PETROBRAS	TECHNICAL SPECIFICATION	No. I-ET-3010.00-5134-323-P4X-001	
	CLIENT: -		SHEET: 1 OF 26
	PROGRAM: -		
	AREA: -		
	TITLE: INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS AND AIR DRYING UNITS		INTERNAL
			ESUP

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INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
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C	GENERAL REVISION. REVISED WHERE INDICATED.
D	MODIFICATIONS FROM REV. C WERE KEPT INDICATED. MODIFIED ITEMS 5.5.1, 5.5.2. ADDED ITEMS 5.1.13, 5.3.1, 8.3 AND 12.23.

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DATE	OUT/14/20	APR/08/21	SEP/05/22	JUN/14/24	JUL/22/24				
EXECUTION	UPF8	UPF8	UPF8	DVHD	HR7O				
CHECK	CXLB	U4T4	CXLB	HR7O	DVHD				
APPROVAL	CXM6	CXM6	CXM6	EGKA	CXM6				

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SUMMARY

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1. OBJECTIVE

1.1 This specification covers the minimum requirements for design, engineering, materials, fabrication, inspection, testing, pre-commissioning and commissioning of INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS.

1.2 The PACKAGE is composed by the units defined in INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET and this technical specification.

2. DEFINITIONS AND ABBREVIATIONS

2.1 DEFINITIONS

All terms and definitions are established in the latest revision of I-ET-3010.00-1200-940-P4X-002 – General Technical Terms.

2.2 ABBREVIATIONS:

CLASS - Classification Society

DAM - Data Acquisition Module

FAT - Factory Acceptance Test

HMI - Human Machine Interface

MMS - Machinery Monitoring System

MPS - Machinery Protection System

NDT - Non-Destructive Tests

PPF - Pocket Passing Frequency

UCP - Unit Control Panel

3. NORMATIVE REFERENCES

All INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS shall comply with the requirements of this technical specification, data sheets, documents, codes and standards as stated below.

3.1 CLASSIFICATION

PACKAGER/MANUFACTURER shall perform the work in accordance with the requirements of Classification Society. PACKAGER/MANUFACTURER is responsible for submitting to the Classification Society all documentation in compliance with stated Rules.

3.2 APPLICABLE CODES, STANDARDS AND GOVERNMENTAL REGULATIONS

3.2.1. The following codes and standards shall be fully complied with:

AISC

AISC 335-89 Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design

API

API-RP-2A Planning, Designing, And Constructing Fixed Offshore Platforms - Working Stress Design

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API 619	Rotary-type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries
API 677	General-Purpose Gear Units for Petroleum, Chemical and Gas Industry Services

ASME

ASME BPVC Section VIII Div. 1	Rules for Construction of Pressure Vessels
ASME BPVC Sec IX	Welding and Brazing Qualifications
ASME B31.3	Process Piping
ASME B16.5	Pipe Flanges and Flanged Fittings

AWS

AWS D1.1	Structural Welding Code – Steel

IEC

IEC 60034	Rotating Electrical Machines
IEC 60584	Thermocouples
IEC 60751	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors
IEC 61892	Mobile and Fixed Offshore Units – Electrical Installations – All parts
IEC 60092-502	Electrical Installation in Ships – Tankers – Special Features
IEC 61641	Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault

ISO

ISO 1217	Displacement compressors – Acceptance tests
ISO 8573	Compressed Air: Part 1 Contaminants and Purity Classes
ISO 14691	Petroleum, petrochemical and natural gas industries - Flexible couplings for mechanical power transmission - General-purpose applications

IOGP

IOGP S-613	Specification for Air Dryer Packages
IOGP S-613Q	Quality Requirements for Air Dryer Packages

TEMA

TEMA	Standards of the Tubular Exchanger Manufacturers Association

3.2.2. All annexes of API 619 are mandatory, with the exception of typical mounting plate arrangement annex, which shall be kept as a reference (informative).

3.2.3. The following codes and standards shall be complied whenever explicitly mentioned in the text:

ENERGY INSTITUTE

Energy Institute	Guidelines for the Avoidance of Vibration Induced Fatigue Failure In Process Pipework

3.3 BRAZILIAN REGULATIONS

NR 10	Segurança em Instalações e Serviços em Eletricidade (Safety in Electrical Facilities and Services)
NR-12	Segurança no Trabalho em Máquinas e Equipamentos (Safety on Labour in Machines and Equipment).
NR 13	Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento (Boilers, Pressure Vessels, Piping and Metallic Storage Tanks)
NR 26	Sinalização de Segurança (Safety Signaling)
NR 37	Segurança e Saúde em Plataformas de Petróleo (Safety and Health in Petroleum Platforms)

3.3.1. Brazilian Government regulations are mandatory and shall prevail over the requirements of this specification and other references herein.

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3.3.2. PACKAGER/MANUFACTURER shall comply with any other government regulations stated in the Contract and not listed above.

3.4 APPLICABLE DOCUMENTS

The following design documents shall be fully complied with:

3.4.1. TYPICAL DOCUMENTS

General

I-ET-3000.00-0000-940-P4X-002	Symbols for Production Units Design
I-ET-3000.00-1200-940-P4X-001	Tagging Procedure for Production Units Design
I-ET-3010.00-1200-940-P4X-002	General Technical Terms
I-ET-3010.00-1350-940-P4X-001	Systems Operation Philosophy
I-ET-3010.00-5400-947-P4X-002	Safety Signalling

Mechanical

I-ET-3010.00-1200-200-P4X-115	Requirements for Piping Fabrication Assembly and Commissioning
I-ET-3010.00-1200-251-P4X-001	Requirements for Bolting Material
I-ET-3010.00-1200-300-P4X-001	Noise and Vibration Control Requirements
I-ET-3010.00-1200-431-P4X-001	Thermal Insulation for Maritime Installations
I-ET-3010.00-1200-955-P4X-001	Welding
I-ET-3010.00-1200-956-P4X-002	General Painting
I-ET-3010.00-1200-956-P4X-001	Qualification Tests for Paint Systems
I-ET-3010.00-1200-540-P4X-001	Requirements for Pressure Vessels Design and Fabrication
DR-ENGP-I-1.15	Color Coding

Electrical

I-DE-3010.00-5140-700-P4X-003	Grounding Installation Typical Details
I-DE-3010.00-5140-797-P4X-001	Electrical System Automation Architecture Diagram
I-DE-3010.00-5140-797-P4X-002	Electrical System Automation Typical Actuation Diagrams
I-ET-3010.00-5140-700-P4X-001	Specification for Electrical Design for Offshore Units
I-ET-3010.00-5140-700-P4X-002	Specification for Electrical Material for Offshore Units
I-ET-3010.00-5140-700-P4X-003	Electrical Requirements for Packages for Offshore Units
I-ET-3010.00-5140-700-P4X-005	Requirements for Human Engineering Design for Electrical Systems of Offshore Units
I-ET-3010.00-5140-700-P4X-007	Specification for Generic Electrical Equipment for Offshore Units
I-ET-3010.00-5140-700-P4X-009	General Requirements for Electrical Material and Equipment for Offshore Units
I-ET-3010.00-5140-741-P4X-004	Specification for Low-Voltage Generic Electrical Panels for Offshore Units
I-ET-3010.00-5140-712-P4X-001	Low-Voltage Induction Motors for Offshore Units
I-ET-3010.00-5140-741-P4X-001	Low-Voltage Motor Control Center and Switchgear for Offshore Units
I-ET-3010.00-5140-772-P4X-002	Specification for Low-Voltage Frequency Converters, Softstarters and Inverters for Offshore Units
I-ET-3010.00-5140-797-P4X-001	Electrical System Automation Architecture
I-LI-3010.00-5140-700-P4X-001	Electrical Equipment Data-Sheet Models
I-LI-3010.00-5140-797-P4X-001	Electrical System Automation Interface Signals List

Instrumentation and Automation

I-ET-3010.00-1200-800-P4X-002	Automation, Control and Instrumentation on Package Units
I-ET-3010.00-5500-854-P4X-001	Machinery Monitoring System (MMS)
I-ET-3010.00-5520-888-P4X-001	Automation Panels

Naval

I-ET-3010.00-1350-960-P4X-001	Design Requirements – Naval Architecture

3.4.2. SPECIFIC PROJECT DOCUMENTS

This section specifies documents that are referenced along the text and are part of a specific project. For that reason, the document's identification number is not yet defined and may vary according to project. The document title may also vary slightly from one project to another. Project's DOCUMENT LIST shall be consulted in order to verify the correct document number and title.

General

GENERAL ARRANGEMENT
AREA CLASSIFICATION – GENERAL
METOCEAN DATA

Mechanical

PIPING SPECIFICATION FOR TOPSIDE
HULL/ACCOMMODATION MECHANICAL HANDLING PROCEDURES
MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN
TOPSIDES STRUCTURAL REQUIREMENTS

Process

INSTRUMENT/SERVICE AIR COMPRESSION UNIT (Datasheet)
INSTRUMENT/SERVICE AIR SYSTEM (P&ID)
GENERAL SPECIFICATION FOR AVAILABLE UTILITIES

Instrumentation and Automation

AUTOMATION INTERFACE OF PACKAGE UNITS

Naval

MOTION ANALYSIS

3.5 CONFLICTING REQUIREMENTS

SUPPLIER shall present in writing any conflict between the requirements of this specification and related codes and standards, specification, etc. for PETROBRAS's resolution prior to manufacturing.

4. DESIGN AND GENERAL REQUIREMENTS

4.1 DESIGN LIFE

4.1.1. MANUFACTURER/PACKAGER shall design the equipment for a 30-year life in a corrosive offshore environment without the need for replacement of any major component due to wear, corrosion, fatigue, or material failure.

4.1.1.1. MANUFACTURER/PACKAGER shall present an obsolescence management plan for any component or auxiliary equipment with a life cycle lower than 30 years.

4.1.1.2. PACKAGER shall present a qualification report for all sub-suppliers and shall indicate all quality criteria considered in the evaluation. Qualification criteria model shall be approved by PETROBRAS.

4.1.1.2.1. PACKAGER shall use only fully quality compliant sub-suppliers.

4.1.2. All equipment and components shall be manufactured up to two years before the delivery date at most.

4.2 DESIGN CONDITIONS

4.2.1. PACKAGER/MANUFACTURER shall design the equipment for the full range of operational conditions as specified in the INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET and INSTRUMENT / SERVICE AIR SYSTEM P&ID.

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4.2.2. Quantity and tag of INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNIT and AIR DRYING UNIT defined as “Essential Equipment”, according to CLASS and IMO MODU CODE requirements, are set forth in INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET.

4.2.3. MANUFACTURER/PACKAGER shall design all components and parts to have infinite life fatigue under dynamic effects caused by the internal flow and by ship motion and under corrosive offshore environment.

4.2.3.1. MANUFACTURER/PACKAGER shall present a report demonstrating structural robustness against fatigue. Special attention shall be given to welded connections.

4.2.3.2. The report shall demonstrate that all natural frequencies that may be excited by the internal pressure pulsations are 20% above or 20% below the compressors’ Pocket Passing Frequencies (PPF).

4.3 EQUIPMENT LOCATION

The INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNIT shall be installed on the location defined in GENERAL ARRANGEMENT drawing of the UNIT.

4.4 SAFETY REQUIREMENTS

4.4.1. PACKAGER/MANUFACTURER shall provide personnel safety protection according to Regulatory Standards (NR).

4.4.2. PACKAGER/MANUFACTURER shall provide warning signs in Brazilian Portuguese language where risk of personnel injury exists.

4.4.3. Rotating equipment outer parts, such as pulleys, couplings, belts and flywheels, shall have rigid protection and shall be capable of being easily removed, with uncongested access.

4.4.4. Safety signalling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 Safety Signalling Specification.

4.4.5. For area classification, refer to the drawing AREA CLASSIFICATION – GENERAL.

4.5 NOISE AND VIBRATIONS

4.5.1. Noise and vibration control concerning human exposure shall be performed according to I-ET-3010.00-1200-300-P4X-001 – Noise and Vibration Control Requirements.

4.5.2. Maximum acceptable sound level shall be 90 dB in 1 meter from the unit and 2 meters from ground.

4.6 ENVIRONMENTAL CONDITIONS

MANUFACTURER/PACKAGER shall design and supply the equipment suitable for the environment and range of ambient conditions defined in the document METOCEAN DATA [document supplied by PETROBRAS] and also the range of ambient conditions at the construction yard.

4.7 MOTIONS AND ACCELERATION

4.7.1. PACKAGE shall be able to withstand and operate in accordance with I-ET-3010.00-1350-960-P4X-001 - Design Requirements – Naval Architecture.

4.7.2. PACKAGER/MANUFACTURER shall design the PACKAGE in accordance with the motion requirements in the Report – MOTION ANALYSIS [document supplied by PETROBRAS].

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4.7.3. MANUFACTURER/PACKAGER shall design the equipment to withstand inertial forces during transportation from construction site to operation site (onshore or offshore).

4.7.4. For the Hull loading conditions details and the maximum designed operational trim and heel inclinations refer to I-ET-3010.00-1350-960-P4X-001 - DESIGN REQUIREMENTS - NAVAL ARCHITECTURE.

5. PACKAGE SPECIFICATION

5.1 GENERAL

5.1.1. Routine maintenance and removal of components and subassemblies requiring periodic replacement or overhaul shall be achieved without dismantling adjacent equipment.

5.1.2. PACKAGER shall design the package in such a way that the operator can have unobstructed access to the parts for routine maintenance.

5.1.3. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS process is described in the INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET and INSTRUMENT / SERVICE AIR SYSTEM P&ID.

5.1.4. The utility requirements and consumption of the equipment shall be clearly defined by PACKAGER in the technical proposal and detailed design. The consumption of utilities shall comply with the requirements of GENERAL SPECIFICATION FOR AVAILABLE UTILITIES.

5.1.5. The PACKAGE, including all auxiliary equipment, shall be assembled, aligned and pre-checked in PACKAGER's shop, allowing shipment to the shipyard with minimal fieldwork.

5.1.6. The PACKAGE shall be manufactured, inspected, and verified to comply with all specifications mentioned in NORMATIVE REFERENCES section and the Classification Society regulations.

5.1.7. For foreign made equipment, MANUFACTURER/PACKAGER shall purchase the standard manufacturing parts (couplings, mechanical type seals, bearings) from MANUFACTURERS with representative branches located in Brazil, with service parts and maintenance workshops.

5.1.8. Thermal insulation for personnel protection shall be according to I-ET-3010.00-1200-431-P4X-001 - Thermal Insulation for Maritime Installations.

5.1.9. PACKAGER/MANUFACTURER shall use the international system units (SI units) for all intents and purposes.

5.1.10. PACKAGER shall supply and mount all drivers.

5.1.11. PACKAGER shall include in the scope of supply a power panel for each Air Compressor Unit. Refer to section 5.8 for Electrical Requirements.

5.1.12. PACKAGER shall carry out a train Torsional Analysis in accordance with API 619.

5.1.12.1. A full Torsional Analysis Report shall be provided including the data in sufficient detail to allow independent audit of the results.

5.1.13. Intercooler and Aftercooler heat exchangers shall be of the water-cooled shell and tube type with air on the tube side.

5.2 AIR COMPRESSOR

5.2.1. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR shall be oil free rotary screw type, driven by electric motors with variable speed driver – frequency converter.

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5.2.2. The INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR shall be provided with a load control system using VSD, in accordance with INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET and INSTRUMENT / SERVICE AIR SYSTEM P&ID.

5.2.3. The compressor performance shall comply with the INSTRUMENT/SERVICE AIR COMPRESSION UNIT datasheet.

5.2.4. Each compressor, including intercooler, aftercooler, filters, liquid separator, auxiliaries and controls shall be built on a baseplate, in a noise reducing enclosure.

5.2.5. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR shall comply with the requirements of API 619.

5.2.6. Shaft sleeves shall be provided under all shaft sealing areas.

5.2.7. Major parts of rotating elements shall be dynamically balanced, individually to ISO 1940-1:2003, grade G2,5 or better. Each rotor shall be dynamically balanced in an assembled condition.

5.2.8. Rotors shall be designed with the first lateral critical speed at least 20 percent above the maximum operating speed.

5.2.9. Bearings shall be of rolling element type, which can be either a ball or roller bearing.

5.2.10. Timing gears shall be of the helical type. The rating shall be based on the electric motor nameplate power rating.

5.2.11. Couplings of compressor drive train (compressor, motor and gearbox) shall be non-lubricated and designed to reduce torque peaks.

5.2.12. Coupling guards shall be manufactured from a non-sparking material.

5.2.13. Cooling System

5.2.13.1. Air compressors shall be fresh water cooled.

5.2.13.2. Machine mounted coolers are not acceptable.

5.2.13.3. Coolers' tube nominal diameter shall not be less than 5/8".

5.2.14. The air intake filter shall be designed for 110% of the rated air flow.

5.2.15. PACKAGER shall design filter for no less than 6-month continuous campaign without failures or maintenance intervention due to saturated condition.

5.2.16. PACKAGER shall install and supply a differential-pressure-indicating transmitter for each filter.

5.2.17. Threaded connections shall not be used on equipment casing.

5.2.18. PACKAGER shall design forced lubricating oil system to guarantee continuous and proper lubrication under all critical scenarios imposed by ship motion and environment.

5.2.18.1. Dual oil coolers and dual oil filters shall be supplied in SS 316L.

5.2.18.2. The changeover between redundant components in the lube oil system (e.g. twin coolers and twin filters) shall be possible to be performed during the operation of the package.

5.2.18.3. Main and auxiliary lube oil pumps shall be supplied.

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5.2.18.3.1. For variable speed compressors, main lube oil pump shall be electric motor driven. For fixed speed compressors, main lube oil pump shall be shaft driven.

5.2.18.3.2. Auxiliary lube oil pump shall be electric motor driven.

5.2.18.4. PACKAGER shall install and supply level transmitter on the oil reservoir. PACKAGER shall design the level monitoring philosophy considering ship movement to avoid false alarm.

5.2.18.5. An oil bypass line around the oil cooler with a temperature-control valve shall be included to regulate the oil-supply temperature.

5.2.19. Gearboxes shall conform to the requirements of API 677.

5.3 AIR DRYER

5.3.1. The AIR DRYING UNIT shall comply with the requirements of IOGP S-613, IOGP S-613Q and those defined in this Technical Specification.

5.3.2. The AIR DRYING UNIT shall be of self-regenerating adsorption type and drying element shall be activated alumina.

5.3.2.1. The AIR DRYING UNIT shall be able to regenerate with the outlet dry air in case of blower failure.

5.3.3. Air shall be delivered with proper dew point in accordance with the INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET.

5.3.4. MANUFACTURER shall inform the necessary air flow rate to activate alumina bed regeneration.

5.3.5. The operation period of each AIR DRYER shall be at least 4 hours (as a minimum).

5.3.6. The operational sequence of the AIR DRYERS shall be performed by humidity set control fitted at outlet of the unit.

5.3.7. AIR DRYING UNIT PRE-FILTERs and AIR DRYING UNIT AFTER-FILTERs shall be installed inside AIR DRYING UNIT baseplates.

5.3.8. AIR DRYER, AIR DRYING UNIT PRE-FILTER and AIR DRYING UNIT AFTER-FILTER shall be considered as pressure vessels.

5.3.9. If operation of the AIR DRYING UNIT is interrupted, unit's implemented logic shall guarantee that the necessary time for the air dryer vessel in regeneration cycle has been achieved.

5.3.9.1. Unit's implemented logic shall also allow the switch of the air dryer vessel from regeneration to adsorption (drying) cycle only after the temperature of the air dryer vessel in regeneration is reduced to a maximum value.

5.3.9.2. Maximum temperature of the air dryer vessel after regeneration cycle shall be defined by PACKAGER/MANUFACTURER and informed in the datasheet.

5.3.9.3. Operation sequence of AIR DRYING UNIT shall not be exclusively based on time counting. Depressurization, equalization and tower switch shall only begin or end when the required pressure levels are reached.

5.4 PIPING

5.4.1. All piping shall be designed, fabricated, and inspected in accordance with ASME B31.3 and PIPING SPECIFICATION FOR TOPSIDE.

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5.4.2. Tubing nominal diameter shall not be less than ½".

5.4.3. Threaded connections shall not be used.

5.4.4. All connections shall be located at baseplate edge and provided with flanged connections, according to ASME B16.5 and PIPING SPECIFICATION FOR TOPSIDE. Locations, size and rating of all connections shall be clearly defined by PACKAGER/MANUFACTURER.

5.4.5. All auxiliary piping shall terminate with block valves at the edge of the baseplate and shall be designed to allow easy disconnection of pipework. Drains and vents shall be flanged with valves.

5.4.6. After completion of fabrication, all fabricated pipe spools shall be internally and externally cleaned to remove all loose scale, weld spatter, sand, and other foreign materials.

5.4.7. PACKAGER shall design air piping with adequate supports to prevent undue loads on compressor flanges, including transient loads such as blowoff.

5.4.8. PACKAGER shall check and approve all piping with respect to stresses, vibration and layout. Piping support shall be provided at baseplate edge.

5.4.9. Spectacle blinds shall be supplied and assembled for maintenance and testing.

5.4.10. Blow-off valve outlets shall be routed outside the PACKAGE hood.

5.4.11. PACKAGER shall design piping gaskets to have the same inner diameter as the corresponding pipe. Gaskets shall be resistant and shall not fragment during normal operation or during transients.

5.4.12. Vibration damping devices may be installed to reduce vibration transmission within the package.

5.4.13. Auxiliary piping connections furnished on the purchased equipment shall be impression stamped or permanently tagged to agree with the vendors connection table or general arrangement drawing. Service and connection designations shall be indicated.

5.5 MATERIAL SELECTION AND CERTIFICATION

5.5.1. Air piping and tubing material shall be SS 316/316L. If PACKAGER requires the use of other material selection for air piping, the alternative selection shall be subject to PETROBRAS approval.

5.5.2. Intercooler and aftercooler heat exchanger tube bundle (tubes, tubesheet and baffles) material shall be SS 316L. Shells shall be carbon steel or cast iron, painted on the inside with a suitable coating for corrosion protection.

5.5.3. For auxiliary equipment and other equipment components, the SELLER shall be responsible for the materials selection considering the philosophy detailed at MATERIAL SELECTION PHILOSOPHY FOR DETAILED DESIGN, and the operational condition and process data stated at INSTRUMENT/SERVICE AIR COMPRESSION UNIT data sheet.

5.5.4. In all cases, SELLER shall submit the detailed material selection report, including all piping, equipment and their components, for PETROBRAS approval prior to manufacturing activities.

5.5.5. SELLER shall be responsible for obtaining all necessary certification of the equipment, work and materials.

5.5.6. SELLER, through the independent certifying authority, shall supply all certificates related to the materials, inspections, tests and qualification activities detailed in the approved Quality Plan.

5.5.7. Dissimilar materials shall be isolated to avoid galvanic corrosion.

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5.5.8. Moisture separators shall be of SS 316L when not integrated to cooler shell. PACKAGER shall subject all welds to NDT.

5.6 PRESSURE VESSELS (DESIGN AND FABRICATION)

5.6.1. Pressure vessels shall comply with I-ET-3010.00-1200-540-P4X-001 - Requirements for Pressure Vessels Design and Fabrication.

5.6.2. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNIT INTERCOOLER and INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNIT AFTERCOOLER shall follow TEMA standard and shall be considered as pressure vessels.

5.6.3. Threaded connections shall not be used in pressure parts.

5.6.4. PACKAGER shall design the moisture separator to withstand pulsation and other dynamic effects of the flow, such as inducted vibration. PACKAGER shall present a structural report including fatigue life analysis of the welds.

5.7 INSTRUMENTATION AND CONTROL

5.7.1. General

5.7.1.1. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS PACKAGE are classified according to the specification for AUTOMATION INTERFACE OF PACKAGE UNITS.

5.7.1.2. The PACKAGE automation, control and instrumentation shall fully comply with I-ET-3010.00-1200-800-P4X-002 – Automation, Control and Instrumentation Package Units, I-ET-3010.00-1350-940-P4X-001 – Systems Operation Philosophy and AUTOMATION INTERFACE OF PACKAGE UNITS.

5.7.1.3. All sensors shall be suitable for prevailing temperatures. When applicable, field amplifiers, transducers, etc., shall be installed as per PACKAGER/MANUFACTURER practices, according to the area classification and to protect them against mechanical damage.

5.7.1.4. For control panel specification, refer to the requirements in I-ET-3010.00-5520-888-P4X-001 - Automation Panels.

5.7.1.5. PACKAGE unit equipment will be provided with PACKAGER/MANUFACTURER's control system and safeguarding incorporated.

5.7.1.6. PACKAGER/MANUFACTURER shall assume total responsibility for the instrumentation, design, engineering, operational philosophy, and the PLC based control and safeguarding systems. These are part of PACKAGER/MANUFACTURER's scope, unless specified otherwise.

5.7.1.7. The INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS shall be provided with all necessary instruments, instrumented valves, equipment and accessories (such as, but not limited to, thermowells, tubing, connections, cables, etc.) to operate safely, adequately and without interruption in a tropical marine environment.

5.7.1.8. PACKAGER shall not use discrete, direct mounted, field switches for alarm and instrumented protective functions (IPFs). A signal transmitter/transducer and/or trip amplifier shall always be used.

5.7.1.9. PACKAGER shall install and supply PT-100 RTD IEC 60751 compliant for temperature monitoring. Wherever temperature is expected to exceed 500°C, thermocouple IEC 60584 compliant shall be used.

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5.7.1.10. Thermowells shall be of ¾".

5.7.1.11. Thermostat shall not be used for temperature control.

5.7.2. Automation, Control and Instrumentation System Cabling

5.7.2.1. All wiring within the limits of the enclosure shall be clearly marked on the wire and at the terminal.

5.7.2.2. All cabling between the driver and the local gauge board shall be furnished. All cables and cable routes shall contain at least 20% of the extra capacity.

5.7.3. Alarms and Shutdown

5.7.3.1. The minimum alarm and shutdown functions shall be as required on the INSTRUMENT / SERVICE AIR SYSTEM P&ID and matrix of cause and effect.

5.7.3.2. For packages with Direct Online (DOL) startup method, the control system shall provide warning to the operator that a hot-start condition exists for the motor driver after it is shut down and an adequate cool-down time period has not occurred for restart of the driver.

5.7.4. Monitoring Requirements

5.7.4.1. The equipment that shall be monitored and the monitoring requirements shall be according to I-ET-3010.00-5500-854-P4X-001 – Machinery Monitoring System (MMS).

5.7.4.2. Monitoring sensors for motors shall be in accordance with I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units.

5.7.4.3. All equipment sensors shall be compatible with MPS/DAM, as described in I-ET-3010.00-5500-854-P4X-001 - Machinery Monitoring System (MMS).

5.7.4.4. Equipment shall be supplied with all sensors necessary for monitoring installed, configured, and connected to junction box.

5.7.4.5. Bearing housing surfaces shall be prepared for accelerometer installation.

5.7.4.6. One radial accelerometer shall be installed for each bearing housing.

5.7.4.7. MANUFACTURER/PACKAGER shall supply and install proximity probes on thrust bearings for axial position monitoring. Two proximity probes shall be installed for each thrust bearing.

5.7.4.8. PACKAGER/MANUFACTURER shall supply and install one phase reference transducer for each different shaft speed.

5.7.4.9. PACKAGER shall supply and install level transmitters on each moisture separator.

5.7.4.10. A high frequency accelerometer shall be supplied, installed and calibrated in accordance with API Std 670 on the machined surface of the gear casing.

5.7.4.11. A temperature transmitter shall be provided on each inlet of cooling water in the PACKAGE. Temperature values shall be shown on the panel, with alarm indication in case the maximum temperature defined in GENERAL SPECIFICATION FOR AVAILABLE UTILITIES is reached.

5.7.4.12. The vibration signals (including displacement and accelerometers) of the whole train shall have an unfiltered output at the UCP (one per channel) for recording and maintenance purposes.

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5.8 ELECTRICAL REQUIREMENTS

5.8.1. Electrical equipment shall be manufactured and tested in compliance with Classification Society and IEC requirements, unless otherwise stated.

5.8.2. Air-drying Equipment and auxiliaries shall not be fed by a PACKAGE electrical power panel. Refer to I-ET-3010.00-5140-700-P4X-003 - Electrical Requirements for Packages for Offshore Units for details.

5.8.3. Electronic type frequency converter devices shall be provided for motors with rated power above 110 kW.

5.8.4. Frequency converter shall be installed inside the PACKAGE electric power panel.

5.8.5. Electrical power panel shall have internal arc fault monitoring devices with instantaneous trip sent to upstream panel and shall be certified for internal arc, according to IEC 61641 to at least Arcing Class A (personnel protection, complying with criteria 1 to 5).

5.8.6. The frequency converter shall allow the soft starting of electric motor and shall also control the compressor capacity through modulation. The electric motor shall have appropriate isolation grade e cooling method to withstand capacity control by speed variation.

5.8.7. All electrical equipment and design shall fully comply with documents:

- I-ET-3010.00-5140-700-P4X-002 - Specification for Electrical Material for Offshore Units;
- I-ET-3010.00-5140-700-P4X-007 - Specification for Generic Electrical Equipment for Offshore Units;
- I-ET-3010.00-5140-700-P4X-009 – General Requirements for Electrical Material and Equipment for Offshore Units;
- I-ET-3010.00-5140-741-P4X-001 – Low-Voltage Motor Control Center and Switchgear for Offshore Units;
- I-ET-3010.00-5140-700-P4X-003 - Electrical Requirements for Packages for Offshore Units.

5.8.8. Electrical installations and PACKAGE electrical interfaces shall comply with requirements of documents:

- I-ET-3010.00-5140-700-P4X-001 - Specification for Electrical Design for Offshore Units;
- I-ET-3010.00-5140-700-P4X-003 - Electrical Requirements for Packages for Offshore Units;
- I-ET-3010.00-5140-700-P4X-005 - Requirements for Human Engineering Design for Electrical Systems of Offshore Units;
- I-LI-3010.00-5140-797-P4X-001 - Electrical System Automation Interface Signals List;
- I-DE-3010.00-5140-797-P4X-001 - Electrical System Automation Architecture Diagram;
- I-ET-3010.00-5140-797-P4X-001 - Electrical System Automation Architecture;
- I-DE-3010.00-5140-797-P4X-002 - Electrical System Automation Typical Actuation Diagrams.

5.8.9. Low-voltage frequency converters shall comply with I-ET-3010.00-5140-772-P4X-002 - Specification for Low-Voltage Frequency Converters, Softstarters and Inverters For offshore Units.

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5.8.10. Low-voltage motors shall comply with requirements of I-ET-3010.00-5140-712-P4X-001 - Low-Voltage Induction Motors for Offshore Units.

5.8.11. Electrical panel shall comply with requirements of I-ET-3010.00-5140-741-P4X-004 - Specification for Low-Voltage Generic Electrical Panels for Offshore Units, being acceptable fixed (not withdrawable) functional units.

5.8.11.1. The withstand arc current value shall be defined by Detailed Design. The arc withstand time shall be at least 300ms.

5.8.12. SUPPLIER shall issue datasheets for electrical equipment, according to templates of I-LI-3010.00-5140-700-P4X-001 - Electrical Equipment Data-Sheet Models.

5.8.13. All materials and equipment proper to be used in hazardous areas, shall have conformity certificates complying with INMETRO Portaria n° 115, March 21st, 2022 and shall be approved by Classification Society.

5.8.13.1. Electrical equipment installed in external safe areas, that shall be kept operating during emergency shutdown ESD-3P or ESD-3T shall be certified for installation in hazardous areas Zone 2 (EPL Gc) Group IIA temperature T3, unless they are automatically disconnected if there is gas in the equipment area, according to IEC 61892-1.

5.8.14. All equipment and materials shall be suitable for service on marine and petrochemical environments, and able to withstand the severe tropical, damp and saline atmospheric local conditions.

5.8.15. PACKAGER/MANUFACTURER shall inform all the PACKAGE loads for purpose of external design.

5.8.16. If the requirements are not applied to the proposed system, PACKAGER/MANUFACTURER shall indicate the deviations and explain them.

5.8.17. Grounding installations inside the PACKAGE shall comply with requirements of I-ET-3010.00-5140-700-P4X-001 – Specification for Electrical Design for Offshore Units and I-DE-3010.00-5140-700-P4X-003 – Grounding Installations Typical Details.

5.9 MAINTENANCE HANDLING

5.9.1. PACKAGER/MANUFACTURER and SUPPLIER shall follow the requirements for maintenance handling on HULL/ACCOMMODATION MECHANICAL HANDLING PROCEDURES.

5.9.2. PACKAGER/MANUFACTURER shall supply spreader bars and specific handling devices for maintenance with the applicable certificates.

5.9.3. Lifting facilities shall permit the equipment to be lifted by crane as a single point lift for transportation and installation.

5.9.3.1. The design and manufacture of the lifting lugs shall be certified.

5.9.3.2. PACKAGER shall arrange equipment, piping and superstructure in such a way that the center of gravity coincides approximately with the geometrical center of the baseplate.

5.10 BASEPLATE / SUPPORT STRUCTURE

5.10.1. The baseplate shall be designed to accommodate the entire equipment within the scope of supply, with the possible exceptions mentioned on item 5.11 - LAYOUT.

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5.10.1.1. The baseplate shall not distort during lifting, operation and shipment and shall withstand the imposed loads due to the vessel motion. Deflection in any part of the baseplate shall not exceed L/400 (L stands for total length of the baseplate) and stress values shall secure margin from the structural limits and consider dynamic effects during handling.

5.10.2. SUPPLIER shall design and detail all structural components, including calculation report and detailing drawings. SUPPLIER shall fabricate and assemble the support structures in accordance with TOPSIDES STRUCTURAL REQUIREMENTS.

5.10.3. PACKAGER shall design baseplate for 3-point or multipoint support.

5.10.4. PACKAGER shall design baseplate and supports in such a way that crevice corrosion is avoided.

5.10.5. PACKAGER/MANUFACTURER shall design lifting pad eyes in accordance with project TOPSIDES STRUCTURAL REQUIREMENTS or Classification Society or Marine Warranty Surveyor Rules, where the most restrictive requirements shall prevail.

5.10.5.1. PACKAGER/MANUFACTURER shall furnish any slings, spreaders bars, etc. with applicable certificates.

5.10.6. The baseplate shall resist all sling forces, including both horizontal and vertical components of the applied sling angle (sling angles shall be within between 50 and 90 degrees with the horizontal plane).

5.10.7. The baseplate shall be of the MANUFACTURER's standard design, complete with a drip pan and drain connections.

5.10.7.1. One 1½" NPT minimum or flanged drain connection shall be provided at the short side of the baseplate where liquid accumulates.

5.10.7.2. Draining points shall be installed on the lowest point of the drip pan according to the operational trim of the UNIT.

5.10.8. The baseplate shall be welded to the supporting structures.

5.10.8.1. The floor shall be made of stiffened plate material with a raised on-slip tread.

5.10.8.2. Welds underneath baseplate beams shall be ground flush.

5.10.8.3. Baseplate shall have 2 diagonally opposed earthing bars.

5.10.9. Welding shall be carried out with procedures and operators qualified in accordance with the ASME BPVC section IX.

5.10.9.1. Welding shall not be performed before qualified welding procedures have been approved.

5.10.9.2. Intermittent fillet welds shall not be permitted.

5.11 LAYOUT

5.11.1. Package layout and arrangement shall be designed to provide sufficient access for ease of operability and maintenance, and to maximize safety. PACKAGER shall be responsible to ensure that the layout of all equipment and components are conducive to efficient and safe operation.

5.11.2. Packages shall be designed and fabricated such that all equipment and components are located entirely within the baseplate perimeter, including all equipment, piping, valves, electrical, UCP (including HMI), instrumentation and controls. The projection of such items beyond the perimeter of the baseplate shall be strictly prohibited, unless approved in writing by PETROBRAS.

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5.11.3. Instrument rack shall be outside the hood but inside baseplate area.

Note: This configuration avoids overheat of the instrumentation due to proximity to heat generating components.

5.11.4. Moisture accumulation points between compression stages shall be in a lower level than the corresponding stages to prevent condensate entering the compressor.

5.11.5. VSDs and INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR POWER PANELS shall not be installed on the PACKAGE installation location. PACKAGER/MANUFACTURER shall refer to the GENERAL ARRANGEMENT of the UNIT.

5.11.6. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNITS and AIR DRYING UNITS shall be fully operable in their installation location, defined on section 4.3 - EQUIPMENT LOCATION.

5.12 PAINTING

5.12.1. Painting and coating shall be in accordance with I-ET-3010.00-1200-956-P4X-002 – General Painting and DR-ENGP-I-1.15 – Color Coding.

5.12.2. All components shall be delivered fully painted/coated, except on the machined surfaces for alignment shims, which shall be protected with a coating against corrosion.

5.12.3. The performed pre-treatment and complete coating shall be in accordance with the paint MANUFACTURER's data sheets.

6. NAMEPLATES

6.1 The INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNIT and AIR DRYING UNIT equipment shall have nameplates in Brazilian Portuguese language, made of stainless steel AISI 316L, with 3 mm minimum thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location. Nameplates shall include at least the following information:

- Petróleo Brasileiro S.A. – PETROBRAS;
- Purchase order number;
- PACKAGER/MANUFACTURER's name;
- Year of build;
- Serial number;
- Main data for design, operation and testing (Power, Discharge Pressure, Discharge Temperature, Rotation, Flow rate in normal reference);
- Maximum Allowable Working Pressure of the casing;
- Module and UNIT identification;
- Driver power rating and speed;
- Maximum continuous speed;
- Equipment TAG;
- Empty Weight;
- Design Code;
- Service.

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6.2 For pressure vessels (filters, heat exchangers, moisture separators, among others, as per ASME BPVC Sec VIII definition) the nameplates shall be according to I-ET-3010.00-1200-540-P4X-001 – Requirements for Pressure Vessels Design and Fabrication.

6.3 Valves, instruments and orifices shall have a nameplate with tag number and serial number.

6.4 Auxiliary equipment shall have nameplates in accordance with respective technical specifications defined on section NORMATIVE REFERENCES.

7. TAG NUMBERING

7.1 For tag rules, refer to I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.

7.2 Tagging of all instruments, electrical, mechanical and piping items, including valves, shall be carried out by PACKAGER/MANUFACTURER and confirmed by PETROBRAS.

7.3 All tag plates shall be made from AISI 316 stainless steel material.

8. SPARE PARTS AND SPECIAL TOOLS

8.1 Spare parts recommended by the Classification Society, if applicable, and those required for NR-13 tests shall be provided.

8.2 All spare parts and special tools shall be detailed in the packing list and shall be consistent with the list of spare parts or special tools issued for the engineering documentation. These items shall have an item number in the packing list, which shall match the item number fixed on the packing.

8.3 If the routine maintenance of Heat Exchangers requires any special tools or kits for disassembly or chemical cleaning of the tube bundles, these tools and kits shall be in the PACKAGER's scope of supply.

9. INSPECTION, TESTING AND COMMISSIONING

9.1 INSPECTION AND TESTING

9.1.1. PACKAGER/MANUFACTURER shall perform all required inspection and testing in accordance with the design and test codes mentioned on section NORMATIVE REFERENCES.

9.1.2. PACKAGER shall submit the Inspection and Test Plan (ITP) based on the SUPPLIER technical data sheet with witnessed inspections and tests identified.

9.1.3. PACKAGER shall ensure that all the witnessed inspection requirements by the Classification Society are fully accommodated and the due notice requirements are satisfied.

9.1.4. Acceptance of shop tests shall not constitute a waiver of requirements to meet the field tests under specified operating conditions, nor shall inspection relieve MANUFACTURER of his responsibilities in any way whatsoever.

9.1.5. For all inspections predicted on ITP, a respective inspection report shall be issued and included in Databook.

9.1.6. INSTRUMENT/SERVICE ROTARY SCREW AIR COMPRESSOR UNIT and AIR DRYING UNITS performance test and hydrostatic test of vessels classified in NR-13 within the PACKAGE shall be witnessed by PETROBRAS. PACKAGER shall invite CLASS surveyor for the performance test.

9.1.7. The following tests shall be included in PACKAGER/MANUFACTURER's scope:

- Hydrotest of all vessels and pipes.
- Electrical continuity checks on all wiring and earthing.
- Electrical insulation tests.
- All tests required for electrical equipment in specific electrical technical specifications of section TYPICAL DOCUMENTS.
- Functional checks on all instruments and valves.
- Radiography examination on all welds of the pressure vessels.

9.2 FACTORY ACCEPTANCE TEST (FAT)

9.2.1. MANUFACTURER shall make preliminary test to ensure that all parts of the equipment are operating satisfactory prior to the arrival of the PETROBRAS's representative. SUPPLIER shall advise PETROBRAS of the test schedule before the planned test dates.

9.2.2. FAT procedure, execution and acceptance criteria shall comply with ISO 1217.

9.2.3. Motors tests shall be in accordance with I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units.

9.2.4. Compressor shall undergo an 4-hour test with the conditions established by the parameters defined on the INSTRUMENT/SERVICE AIR COMPRESSION UNIT DATASHEET. All units shall be tested in this condition.

9.2.5. If it is necessary to dismantle any equipment during the FAT, because of a malfunction, the test may then be invalidated, and a full test shall be required after the repair of the fault.

9.2.6. Acceptance of the FAT shall not be considered as the final acceptance test of the PACKAGE.

9.2.7. PACKAGER/MANUFACTURER shall continuously measure and record vibration and bearing temperature data during FAT. Vibration and bearing temperature measurements shall be included on FAT report.

9.2.8. PACKAGER/MANUFACTURER shall provide vibration and temperature raw data after FAT.

9.2.9. All job Monitoring systems and sensors of the PACKAGE shall be tested on the FAT.

9.3 STRING TEST

9.3.1. MANUFACTURER shall make preliminary test to ensure that all parts of the equipment are operating satisfactory prior to the arrival of the PETROBRAS's representative.

9.3.2. One complete compression PACKAGE (Compression skid + Dryer skid) shall be tested combined in an endurance test of 4 hours long. FAT performance, vibration and temperature criteria shall be used.

9.3.3. PACKAGER/MANUFACTURER shall provide vibration and temperature raw data after String Test.

9.3.4. Vibration measurements on the piping within the PACKAGE shall be made during the string test, The vibration amplitudes shall be within allowable values defined in the Energy Institute's Guidelines for the Avoidance of Vibration Induced Fatigue Failure in Process Pipework.

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9.4 COMMISSIONING

PACKAGE shall undergo a Reliability Acceptance Test Criteria (SAT) on site, in accordance with the requirements of Annex A.

10. PACKAGER/ MANUFACTURER'S RESPONSIBILITY

10.1 Equipment certification and approval as required by the CLASS rules is PACKAGER/ MANUFACTURER´s responsibility. PACKAGER/MANUFACTURER shall communicate directly with Classification Society and provide all documentation necessary to obtain approvals. PETROBRAS shall be copied on all correspondence between PACKAGER/MANUFACTURER and Classification Society. PACKAGER/MANUFACTURER shall obtain approval for all parts of their work as required by Classification Society before shipment of the equipment to the shipyard.

10.2 PACKAGER shall assume full unit responsibility for the complete PACKAGE, including the driver and all auxiliaries.

10.3 If the PACKAGER is a different entity than the air compressor MANUFACTURER, the PACKAGER shall supply an official letter signed by the compressor MANUFACTURER (Original Equipment Manufacturer) indicating that they are a recognized and authorized packager for their products. The letter shall be presented during Technical Bid Phase and shall be dated less than 6 months from the date it is presented.

10.4 Compliance by PACKAGER/MANUFACTURER with the provisions of this specification does not relieve the PACKAGER/MANUFACTURER of his responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions.

11. PREPARATION FOR SHIPMENT

11.1 MARKING

11.1.1. PACKAGER shall adequately mark all items supplied to this specification for identification against a certificate or relevant test documentation. Marking shall be such that it will not damage or impair the component.

11.1.2. Items that cannot be identified shall be rejected. Rejected items may be re-certified by carrying out all relevant testing, with prior approval of PETROBRAS.

11.1.3. PACKAGER shall issue during engineering stage the packing list, which shall contain the item number of each part supplied loose in the PACKAGE.

11.2 SHIPMENT PACKING

11.2.1. Shipment packing preparation of the equipment shall be suitable for 24 months outdoor storage from time of shipment.

11.2.2. PACKAGER shall treat and close off by plastic caps and taped all open ends of pipes. Small bore threaded connections shall be taped over.

11.2.3. PACKAGER shall comply with the requirements of the country to which the equipment is being shipped for packing.

11.2.4. PACKAGER shall protect with corrosion inhibitor all internally unpainted carbon steel pressure vessels and piping prior to shipment. If necessary, PACKAGER/MANUFACTURER shall provide instructions to remove the corrosion inhibitor prior to the commissioning.

11.2.5. PACKAGER/MANUFACTURER shall protect equipment and accessories from corrosion.

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11.2.6. PACKAGER shall remove and separately pack vulnerable instruments for shipment.

11.2.7. Transportation bracing/support should be used where necessary and shall be clearly identified as temporary.

11.2.8. All crates and boxes shall contain sufficient moisture absorbing agent to avoid condensation.

11.2.9. PACKAGER/MANUFACTURER shall specify any limitations applicable to the transportation and installation phase.

11.2.10. PACKAGER shall properly clean internally and free of all loose foreign materials the equipment before packing.

12. DOCUMENTATION REQUIREMENTS

12.1 PACKAGER / MANUFACTURER shall supply a certificate of compliance with the rules of Classification Society.

12.2 Before any document is issued by PACKAGER/MANUFACTURER, document list shall be issued and approved by PETROBRAS.

Note: This is required in order to guarantee that document number in accordance with N-1710 is correct. If PACKAGER/MANUFACTURER assigns wrong document numbers, document number changing procedure is time consuming, therefore detrimental to the project.

12.3 If any other documents are issued at the same time as the document list or even before issuance of document list, these documents will be rejected.

12.4 Document list shall be submitted with the source file, otherwise it will be rejected.

12.5 Title of all documents to be issued by PACKAGER/MANUFACTURER shall have the following format:

- First part – tag number;
- Second part – equipment description;
- Third part – document description

EXAMPLE: C-UC-5134502A/B - Instrument and Service Rotary Screw Air Compressors – General Arrangement Drawing.

12.6 If PACKAGER/MANUFACTURER issues documents which contain information valid for the whole package, title shall be summarized to the compression unit tag and document purpose.

EXAMPLE: UC-5134502A/B – Inspection and Test Plan.

12.7 PACKAGER/MANUFACTURER shall provide source files of all required documents, whenever required by PETROBRAS.

12.8 The equipment shall be supplied with documentation in English language.

12.9 Some documents shall be submitted in Portuguese language, in accordance with definition in this technical specification.

12.10 The following documents shall be issued within the first two weeks from the beginning of the detailed design stage and approved before manufacturing or procurement starts:

- Piping and Instrument diagram, which shall follow I-ET-3000.00-0000-940-P4X-002 - Symbols for Production Units Design;

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- General arrangement drawing;
- Utility consumption list and heat dissipation;
- Weight and center of gravity datasheet;
- Inspection and test plan (ITP), including auxiliary equipment.

12.11 The following documents shall be issued and approved before FAT. If these documents are not approved prior to the FAT, PETROBRAS will not attend the FAT and will not consider it as executed:

- Main equipment datasheet;
- Performance curve;
- Hydrostatic test report.
- Painting and insulation specification;
- Lateral and Torsional analysis report;
- Non-Destructive Tests report;
- Noise datasheet;
- Sub-supplier qualification report;
- FAT procedure.

12.12 The following documents shall be issued and approved before delivery of the PACKAGE. If these documents are not approved prior to the delivery of the PACKAGE, PETROBRAS will not attend to the receiving inspection, and will not consider the receiving of the PACKAGE:

- Nameplate drawing;
- Noise report;
- FAT report;
- Handling drawing for installation;
- Painting report.
- Installation manual.
- Packing list.
- Electrical motors data-sheets, dimensional drawings and all other documents required in specific technical specifications.
- All documents required for electrical equipment in specific technical specifications.
- Certificates of all electrical equipment required to operate in hazardous areas.

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12.13 All documents on annex “Typical vendor drawing and data requirements” of API 619 shall be submitted to PETROBRAS for analysis and approval, besides the additional documents below. These documents, besides those mentioned previously in this section, shall be issued and approved before issuance of the Databook. Otherwise, PETROBRAS will not accept the Databook:

- Coupling drawing.
- Details drawings of pressure vessels.
- Outline drawings of auxiliary equipment.
- List of spare parts for commissioning and start up.
- List of recommended spare parts for two years of operation.
- List and datasheets of instruments and instrumented valves.
- List of set points, alarms and shutdown.
- Cable list.
- Logic diagrams.
- Cause and effect charts.
- Loop diagram.
- Electromechanical panel drawing.
- Memory maps.
- Automation architecture.
- Interconnection wiring diagram.
- Calculation notes of control valves, PSVs, thermowells and flowmeters.
- I/O List.
- HMI screen layout.
- Calibration certificates of instruments, control valves and PSVs.
- Databook index.
- Fabrication procedures of pressure vessels classified in NR-13.
- NDT procedures of pressure vessels classified in NR-13.
- Calculation reports of pressure vessels.
- Welding, heat treatment and NDT reports, specially for pressure vessels.
- Material certificates of all pressurized components, specially for pressure vessels.

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- Hydrotest procedures and reports of piping and pressure vessels. For pressure vessels classified in NR-13, hydrotest reports shall contain the Qualified Professional signature, as per NR-13 requirement.

12.14 All documents to be issued for motors during Detailed Design shall be according to I-ET-3010.00-5140-712-P4X-001 - Low-Voltage Induction Motors for Offshore Units.

12.15 Required documents to be issued for power panels shall comply with I-ET-3010.00-5140-741-P4X-004 – Specification for Low-Voltage Generic Panels for Offshore Units.

12.16 Required documents to be issued for variable speed drives shall comply with I-ET-3010.00-5140-772-P4X-002 - Specification for Low-Voltage Frequency Converters, Softstarters and Inverters for Offshore Unit.

12.17 Performance curves shall include the rated point and the allowable operating region.

12.18 Datasheets and outline drawings shall be submitted not only for the main equipment, i.e., the compressors, but also for the auxiliary equipment. PACKAGER/MANUFACTURER may include data in the outline drawing of each auxiliary equipment rather than issuing a separate datasheet for the auxiliary equipment, under approval of PETROBRAS.

12.19 PACKAGER/MANUFACTURER shall include manual of auxiliary equipment in the Databook.

12.20 All inspections, NDTs and tests predicted by PACKAGER in the Inspection and Test Plan shall have a report, which shall be included in the Databook.

12.21 Progress reports shall be issued periodically, in accordance with total duration of the fabrication time (e.g., every two weeks or every month).

12.22 PACKAGER's/MANUFACTURER's operation and maintenance manual shall contain the specification of lubricant fluids, besides periodicity to replace it. A lubricant schedule may be issued separately.

12.23 PACKAGER/MANUFACTURER operation and maintenance manual shall contain detailed instructions for cleaning the PACKAGE's heat exchangers, considering both the cooling water and process sides.

12.24 PACKAGER shall provide a schedule stating the expected time between major overhauls. This schedule can be included in the maintenance manual or issued as a separate document.

12.25 Installation manual shall contain all recommendations for preservation during storage on erection stage and long-term storage. If PACKAGER/MANUFACTURER fails to provide this information on the installation manual, any damages due to the lack of preservation will be PACKAGER/MANUFACTURER's responsibility.

12.26 Installation manual shall also contain all consumables to be used for erection, commissioning and start up, preferably in a summarized list.

12.27 PACKAGER/MANUFACTURER shall provide original documents in PDF format for all required documents. Extracted figures from catalogue or manual, especially for the outline drawings of components such as couplings, mechanical seals and auxiliary equipment, will not be accepted.

12.28 General arrangement drawings shall contain the connection list, i.e., a list with all connection tie in points of the baseplate, which shall have the following minimum information: Connection identification number (which shall be indicated in the drawing), connection description, connection specification (design code), rating, flange face type, connection nominal diameter and fluid.

12.29 Operation manual shall contain, among other information, the control system description of the PACKAGE.

12.30 Each material certificate and NDT report provided shall be preceded by a PACKAGER/ MANUFACTURER sheet, informing to which part of the equipment the document refers.

12.31 PACKAGER/MANUFACTURER is required to indicate on the general arrangement drawing the distance required for removal of all internal parts, which shall be disassembled periodically for maintenance, in accordance with recommendations on the maintenance manual.

12.31.1. SUPPLIER shall include this information on the respective handling arrangement drawing or handling study, along with the required handling equipment used to remove and transport the internal part. SUPPLIER is also required to check if there is any clash between the space required to remove the internal part and any obstacle nearby the PACKAGE using the 3D model.

12.32 PACKAGER/MANUFACTURER shall provide complete documentation of the monitoring sensors installed in the equipment.

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ANNEX A

ANNEX A - Equipment Reliabilit

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