 of API [STD 618:2007](#))

Replace the first and second paragraphs by: Unless otherwise specified, the whole train furnished by the vendor (compressor, driver, gear and auxiliary equipment) shall conform to the maximum allowable sound pressure level of 85 dB (A), slow-response, measured at 1 m (3.28 ft) from the equipment surfaces. Additionally, 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 and sound power level data per octave band for the equipment of quoted equipment and including copies of noise level test certificates performed on similar equipment.

6.3 Substitution (6.1.12 of API [STD 618:2007](#))

Motors, electrical components, and electrical installations including field instruments and controls shall be suitable for the area classification (zone, group, temperature class) specified by PETROBRAS on the data sheets and shall meet the requirements of IEC [60079-0](#) as well as local codes specified and furnished by PETROBRAS on request.

6.4 Substitution (6.1.17 of API [STD 618:2007](#))

The purchaser and the manufacturer shall agree on the details of an initial installation check by the vendor's representative and an operating temperature alignment check at a later date. Such checks shall include, but not be limited to, initial alignment check, grouting, crankshaft web deflection, piston-rod runout, driver alignment, motor air gap, outboard bearing insulation, bearing checks, and piston end clearance.

6.5 Addition (6.1.20 of API [STD 618:2007](#))

Unless otherwise specified, the equipment, including all auxiliaries, shall be suitable for outdoor installation and operation.

6.6 Addition (6.1.24 of API [STD 618:2007](#))

Vendor is required to clearly state in proposal the compressor zero percent load maximum allowable operating time. See also item 7.6.2.4 of API [STD 618:2007](#).

6.7 New (6.1.27 of API [STD 618:2007](#))

New models or prototypes are not acceptable. A minimum of 25 000 hours continuous operation under similar operating conditions shall be demonstrated for 50 machines of the same model and 25 machines of the same size as the one offered, unless otherwise specified. Refurbished equipment or parts are not acceptable.

The following parameters shall be considered to indicate similar operating conditions and shall be plotted in an experience plot: power, discharge pressure, capacity, special services (H₂, H₂S etc.) and number of cylinders.

6.8 Addition (6.2.2 of API [STD 618:2007](#))

If extended studs are provided for hydraulic tensioning, the exposed threads shall be protected by a cover.

6.9 Substitution (6.4 of API [STD 618:2007](#))

Compressors shall be conservatively rated at a speed not in excess of that known by the manufacturer to result in low maintenance and trouble-free operation under the specified service conditions. The maximum average piston speed for nonlubricated services shall be 3,3 m/s (650 fpm). For lubricated cylinders the respective limit shall be 4,4 m/s (866 fpm). Higher piston speeds may be submitted for PETROBRAS' specific approval provided that vendor can prove successful experience with similar designs at similar applications. Nevertheless, such higher speeds shall be considered an important parameter to determine equipment choice.

6.10 Deletion (6.7.4 of API [STD 618:2007](#))

Removed from API [STD 618:2007](#).

6.11 Addition (6.8.1.2 of API [STD 618:2007](#))

Cylinders, including valve chambers and clearance pockets, shall be designed so as to prevent the possibility of liquid trapping.

6.12 Addition (6.8.2.2 of API [STD 618:2007](#))

Liners shall have an interference fit, and shall be held in place by positive mechanical means, such as a shoulder. Liners held in place only by an interference fit are unacceptable.

6.13 Addition (6.8.3.4.3 of API [STD 618:2007](#))

In case of risk of gas condensation, vendor is required to comment on PETROBRAS cooling system specification before proposal.

6.14 Modification (6.8.4.1.16 of API [STD 618:2007](#))

Replace the first sentence by: Unless otherwise specified, compressors with shaft power above 400 kW, shall be provided with DN 12 (NPT 1/2) indicator taps at each cylinder end.

6.15 Substitution (6.10.3.2 of API STD 618:2007)

Replace the first paragraph by: Wear bands shall be of single-piece construction designed to prevent underside pressurization. If feasible, pistons shall be segmented to facilitate wear band installation. Piston ring carriers for multi-piece pistons shall be furnished in wear resistant material. Wear bands shall be nonmetallic for lubricated and nonlubricated services, and shall not overrun fully-open singlehole valve ports or liner counterbores by more than one half the width of the wear band.

6.16 Addition (6.10.4.1 of API STD 618:2007)

Chrome plated piston rods are not acceptable.

6.17 New (6.10.4.7 of API STD 618:2007)

Special consideration shall be given to gas entrained between piston and piston rod. Vendor is required to provide means of adequate depressurization before disassembly of such components.

6.18 Substitution (6.11.1 of API STD 618:2007)

Crankshafts shall be forged in one piece (but may have provision for removable counterweights) and shall be heat-treated and machined on all working surfaces and fits. They shall be free of sharp corners. Main and crankpin journals shall be ground to size. Drilled holes or changes in section shall be finished with generous radii and shall be highly polished. Forced lubrication passages in crankshafts shall be drilled. See 8.2.2.3.3 of API STD 618:2007 for ultrasonic testing of crankshafts.

6.19 Modification (6.11.3 of API STD 618:2007)

Replace the first and second sentence by: Connecting rods shall be forged steel with removable caps.

6.20 Modification (6.11.5 of API STD 618:2007)

Replace the first sentence by: The crankcase shall be provided with relief devices to protect against rapid pressure rise.

6.21 Modification (6.12.1.4 of API STD 618:2007)

Replace the last sentence of the first paragraph by: Provisions for the injection of buffer gas shall also be provided.

6.22 Modification (6.12.1.5 of API STD 618:2007)

Replace the last sentence of the first paragraph by: If necessary, provisions for lubrication of this segmental packing shall be furnished by the vendor. Provisions for the injection of buffer gas shall also be provided.

6.23 Modification (6.12.2.1 of API STD 618:2007)

Replace the last sentence of the first paragraph by: Unless otherwise specified, distance pieces (or compartments) shall be equipped with solid metal covers.

6.24 Modification (6.13.1.1 of API STD 618:2007)

Replace the last sentence by: If necessary, shields shall be provided in the crosshead housings over the oil return drains from the wiper-packing stuffing boxes to prevent splash flooding.

6.25 Modification (6.13.1.2 of API STD 618:2007)

Replace second sentence by: Packing case flanges and cups shall be supplied in stainless steel.

6.26 Substitution (6.14.2.1.4 b. of API STD 618:2007)

Main oil pump - (materials in accordance with 6.14.2.1.5 of API STD 618:2007) which, unless otherwise specified, shall be shaft-driven, either directly or through gears or a chain, and shall be accessible for maintenance without draining the oil from crankcase.

6.27 Addition (6.14.2.1.7 of API STD 618:2007)

Vents shall be provided with restriction orifices of 1/8 inch (3 mm) size.

6.28 Addition (6.14.2.1.9 of API STD 618:2007)

Crankcase bottom (oil reservoir) shall be sloped, and provided with a tapped drain opening at the lowest point and a vent opening at the highest point.

6.29 New (6.14.2.1.11 of API STD 618:2007)

Oil pumps shall not require priming for proper operation.

6.30 New (6.14.2.1.12 of API STD 618:2007)

Both main and auxiliary pumps shall be provided with stainless steel suction strainers, sized not less than 60 mesh. Losses shall not exceed 14 kPa (2 psi).

6.31 New (6.14.2.1.13 of API STD 618:2007)

All fixed bearings shall be provided with individual oil supply on external parts. Other design solutions, such as lubrication of these bearings through crankshaft channels or grooves shall be submitted for approval.

6.32 Modification (6.14.3.1.2 of API STD 618:2007)

Replace first sentence by: Unless otherwise specified, lubricators shall be crankshaft-driven.

6.33 Modification (6.14.3.1.9 of API STD 618:2007)

Replace first sentence by: Unless otherwise specified, lubricants for frame and cylinders shall be mineral oil. If vendor's design requires a synthetic type, oil specification shall be submitted to PETROBRAS for approval during bid clarifications.

6.34 Addition (6.15.1.1 of API [STD 618:2007](#))

Even when the severity of operating conditions may eventually preclude the compressor of meeting the objective of a high uninterrupted service time, valve materials shall be suitable for, at least, 8 000 hours of compressor continuous operation at rated conditions.

6.35 Modification (6.15.1.2 of API [STD 618:2007](#))

Replace the last sentence by: When no such designation is available, the vendor's material specification, giving physical properties, chemical composition, and test requirements shall be submitted before proposal for purchaser's approval.

6.36 Modification (6.15.1.15 of API [STD 618:2007](#))

Replace the first sentence by: The minimum quality bolting material for all pressure joints shall be high temperature alloy steel such as ASTM [A 193](#), Grade B7.

6.37 Addition (6.15.2.1 of API [STD 618:2007](#))

If not specified differently in the data sheet, the cast iron acceptable for pressure-containing cylinders parts in H₂S/H₂ service is ASTM A395 type I or II. For H₂S service, ductile cast iron ASTM [A 395](#) type I or II shall follow ANSI/NACE [MR0175](#)/ISO [15156-1](#).

6.38 Addition (6.15.2.2 of API [STD 618:2007](#))

Valve covers shall also be in steel.

6.39 Modification (6.15.8.3 of API [STD 618:2007](#))

Replace the third sentence by: For materials and thickness' not covered by ASME [Section VIII - Division I](#) or the specified pressure design code, testing requirements shall be specified by the vendor and approved by the purchaser.

6.40 Addition (6.16.1 of API [STD 618:2007](#))

The nameplates shall be written in Portuguese.

7 Accessories**7.1 Substitution (7.1.1.10 of API [STD 618:2007](#))**

The supporting feet of drivers shall be provided with vertical jackscrews regardless of the weight.

7.2 Substitution (7.1.2.2 of API [STD 618:2007](#))

For motor-driven units, the motor nameplate rating (exclusive of service factor) shall be a minimum of 110 percent of the greatest power required (including gear and coupling losses) for any of the specified operating conditions.

7.3 Modification (7.2.1.2 of API STD 618:2007)

Replace the second sentence by: The coupling shall be non-lubricated, stainless steel flexible membrane, torsionally-rigid, spacer-type.

7.4 Substitution (7.2.1.3 of API STD 618:2007)

Unless otherwise specified, couplings shall conform to API STD 671/ISO 10441 for rated power greater than 1 200 kW. Coupling mountings shall conform to API STD 671/ISO 10441.

7.5 Addition (7.2.1.11 of API STD 618:2007)

The coupling shall be designed to enable replacement of component parts without removing the driver shaft or any other main drive component from the system.

7.6 New (7.2.1.12 of API STD 618:2007)

The coupling shall be sized to meet maximum power, torque and torque fluctuation requirements for the specified (normal and transient) or unusual (emergency) operating conditions, with the stress of parts subject to cyclic forces conservatively below fatigue limits.

The coupling shall be suitable for emergency shutdown of the unit under loaded conditions.

The coupling shall be suitable for torsional frequencies of driver and compressor (no resonances within all range of speeds).

7.7 New (7.2.1.13 of API STD 618:2007)

Couplings shall be adequate for expansion and other end-movement of shafts without subsequent overstressing or other thrust-absorbing components in the drive system. When the driver is a motor with sleeve bearings, limited end-float couplings shall be furnished to center the driver-rotating element under all operating conditions. Unless specified by PETROBRAS on the data-sheets, end-float limits shall be mutually agreed upon by compressor vendor, coupling manufacturer and motor manufacturer, and shall be submitted to PETROBRAS for approval.

The compressor (or gear, if any) shall be designed to accept the maximum motor thrust.

7.8 Addition (7.3.2 of API STD 618:2007)

System shall be furnished with filters and coolers. Filters shall be provided with magnetic plugs.

7.9 Modification (7.5.3.6 of API STD 618:2007)

Replace the second sentence by: The vendor shall provide the design for the anchor bolts.

7.10 Addition (7.6.1.3 of API STD 618:2007)

The vendor shall provide all necessary system instrumentation within contracted scope of supply. The specification of protective devices for the compressor, auxiliary equipment, driver and accessories is of vendor's concern and responsibility. In those cases when devices are already specified in data sheets, it is also vendor's responsibility to comment on and complement the specifications.

7.11 Substitution (7.6.6.6 of API STD 618:2007)

Unless otherwise specified, contacts shall be configured to open (deenergize) to initiate alarms and shutdowns.

NOTE Contacts that open (deenergize) are normally considered to be fail safe.

7.12 New (7.6.9 of API STD 618:2007)

The use of solenoid valves directly installed in process piping shall be subjected to previous approval of PETROBRAS.

7.13 Substitution (7.9.4.1.2 of API STD 618:2007)

Unless otherwise specified, the analysis shall be performed by the compressor vendor.

7.14 Addition (7.9.4.2.1 of API STD 618:2007)

Vendor is responsible for the execution and interpretation of the pulsation analysis. Details of the piping and equipment layout will be supplied by PETROBRAS for the execution of the respective analysis. If analysis indicates the need of thorough modifications in pulsation dampers or piping, a new study shall be performed after such modifications have been made.

7.15 Substitution (7.9.5.1.2 of API STD 618:2007)

The maximum allowable working pressure for any component shall not be less than the set pressure of the relief valve (plus accumulation) serving that component and, in any case, shall not be less than a gauge pressure of 4 bar (60 psig).

Suction-side equipment between the block valve and the compressor cylinder shall be rated for discharge pressure or have a protective relief valve provided by vendor.

7.16 Substitution (7.9.5.1.4 of API STD 618:2007)

All butt welds shall be 100 % radiographed for hazardous services.

7.17 Substitution (7.9.5.1.22 of API STD 618:2007)

The dynamic and static stresses on the pulsation suppression device internals that result from pulsation induced shaking forces and pressure-induced static forces shall be analyzed to confirm compliance with 7.9.4.2.4 of API STD 618:2007.

7.18 Modification (7.11.2 of API STD 618:2007)

Replace the last item by: e. If applicable, hydraulic tensioning tools.

8 Inspection and Testing**8.1 Substitution (8.1.2 of API STD 618:2007)**

The purchaser's representative and the vendor shall indicate compliance in accordance with the inspector's checklist (Annex K) by initialing, dating and submitting the completed checklist to the purchaser before shipment.

8.2 Substitution (8.1.6 of API STD 618:2007)

The amount of advanced notification required for a witnessed or observed inspection or test shall be as specified. An observed test shall not be conducted until the specified time.

NOTE The notification shall be issued only after the procedure approval by purchaser.

8.3 New (8.1.11 of API STD 618:2007)

At least 6 weeks before the first scheduled test, the vendor shall submit to PETROBRAS, for review and comment, detailed procedures for all applicable inspection and test, either specified in API STD 618:2007 or by PETROBRAS, test program, instrumentation required and acceptance criteria for all monitored parameters. Any relevant anomalous condition such as reduced speed; gear, coupling, control devices or oil system other than purchased, shall be clearly mentioned and demonstrated.

8.4 New (8.2.2.1.4)

Cylinders shall be inspected by ultrasonic test or radiography test (whenever feasible) in accordance with 8.2.2.2 or 8.2.2.3 of API STD 618:2007 for Hydrogen and/or H₂S service.

8.5 Modification (8.3.3.1 of API STD 618:2007)

All compressors, drivers, and gear units shall be shop tested in accordance with the specified.

8.6 Modification (8.3.3.2 of API STD 618:2007)

Unless otherwise specified, the shop test of the compressor shall comprise a 4-hour unloaded running test.

8.7 Substitution (8.3.3.7 of API STD 618:2007)

After 4-hour mechanical running test, Vendor shall carry out:

- a) boroscope inspection for verifying the compressor internals (cylinder, liner, piston rod, piston). In case of any abnormality was observed, vendor shall perform a strip test for all cylinders.
- b) upper half main bearings inspection;
- c) crankshaft web deflection check.

8.8 New (8.3.3.8 of API STD 618:2007)

Job flywheel shall be used during the mechanical running test.

9 Vendor's Data**9.1 Modification (9.2.3 of API STD 618:2007)**

Replace the item "s" by: "When specified, vendor shall include in proposal a special list (vendor's standard reference list shall always be included) of similar machines installed (see 6.7 of this Standard) and operating under conditions at least as severe as the specified on data sheets, including the following information:

- compressed fluid characteristics (density, special service - H₂, H₂S etc);
- rated operating point data (capacity, suction and discharge pressure);
- number of stages and number of cylinders per stage;
- power rating;
- material class, as per API STD 618:2007 Appendix H;
- supply and start up dates;
- user's name and location.

9.2 Addition (9.2.3 of API STD 618:2007)

x. scope of supply.

z. exceptions to the specifications:

- data sheets;
- supplementary job specifications (if any);
- this Standard and other applicable PETROBRAS standards;
- API Standard 618.

9.3 Substitution (9.3.3.3 of API STD 618:2007)

The vendor shall furnish the data required for independent rod load, gas load, and reversal calculations.

	DATA SHEET		No.	REV.	
	TITLE: RECIPROCATING COMPRESSOR SI UNIT			SHEET	of

1 APPLICATION TO: ☐ PROPOSAL ☐ PURCHASE ☒ AS BUILT

2 FOR: _____ UNIT: _____

3 SITE: _____ SERVICE: _____

4 NO. REQ'D: _____ MANUFACTURE: _____

5 MODEL: _____ VENDOR: _____

6 SIZE/TYPE: _____ DRIVER: _____

7 SERIAL NO.: _____ MANUFACTURE NO.: _____

8 COMPR. THROWS: TOTAL NO.: _____ NO. WITH CYLS: _____ NOMINAL FRAME RATING _____ BkW@RATED rpm OF _____

9 ☐ MAXIMIN ALLOWABLE SPEED _____ / _____ rpm

10 DRIVE MFGR _____ DRIVER NAMEPLATE kw / OPERATING rpm _____ / _____

11 DRIVE SYSTEM: ☐ DIRECT COUPLED ☐ GEARED & COUPLET ☐ V-BELT

12 TYPE OF DRIVER: ☐ IND. MOTOR ☐ SYN. MOTOR ☐ STEAM TURBINE ☐ GAS TURBINE ☐ GAS ENGINE

13 NO NEGATIVE TOLERANCE APPLIES: ☐ YES - PURCHASER TO FILL IN "REQUIRED CAPACITY" LINES CYLINDERS: ☐ LUBE

14 (NNT) ☐ NO - PURCHASER TO FILL IN "MFGR'S RATED CAP" LINES ☐ NON-LUBE

15 ☐ MAX ACCEPTABLE PISTON SPEED _____ m/s

OPERATING CONDITIONS (EACH MACHINE)

☐ SERVICE OR ITEM NO.					
☐ NORM. OR ALT. CONDITION					
☐ STAGE					
☐ CERTIFIED PT. ☒ CHECK ONE					
☐ MOLECULAR WEIGHT					
☐ C _p /C _v (K) @ 65 °C OR _____ °C					
INLET CONDITIONS: AT INLET TO:	☐ PULSE DEVICES	☐ COMPRESSOR CYLINDER FLANGES			
☐ PRESSURE, kPa a @PUL. SUPP. INLET	☐ SIDE STREAM TO	STAGE(S), THESE INLET PRESS ARE FIXED			
☐ PRESSURE, kPa a @CYL. FLANGE					
☐ TEMPERATURE, °C					
☐ REF.: SIDE STREAM TEMPS, °C					
☐ COMPRESSIBILITY ☐ Z ₁ ☐ Z _{AVG}					
INTERSTAGE: INTERSTAGE ΔP INCLUDES: ☐ PULSE DEVICES ☐ PIPING	☐ COOLERS	☐ SEPARATORS	☐ OTHER		
☐ ΔP BETWEEN SYAGES, % / kPa	/	/	/	/	/
DISCHARGE CONDITIONS: AT OUTLET FROM:	☐ PULSE DEVICE	☐ COMP CYL FLANGES	☐ OTHER		
☐ PRESSURE, kPa a @ CYL. FLANGE					
☐ PRESSURE, kPa a @ PUL. SUPP. OUTLET					
☐ TEMPERATURE, ADIABATIC, °C					
☐ TEMPERATURE, PREDICTED, °C					
☐ COMPRESSIBILITY ☐ Z ₁ ☐ Z _{AVG}					
*REQUIRED CAPACITY, RATED FOR PROCESS, AT INLET TO COMPRESSOR, NO NEGATIVE TOLERANCE -0%					
☐ kg/h CAPACITY SPECIFIED IS ☐ WET ☐ DRY					
☐ Nm ³ /h (101,3 kPa a & 0 °C)					
MGFR'S RATED CAPACITY (AT INLET TO COMPRESSOR) & Kw @ CERTIFIED TOLERANCE OF ±3 % FOR CAP & ±3 % FOR KW					
☐ kg/h CAPACITY SPECIFIED IS ☐ WET ☐ DRY					
☐ INLET, m ³ /h					
☐ Nm ³ /h (101,3 kPa a & 0 °C)					
☐ kW/STAGE					
☐ TOTAL BkW @ COMPRESSOR SHAFT					
☐ TOTAL kW INCLUDING V-BELT & GEAR LOSSES					

49 *CAPACITY FOR NNT

50 MANUFACTURERS = REQUIRED ÷ 0,97

51 REQUIRED = MANUFACTURER'S x 0,97

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53 NOTES:

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THE INFORMATION CONTAINED IN THIS DOCUMENT IS PETROBRAS PROPERTY AND MAY NOT BE USED FOR PURPOSES OTHER THAN THOSE SPECIFICALLY INDICATED HEREIN.

THIS FORM IS PART OF PETROBRAS N-1854 REV. D ANNEX A - SHEET 02/21.

	DATA SHEET		No. _____		REV. _____		
	TITLE: RECIPROCATING COMPRESSOR SI UNIT					SHEET _____	of _____

1	GAS ANALYSIS AT OPERATING CONDITIONS								REMARKS	
2	MOLE % (BY VOLUME) ONLY									
3	☐ SERVICE / ITEM NO.									
4	☐ NORMAL OR ALT									
5	☐ STAGE									
6		SYMBOL	MW							
7	AIR		28,966							
8	OXYGEN	O ₂	32,000							
9	NITROGEN	N ₂	28,016							
10	WATER VAPOR	H ₂ O	18,016							
11	CARBON MONOXIDE	CO	28,010							
12	CARBON DIOXIDE	CO ₂	44,010							
13	HYDRO SULFITE	H ₂ S	34,076							
14	HYDROGEN	H ₂	2,016							
15	METHANE	CH ₄	16,042							
16	ETHYLENE	C ₂ H ₄	28,052							
17	ETHANE	C ₂ H ₆	30,068							
18	PROPYLENE	C ₃ H ₆	42,078							
19	PROPANE	C ₃ H ₈	44,094							
20	I-BUTANE	C ₄ H ₁₀	58,120							
21	N-BUTANE	C ₄ H ₁₀	58,120							
22	I-PENTANE	C ₅ H ₁₂	72,146							
23	N-PENTANE	C ₅ H ₁₂	72,146							
24	HEXANE PLUS									
25	AMMONIA	NH ₃	17,031							
26	HYDRO CHLORIDE	HCl	36,461							
27	CHLORINE	Cl	70,914							
28	CHLORIDES-TRACES									
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42	☐ CALCULATED MOL WT.									
43	☐ C _p /C _v (K) @ 65° OR _____ °C.									
44	SITE / LOCATION CONDITIONS									
45	ELEVATION _____	m	BAROMETER _____	kPa	a	AMBIENT TEMPS: MAX _____	°C.	MIN _____	°C.	
46	☐ MIN. DESIGN METAL TEMP _____		°C.	RELATIVE HUMIDITY: MAX _____		%	MIN _____	%		
47	COMPRESSOR LOCATION	☐ INDOOR	☐ HEATED	☐ UNHEATED	☐ AT GRADE LEVEL	☐ ELEVATED _____	m			
48		☐ OUTDOOR	☐ NO ROOF	☐ UNDER ROOF	☐ PARTIAL SIDES	☐ PLATFORM		☐ ON SHORE		
49		☐ OFF-SHORE	☐ WEATHER PROTECTION REQ.		☐ TROPICALIZATION REQ.					
50		☐ WINTERIZATION REQUIRED								
51	UNUSUAL CONDITIONS	☐ CORROSIVES	☐ DUST	☐ FUMES	☐ OTHER _____					
52			☐ SALTY ATMOSPHERE							
53	ELECTRICAL CLASSIFICATIONS									
54			HAZARDOUS				NON-HAZARDOUS			
55	MAIN UNIT	☐ ZONE _____	GAS GROUP _____	TEMP. CLASS _____		☐				
56	LO CONSOLE	☐ ZONE _____	GAS GROUP _____	TEMP. CLASS _____		☐				
57	CW CONSOLE	☐ ZONE _____	GAS GROUP _____	TEMP. CLASS _____		☐				
58										
59										
60										

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	DATA SHEET	No.	REV.
			SHEET of
	TITLE: RECIPROCATING COMPRESSOR SI UNIT		

PART LOAD OPERATING CONDITIONS

CAPACITY CONTROL BY: ☐ MFG'S CAP. CONTROL ☐ PURCHASERS BY-PASS ☐ BOTH ☐ OTHER _____
FOR: ☐ PART LOAD COND. ☐ START UP ONLY ☐ BOTH
WITH: ☐ AUTO LOADING DELAY INTERLOCK ☐ AUTO IMMEDIATE UNLOADING
USING: ☐ FIXED VOLUME POCK ☐ SUCTION VALVE UNLOADERS: ☐ FINGER ☐ PLUG ☐ OTHER _____
ACTION: ☐ DIRECT (AIR-TO-UNLOAD) ☐ REVERSE (AIR-TO-LOAD / FAIL SAFE)
NUMBER OF STEPS: ☐ ONE ☐ THREE ☐ FIVE ☐ OTHER _____
☐ RAIN COVER REQUIRED OVER UNLOADERS

ALL UNLOADING STEPS BASIS MANUFACTURES CAPACITY SHOWN ON PAGE _____ AND TRANSIENT CONDITIONS

INLET AND DISCHARGE PRESSURE ARE ☐ AT CYLINDER FLANGES ☐ PULSATION SUPPRESSOR FLANGES

☐ SERVICE OR ITEM NO. ☐ NORM. OR ALT. CONDITION ☐ STAGE ☐ PERCENT CAPACITY ☐ WEIGHT FLOW. Kg/h ☐ Nm ³ /h (101,3 kPa a & 0 °C) ☐ POCKETS / VALVES OPERATION* ☐ POCKET CLEARANCE ADDED, % ☐ TYPE UNLOADERS, PLUG / FINGER ☐ INLET TEMPERATURE, °C. ☐ INLET PRESSURE, kPa a ☐ DISCHARGE PRESSURE, kPa a ☐ DISCHARGE TEMP., ADIABATIC, °C. ☐ DISCHARGE TEMP., PREDICTED, °C. ☐ VOLUMETRIC EFF., % HE/ % CE ☒ CALC. GAS ROD LOAD, Kn, C** ☐ CALC. GAS ROD LOAD, Kn, T** ☐ COMB. ROD LOAD, Kn, C (GAS & INERTIA) ☐ COMB. ROD LOAD, Kn, T (GAS & INERTIA) ☐ ROD. VER. / MIN DEGREES @ X-HD PIN*** ☐ BkW / STAGE ☐ TOTAL Kw @ COMPRESSOR SHAFT ☐ TOTAL kW INCL. V-BELT & GEAR LOSSES	
---	--

* SHOW OPERATION WITH THE FOLLOWING SYMBOLS:

HEAD END	}	= HE	}	PLUS	SUCTION VALVE(S) UNLOAD	= S	
OR					OR	FIXED POCKET OPEN	= F
CRANK END		= CE			OR	VARIABLE POCKET OPEN	= V

EXAMPLE: HE - F / CE - S = HEAD END FIXED POCKET OPEN / CRANK END SUCTION VALVE(S) UNLOADED

C = COMPRESSION / T = TENSION *X-HD = CROSSHEAD

MINIMUM PRESSURE REQUIRED TO OPERATE CYLINDER UNLOADING DEVICES, _____ kPa

CYLINDER UNLOADING MEDIUM: ☐ AIR ☐ NITROGEN ☐ OTHER _____

PRESSURE AVAILABLE FOR CYLINDER UNLOADING DEVICES, MAX/MIN _____ / _____ kPa

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	DATA SHEET		No.	REV.
	TITLE: RECIPROCATING COMPRESSOR SI UNIT			SHEET
				of

1	SCOPE OF BASIC SUPPLY			
2	☐ COMPRESSOR	☐ LUBE	☐ NON-LUBE	
3	☐ DRIVER	☐ VARIABLE SPEED	SPEED RANGE _____ rpm TO _____ rpm	
4	☐ INDUCTION MOTOR	☐ SYNCHRONOUS MOTOR	☐ STEAM TURBINE	☐ ENGINE ☐ OTHER _____
5	☐ API STD 541	☐ API STD 546	☐ API STD 611	☐ API STD 612
6	☐ OUTBOARD BEARING	☐ PROVISION FOR DRY AIR PURGE FOR OUTBOARD BEARING		
7	☐ SLIDE BASE FOR DRIVER	☐ SOLEPLATE FOR DRIVER	☐ BASEPLATE FOR COMP. TRAIN	
8	☐ MOTOR STARTING EQUIPMENT / DEFINE			
9	☐ GEAR:	☐ BASEPLANTE FOR GEAR	☐ API STD 613	☐ API STD 677
10	☐ COUPLING(S):	☐ LOW SPD ☐ HI-SPD	☐ QUILL SHAFT	☐ KEYLESS DRIVE ☐ KEYED DRIVE
11		☐ API STD 671		
12	☐ V-BELT DRIVE:	☐ SHEAVES & V-BELTS:	☐ STATIC CONDUCTION V-BELTS	☐ BANDED V-BELT
13	☐ DRIVE GUARD(S):	☐ MANUFACTURER'S STD	☐ NON-SPARKING	☐ CALIF CODE ☐ API STD 671 - APPENDIX C
14	☐ OTHER _____			
15				
16	☐ PULSATION SUPPRESSORS WITH INTERNALS:		☐ INITIAL INLET & FINAL DISCHARGE	☐ SUPPORTS
17			☐ INTERSTAGE	☐ SUPPORTS
18	☐ PULSATION SUPPRESSORS WITHOUT INTERNALS:		☐ INITIAL INLET & FINAL DISCHARGE	☐ SUPPORTS
19			☐ INTERSTAGE	☐ SUPPORTS
20	☐ SUPPRESSOR(S) TO HAVE MOISTURE REMOVAL SECTION:		☐ INITIAL INLET ONLY	☐ ALL INLET SUPPRESSORS
21	☐ ACOUSTICAL SIMUL. STUDY (DESIGN APPROACH)		☐ 1 ☐ 1, W / SIMPLIFIED ANALYSIS OF PIPING SYSTEM	
22	☒ DIGITAL ☒ ANALOG		☐ 2, WITH ACOUSTIC SIMULATIO	
23			☐ 3, WITH ACOUSTIC SIMULATION AND MECH RESP. OF PIPING	
24	STUDY TO CONSIDER:		ALL SPECIFIED LOAD COND., INCL.	☐ SINGLE ACT., PLUS
25			☐ COMP. OPER. IN PARALLEL	☐ ALTERNATE GASES
26			☐ WITH EXISTING COMPRESSORS AND PIPING SYSTEMS	
27	☐ STUDY TO BE WITNESSED		☐ COMPRESSOR VALVE DYNAMIC RESPONSE	
28	☐ VENDOR REVIEW OF PURCHASERS PIPING ARRANGEMENT		☐ PULSATION SUPPRESSION DEVICE LOW CYCLE FATIGUE ANALYSIS	
29			☐ PIPING SYSTEM FLEXIBILITY	
30				
31	PACKAGE: ☒ YES ☐ NO			
32	☐ SKID ☐ SOLEPLATE	☐ BASEPLATE	☐ BOLTS OR STUDS FOR SOLEPLATE TO FRAME	☐ RAILS ☐ CHOCK BLOCKS ☐ SHIMS
33	☐ SUITABLE FOR COLUMN MOUNTING (UNDER SKID AND/OR BASEPLATE)			
34	☐ LEVELING SCREWS	☐ NON-SKID DECKING	☐ SUB SOLEPLATES	
35	☐ DIRECTED GROUTED	☐ CEMENTED/MORTAR GROUT	☐ EPOXY GROUT; MFG/TYPE _____ / _____	
36	☐ INTERCOOLER(S)	☐ SEPARATOR(S)	☐ AFTERCOOLER(S)	INTERCOOLERS:
37	☐ INTERSTAGE PIP.:	☐ PIPING MATCHMARKED	☐ SHOP FITTED	☐ MACHINE MOUNTED
38	☐ CONDENSATE SEPARATION & COLLECTION FACILITY SYSTEM			☐ OFF MOUNTED
39	☐ INLET STRAINER(S)	☐ INITIAL INLET	☐ SIDESTREAM INLET	☐ SPOOL PIECE FOR INLET STRAINERS
40	☐ MANIFOLD PIPING	☐ DRAINS ☐ VENTS	☐ RELIEF VALVES	☐ AIR/GAS SUPPLY
41	☐ RELIEF VALVE(S)	☐ INITIAL INLET	☐ INTERSTAGE	☐ FINAL DISCHARGE
42	☐ RUPTURE DISC(S)	☐ THRU STUDS IN PIPING FLANGES		
43	☐ CRANKCASE RAPID PRESSURE RELIEF DEVICE(S)			FLANGE FINISH:
44	☐ NO-RETURN VALVE FOR EACH DISCHARGE COMPRESSOR STAGE			☐ API STD 618:2007 - FLANGE FINISH
45	☐ SPECIAL PIPING REQUIREMENTS			☐ FLANGE FINISH PER ASME B16.5
46				☐ SPECIAL FINISH _____
47	☐ INITIAL INLET. ☐ INTERSTAGE SUCTION PIPING ARR'D FOR:			☐ INSULATION ☐ HEAT TRACING
48	☐ FOR ATMOSPHERIC INLET AIR COMPR. ONLY:			☐ INLET AIR FILTER ☐ INLET FILTER-SILENCER
49	☐ PREFERRED TYPE OF CYLINDER COOLING (NOTE 1)			☐ FORCED ☐ THERMOSYPHON _____ STAGE CYL(S)
50				☐ STATIC (STAND-PIPE) _____ STAGE CYL(S)
51				☐ CYL. COOLING WATER PIPING ☐ MATCHMARKED
52				☐ SINGLE INLET / OUTLET MANIFOLD & ALVES ☐ SIGHT GLASS(ES)
53				☐ INDIVIDUAL INLET / OUTLET PER CYL. ☐ VALVE(S)
54				☐ CLOSED SYS. WITH WATER PUMP, COOLER, SURGE TANK & PIPING
55				☐ SHOP RUN ☐ ARRANGED FOR HEATING JACKET AS WELL AS COOLING
56	NOTES:			
57				
58				
59				
60				

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	DATA SHEET		No.	REV.
	TITLE: RECIPROCATING COMPRESSOR SI UNIT			SHEET
				of

1	SCOPE OF BASIC SUPPLY (CONT.) (SEE NOTE 2)				
2	☐ SEPARATE COOLING CONSOLE:	☐ ONE FOR EA UNIT	☐ ONE COMMON TO ALL UNITS	☐ DUAL PUMPS (AUX. & MAIN)	
3		☐ ARRANGED FOR HEATING JACKET WATER AS WELL AS COOLING			
4	☐ FRAME LUBE OIL SYSTEM:	☐ AUX. PUMP	☐ DUAL FILTERS WITH TRANSFER VALVE	☐ SHOP RUN	
5		☐ CONTINUOUS FLOW IN SENSING LINE TO PRESSURE TRANSMITTERS			
6	☐ SEPARATE LUBE OIL CONSOLE:	☐ EXTENDED TO MOTOR OUTBOARD BEARING			☐ SHOP RUN
7	API STD 614 - APPLIES?	☒ YES		☐ NO	
8	☐ CAPACITY CONTROL	☐ SEE DATA SHEET PAGE _____	FOR DETAILS		☐ IN INSTRUMENT & CONTROL PANEL
9	☒ AUTOMATIC ☒ MANUAL	☐ SEPARATE MACHINE MOUNTED PANEL	☐ SEPARATE FREE STANDING PANEL		
10		☐ PNEUMATIC	☐ ELECTRIC	☐ ELECTRONIC	☐ HYDRAULIC
11		☐ PROGRAMMABLE CONTROLLER			
12	☐ INSTRUMENT & CONTROL PANEL	☐ ONE FOR EACH UNIT		☐ ONE COMMON TO ALL UNITS	
13		☐ MACHINE MOUNTED		☐ FREE STANDING (OFF UNIT)	
14					
15	☐ HEALTERS	☐ FRAME LUBE OIL	☐ CYL. LUBRICATORS	☐ COOLING WATER	☐ DRIVER(S) ☐ GEAR OIL
16		☐ ELECTRIC	☐ STEAM		
17	☐ BARRING DEVICE:	☐ MANUAL	☐ PNEUMATIC	☐ ELECTRIC	☐ FLYWHEEL LOCKING DEVICE
18	☐ ROD PRESSURE PACKING COOLING SYSTEM:	☐ SEPARATE CONSOLE		☐ FILTERS	
19	☐ SPECIAL CORROSION PROTECTION:	☒ YES	☐ NO	☐ MFR'S STANDARD	☐ OTHER _____
20	☐ HYDRAULIC TENSIONING TOOLS:	☒ YES	☐ NO		
21	☐ MECHANICAL RUN TEST:	☒ YES	☐ NO	☐ MFR'S STANDARD	☐ API STD 618 ☐ OTHER _____
22	☐ COMPLETE SHOP RUN A TEST OF ALL MACHINE MOUNTED EQUIPMENT, PIPING & APPURTENANCES				
23	PAINTING:	☐ MANUFACTURER'S STANDARD		☐ SPECIAL _____	
24	NAMEPLATES:	☐ U.S. CUSTOMARY UNITS		☐ SI UNITS	
25	SHIPMENT:	☐ DOMESTIC	☐ EXPORT	☐ EXPORT BOXING REQUIRED	
26		☐ STANDARD _____	MONTHS STORAGE PREPARATION, PER SPEC _____		
27		☐ OUTDOOR STORAGE FOR OVER _____		MONTH, PER SPEC _____	
28	☐ INITIAL INSTALLATION AND OPERATING TEMP ALIGNMENT CHECK JOBSITE BY VENDOR REPRESENTATIVE				
29	☐ COMPRESSOR MANUFACTURER'S USER'S LIST FOR SIMILAR SERVICE				
30	☐ PERFORMANCE DATA REQUIRED		☐ PERFORMANCE CURVES		
31			☐ BkW VS. SUCTION PRESSURE CURVES		
32			☐ ROD LOAD / GAS LOAD CHARTS		
33			☐ VALVE FAILURE DATA CHARTED		
34			☐ SPEDD / TORQUE CURVE DATA		
35	☐ BkW VC CAPACITY PERFORMANCE CURVES OR TABLES REQUIRED FOR UNLOADING STEPS AND/OR VARIABLE SUCTION / DISCHARGE PRESSURES				
36	APPLICABLE PURCHASER SPECS:	☒ YES	☐ NO		
37	APPLICABLE USER SPECS:	☒ YES	☐ NO		
38					
39	☐ CYLINDER LUBRICATOR				
40	☐ INSPECTIONS AND TESTS				
41	☐ SPECIAL TOOLS (IF EXISTING)				
42	☐ SPARE PARTS FOR 2 YEARS OPERATION, ERECTING, COMMISSIONING, TEST AND START UP				
43	☐ INSTRUCTION FOR ERECTION AND MAINTENANCE (SEE VENDOR DRAWING AND DATA REQUIREMENTS)				
44	☐ TORSIONAL VIBRATION ANALYSIS OF COMPLETE UNIT				
45	☐ SHOP TESTS				
46	☐ DESIGN AND COORDINATION OF COMPLETE ARRANGEMENT, INCLUDING DRIVER				
47	☐ COMMENT ON PURCHASER'S PIPING AND FOUNDATION DRAWINGS				
48	☐ TRAINING COURSE OG PETROBRAS STAFF				
49	☐ ERECTION AND START UP SUPERVISION INCLUDING INITIAL ALIGNMENT CHECK				
50	NOTES:				
51					
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	DATA SHEET				No. _____				REV. _____		
	RECIPROCATING COMPRESSOR SI UNIT								SHEET _____ of _____		
1 UTILITIES CONDITIONS											
2 ELECTRICAL POWER AC VOLTS PHASE HERTZ DC VOLTS AC VOLTS PHASE HERTZ DC VOLTS											
3 MAIN DRIVER _____ _____ _____ _____ INSTRUMENT _____ _____ _____ _____											
4 AUXILIARY MOTORS _____ _____ _____ _____ ALARM & SHUTDWN _____ _____ _____ _____											
5 HEATERS _____ _____ _____ _____ _____ _____ _____ _____ _____											
6 											
7 INSTRUMENT AIR: INLET TEMP _____ °C PRESSURE: NORMAL _____ kPa MAX/MIN _____ / _____ kPa											
8 DEW POINT _____ °C @ _____ kPa											
9 											
10 STEAM FOR: DRIVES HEATERS											
11 INLET PRESS _____ kPa MAX/MIN _____ / _____ kPa INLET PRESS _____ kPa MAX/MIN _____ / _____ kPa											
12 NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C											
13 EXHAUST PRESS _____ kPa MAX/MIN _____ / _____ kPa EXHAUST PRESS _____ kPa MAX/MIN _____ / _____ kPa											
14 NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C											
15 											
16 COOLING WATER FOR COMPRESSOR CYLINDERS COOLERS											
17 TYPE WATER _____ TYPE WATER _____											
18 SUPPLY PRESS _____ kPa MAX/MIN _____ / _____ kPa SUPPLY PRESS _____ kPa MAX/MIN _____ / _____ kPa											
19 NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C											
20 RETURN PRESS _____ kPa MAX/MIN _____ / _____ kPa RETURN PRESS _____ kPa MAX/MIN _____ / _____ kPa											
21 NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C NORMAL TEMP _____ °C MAX/MIN _____ / _____ °C											
22 											
23 COOLING FOR ROD PACKING											
24 TYPE FLUID _____ SUPPLY PRESS _____ kPa @ _____ °C RETURN _____ kPa @ _____ °C											
25 											
26 FLUED GAS NORMAL PRESSURE _____ kPa MAX/MIN _____ / _____ kPa LHV _____ MJ/m³											
27 COMPOSITION _____											
28 FLUED GAS NORMAL PRESSURE _____ kPa MAX/MIN _____ / _____ kPa LHV _____ MJ/m³											
29 COMPOSITION _____											
30 FLUED GAS NORMAL PRESSURE _____ kPa MAX/MIN _____ / _____ kPa LHV _____ MJ/m³											
31 COMPOSITION _____											
32 CYLINDER UNLOADING MEDIUM: ☐ AIR ☐ N₂ ☐ OTHER _____											
33 PRESSURE AVAILABLE FOR CYL. UNLOADERS DEVICES MAX _____ kPa											
34 NORM _____ kPa											
35 MIN _____ kPa											
36 											
37 NOTES:											