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EXECUTION	CXLB	CXLB	HR7O	HR7O	HR7O				
CHECK	UPF8	UPF8	U4XP	U4XP	DVHD				
APPROVAL	CXM6	CXM6	CXM6	CXM6	CXM6				

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1 OBJECTIVE

1.1 This technical specification covers the minimum requirements for the design, materials, fabrication, assembly, inspection, testing, preparation for shipment, installation, pre-commissioning and commissioning of all electric motor driven centrifugal pumps whose design do not follow API Std 610, including pumps for hull marine systems.

1.2 These requirements shall be complied with, in conjunction with other applicable SUPPLIER's Documents and Standards.

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

DAM: Dynamic Acquisition Module
g: Gravitational acceleration
SS: Stainless Steel
NPSH: Net Positive Suction Head
MMS: Machinery Monitoring System
MPS: Machinery Protection System
UCP: Unit Control Panel (Package Control Panel)

3 SCOPE OF SUPPLY

PACKAGER scope of supply shall include the following:

- Centrifugal pump;
- Electric motor driver;
- Mechanical seals;
- Baseplate with drain pan, lifting lugs, grounding lugs, and drains with valves;
- Couplings and coupling guards;
- Monitoring system, in accordance with I-ET-3010.00-5500-854-P4X-001 – Machinery Monitoring System (MMS) and definitions in this technical specification;
- All necessary instrumentation, including accessories and supports;
- Unit Control Panels, according to AUTOMATION INTERFACE OF PACKAGE UNITS specification [document supplied by OWNER];
- Electrical and instrumentation installation (including cable termination details, motor terminal box details, and grounding);
- Stainless steel (SS 316), copper free aluminum or non-metallic junction boxes mounted at skid edge;
- All piping and their respective utilities skids, such as lube oil, cooling medium and instrument/utility air;
- All raw materials and consumables;
- Gaskets;
- Tightening bolts and nuts;
- Nameplates made of SS 316 in Portuguese for all equipment and instruments;
- Surface preparation and painting proper for offshore installation, according to I-ET-3010.00-1200-956-P4X-002 – General Painting and DR-ENGP-I-1.15 – Color Coding;
- Spreader bars and specific handling devices for installation;
- Technical assistance during installation, pre-commissioning, start-up and commissioning phases;
- Safety signaling in Portuguese;
- All required tests at MANUFACTURER's shop;
- Preparation for shipment and preservation, including equipment handling conditioning and storage at job site;

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- Consumables and special tools for assembly, disassembly, maintenance, commissioning and start-up;
- Spare parts recommended for commissioning, pre-operation, start-up, NR-13 tests and by Classification Society;
- Warranty;
- Thermal insulation for personnel protection according to I-ET-3010.00-1200-431-P4X-001 – Thermal Insulation for Maritime Installations;
- A complete engineering package including design, fabrication, inspection, testing, commissioning documentation, certification and data required on this specification and pump data sheets issued by OWNER.

4 NORMATIVE REFERENCES

Pump PACKAGE shall comply with ASME B73 or ISO 5199 and meet the additional requirements of this technical specification, data sheets, documents as stated below and with those referred to herein. Any conflict between the requirements of this specification and related codes and standards, specification, etc. shall be presented in writing for OWNER's resolution prior to manufacturing.

4.1 Applicable Codes and Standards

The latest issue of the following codes and standards shall be fully complied with:

ASME B16.5	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.3	Process Piping
ASME B73.1	Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process
ASME B73.2	Specification for Vertical In-Line Centrifugal Pumps for Chemical Process
ISO 5199	Technical specifications for centrifugal pumps — Class II
ISO 80079-36 and -37	Explosive Atmospheres – Non-electrical Equipment for Explosive Atmospheres
ASME BPVC Sec. VIII-1	Rules for Construction of Pressure Vessels
ASME PTC 8.2	Centrifugal Pumps
NR-10	Brazilian Government Regulation – Norma Regulamentadora N° 10, Segurança em Instalações e Serviços em Eletricidade
NR-12	Brazilian Government Regulation – Norma Regulamentadora N° 12, Segurança no Trabalho em Máquinas e Equipamentos
NR-13	Brazilian Government Regulation – Norma Regulamentadora N° 13, Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento
NR-26	Brazilian Government Regulation – Norma Regulamentadora N° 26, Sinalização de Segurança
NR-37	Brazilian Government Regulation – Norma Regulamentadora N° 37, Segurança e Saúde em Plataformas de Petróleo
Classification Society	Rules for Offshore Facilities


4.1.1 Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein.


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

4.2 Reference Codes and Standards

The following codes and standards shall be used as reference or followed wherever they are mentioned throughout this specification:

ANSI/HI 9.6.4	Rotodynamic Pumps - Vibration Measurements and Allowable Values
ANSI/HI 14.6	Rotodynamic Pumps - Hydraulic Performance Acceptance Tests
API Std 610	Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries

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API Std 682 ISO 14691	Pumps - Shaft Sealing Systems for Centrifugal and Rotary Pumps Petroleum, Petrochemical, and natural gas industries - Flexible couplings for mechanical power transmission - General-purpose applications		
ISO 15156/all parts	Petroleum and Natural Gas Industries: Materials for Use in H2S-Containing environments in Oil and Gas Production		
4.3 Applicable Documents			
4.3.1 Typical Project Documents			
The following project documents shall be fully complied with:			
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		
Mechanical			
DR-ENGP-I-1.15	Color Coding		
I-ET-3010.00-1200-251-P4X-001	Requirements for Bolting Materials		
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-3010.00-1200-540-P4X-001	Requirements for Pressure Vessels Design and Fabrication		
I-ET-3010.00-1200-955-P4X-001	Welding		
I-ET-3010.00-1200-200-P4X-115	Requirements for Piping Fabrication Assembly and Commissioning		
I-ET-3010.00-1200-956-P4X-002	General Painting		
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-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 and for Offshore Units		
I-ET-3010.00-5140-700-P4X-003	Electrical Requirements for Packages for Offshore Units		
I-ET-3010.00-5140-712-P4X-001	Low-Voltage Induction Motors for Offshore Units		
I-ET-3010.00-5140-712-P4X-002	Medium-Voltage Induction Motors for Offshore Units		
I-ET-3010.00-5140-772-P4X-001	Medium-Voltage Frequency Converter for Offshore Units		
I-ET-3010.00-5140-772-P4X-002	Specification For Low-Voltage Frequency Converters, Soft- Starters and Inverters For Offshore Units		
I-ET-3010.00-5140-797-P4X-001	Electrical System Automation Architecture		
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		
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		
4.3.2 Specific Project Documents			
PACKAGER / MANUFACTURER shall fully comply with the following project documents, supplied by OWNER. Since these documents are specific to each project, their identification numbers are not unique, and their titles may vary slightly from one project to another. Project's DOCUMENT LIST shall be consulted to verify the correct document number and title.			
METOCEAN DATA			

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MOTION ANALYSIS
 PIPING SPECIFICATION FOR TOPSIDE
 PIPING SPECIFICATION FOR HULL
 GENERAL SPECIFICATION FOR AVAILABLE UTILITIES
 FIELD INSTRUMENTATION
 AUTOMATION INTERFACE OF PACKAGE UNITS
 INSTRUMENTATION ADDITIONAL TECHNICAL REQUIREMENTS

5 PACKAGER RESPONSIBILITY

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

5.2 PACKAGER shall assume sole contractual and total engineering responsibility for the items supplied.

5.3 PACKAGER's responsibility shall also include but not be limited to:

- Resolving all engineering questions and/or problems relating to design and manufacturing.
- Providing details as requested, for the main and auxiliary equipment, relating to design and manufacturing.
- Training.

5.4 Compliance by the PACKAGER with the provisions of this specification shall not relieve the PACKAGER's responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions.

5.5 PACKAGER is responsible for all coordination with MANUFACTURERS and collections of all details, drawings and data to achieve optimum design and full submission of all documents requested in the specification.

6 DESIGN REQUIREMENTS

6.1 Operation Environment

PACKAGER / MANUFACTURER shall design and supply the equipment suitable for the marine environment and range of ambient conditions defined in METOCEAN DATA specification [document supplied by OWNER].

6.2 Motion Requirements

6.2.1 PACKAGER / MANUFACTURER shall comply with the necessary design data and information regarding motion requirements given in MOTION ANALYSIS report [document supplied by OWNER].


6.2.2 PACKAGE shall be able to withstand and operate in accordance with I-ET-3010.00-1350-960-P4X-001.

6.3 PACKAGE Requirements

6.3.1 PACKAGER / MANUFACTURER shall design PACKAGE 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.

6.3.2 All pumps shall be in accordance with ISO 5199 or ASME B73 Standard latest edition.

6.3.3 PACKAGER / MANUFACTURER shall provide the complete unit of pump, driver and baseplate with lugs and other lifting structures, if necessary, to facilitate mechanical handling by means of a single point lift.

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6.3.4 Rotary parts, such as couplings, pulleys, and flywheels, shall feature rigid guards, made of non-sparking and non-flammable material in accordance with NR-12.

6.3.5 PACKAGER shall clearly define the utility consumption of the equipment. This information shall also be included in the technical proposal.

6.3.6 PACKAGER / MANUFACTURER shall design the consumption of utilities to comply with the requirements of GENERAL SPECIFICATION FOR AVAILABLE UTILITIES report [document supplied by OWNER].

6.3.7 PACKAGER / MANUFACTURER shall assemble PACKAGE, including all auxiliary equipment, to the maximum extent possible, align, and pre-check in MANUFACTURER'S/ PACKAGER'S shop, allowing shipment to the integration yard with minimal fieldwork.

6.3.8 For foreign made equipment, PACKAGER / MANUFACTURER 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.

6.3.9 PACKAGER / MANUFACTURER shall manufacture, inspect, and verify PACKAGES to comply with all specifications mentioned in Normative References and the Classification Society regulations.

6.3.10 SUPPLIER shall ensure that the area around the pump PACKAGE has enough clearance for maintenance.

6.3.11 SUPPLIER shall create a reserved area on the 3D model to avoid installation of any other equipment or accessory in this area.

6.3.12 PACKAGE shall be designed in compliance with ISO 80079-36 and ISO 80079-37 requirements.

6.3.12.1 PACKAGER shall provide a certificate confirming that the equipment and components of the package is in conformity with both standards including as minimum:

- a) Ignition Hazard Assessment Report as per ISO 80079-36;
- b) Specific the requirements for the design and construction of nonelectrical and equipment type of protection as per ISO 80079-37;
- c) Equipment nameplate including ISO 80079-36 marking requirements.

6.3.13 PACKAGER shall attest on his own responsibility that the equipment has been constructed in accordance with the applicable requirements of the relevant standards in safety matters.

6.3.14 Main Deck Drainage Box pumps shall be self-priming type. No separate system for priming shall be used.


6.3.15 The rotating speed of vertical pumps, other than in-line type, shall not exceed 1800 rpm.

6.4 Performance

6.4.1 PACKAGER / MANUFACTURER shall supply pumps suitable for continuous operation at full load duty, unless otherwise stated in the process data sheets, without shutdown for normal maintenance, for a minimum period of one year.

6.4.2 For pumps with intermittent service, the preventive maintenance shall only be required after a period of 18 months, unless otherwise specified.

6.4.3 Rated flow shall be within the region of 70% to 110% of best efficiency flow rate of the pump as furnished.

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6.4.4 Pumps shall have stable head / capacity curves with continuous head rise to shutoff.

6.4.4.1 When single operation pump, head rise to shutoff shall be of at least 10% from rated head.

6.4.4.2 When parallel operation is specified, the rise to shutoff shall be at least 10% of the rated head but shall not exceed 20% of the head at BEP of rated impeller diameter, as confirmed during performance test.

6.4.4.3 Discharge orifices other head modifiers situated in the pumped fluid discharge to achieve these criteria shall not be acceptable.

6.4.5 The maximum pump discharge pressure (shutoff condition) shall not exceed design pressure for downstream piping and equipment.

6.4.6 Pumps that are specified to operate in parallel:

- Shall have the same shut off head (within a tolerance of $\pm 5\%$ for pumps), which shall be confirmed at the performance test;
- For flowrates between 80% and 110% of BEP, the tested head of all pumps shall be within 3% of each other. This shall not allow any of the pumps to be outside the contractual performance limits.

6.4.7 Pumps driven by electric motor with power above 150kW shall have efficiency at the rated flow above 80% for $n_s > 1500$ ($n_s > 29.1$ metric units) and above 75% for $n_s < 1500$ ($n_s < 29.1$ metric units). The pump's specific speed – n_s – shall be calculated according to API Std 610.

6.4.8 The NPSH required shall be at least 2.0 meters less than the NPSH available.

6.4.8.1 Correction factors are not allowed.

6.4.8.2 OWNER may accept differences between 1.0 and 2.0 meters, but a witnessed NPSH required test shall be performed in accordance with ANSI/HI 14.6.

6.5 Pump Casing

6.5.1 PACKAGER / MANUFACTURER shall clearly mark the direction of rotation of the impeller(s) on the casing by permanent means.

6.5.2 MANUFACTURER shall design the whole pump casing to have a pressure rating allowing it to be tested at the hydrostatic test pressure of the discharge side by mounting blinds to the suction and to the discharge flange.

6.5.3 Where jackscrews are provided to assist in dismantling pump casing mating surfaces, the mating face shall be counter-bored to receive the jackscrew where damage to the face could lead to a leaky joint or improper fit.


6.5.4 Mating surfaces shall be provided with taper dowel-pins or fitted bolts to ensure correct alignment on re-assembly.

6.5.5 Suction and discharge nozzles shall be flanged in accordance with ASME B16.5.

6.5.6 Threaded connections shall not be used.

6.5.7 Casing connections other than suction and discharge nozzles shall be at least DN 15 (NPS 1/2).

6.5.8 Threaded connections shall be tapered.

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6.6 Impellers

6.6.1 Pumps with constant speed drivers shall be capable to providing a head increase of at least 5% at rated capacity by installing a larger diameter impeller.

6.6.2 For closed impeller type pumps, MANUFACTURER shall furnish impellers with renewable wear rings.

6.6.2.1 Renewable wear rings shall be held in place by a press fit with three axial screws, equally spaced.

6.6.3 Welded impellers shall be subject for PETROBRAS approval.

6.7 Mechanical Seals

6.7.1 PACKAGER / MANUFACTURER shall supply pumps with single mechanical seal, API Std 682 Category 1 and Piping Plan 11/61 for horizontal and 13/61 for vertical pumps.

6.7.2 If the Piping Plan is not suitable for the service, PACKAGER shall propose an alternative plan on technical proposal, which shall be approved by OWNER.

6.7.3 PACKAGER / MANUFACTURER shall provide centrifugal pumps with cartridge-type and balanced mechanical seals, with their sleeves independent from the pump's sleeves and shall not be used as centering element of the rotary set.

6.7.4 Pumps in service with temperature over 90°C shall have provisions for cooling the seal flush liquid where necessary, to ensure a temperature of no more than 90°C at the seal face.

6.7.5 Seal materials shall be the seal MANUFACTURER's recommendation for the service.

6.7.5.1 The following material selections, if recommended by the seal MANUFACTURER, shall be subject to the BUYER's approval:

- a) Hard/hard mechanical seal faces combination (e.g. SiC vs SiC).
- b) Seal faces in Tungsten Carbide.
- c) Seal faces with Diamon-like Carbon (DLC) coating.

6.7.6 SUPPLIER may also specify required seal materials on the data sheets. However, seal MANUFACTURER shall validate this material specification.

6.7.7 PACKAGER / MANUFACTURER shall provide seal plates with all necessary 1/2" NPT minimum connections (complete with solid plugs) for flushing, quench, drains and venting.

6.7.8 Plugs shall be of the same material as the seal gland plate.


6.7.9 PACKAGER / MANUFACTURER shall furnish all mechanical seals with close clearance, non-sparking floating throttle bushes.

6.7.10 PACKAGER / MANUFACTURER shall design all sealing system elements to withstand the maximum pressure for different arrangements (serial or in parallel) and for maximum pressure developed by the pump in case of failure in other sealing components, such as the pump throat bushing.

6.8 Auxiliary Piping

6.8.1 PACKAGER / MANUFACTURER shall design, fabricate, and inspect piping in accordance with ASME B31.3.

6.8.2 PACKAGER / MANUFACTURER shall design pipe flanges and flanged fittings in accordance with ASME B16.5.

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6.8.3 Drains and vents shall have flanged valves, unless otherwise stated in the pump data sheets.

6.8.4 Piping shall be suitably supported to the pump baseplate or mounting frame by PACKAGER / MANUFACTURER.

6.8.5 Pumps requiring auxiliary piping for balancing line, sealing or lube oil systems shall be provided with all necessary connections, plus all required piping and fittings, as defined on the data sheets.

6.8.6 PACKAGER / MANUFACTURER shall select the same material as the pump casing for auxiliary piping in contact with the process fluid. All other auxiliary piping shall be made of **SS 316L** unless otherwise specified in pump data sheets.

6.8.7 PACKAGER / MANUFACTURER shall clearly mark the locations of all connections and identify them on the pump drawing.

6.8.8 All auxiliary interface connections shall terminate with block valves and flanges at the edge of the skid.

6.9 Bearings

6.9.1 PACKAGER / MANUFACTURER shall provide pumps with two rolling element bearing assemblies. For vertical pumps, only ASME B73.2 Type VB are acceptable.

6.9.2 Sealed bearings filled with grease shall not be used when nd_m factor is greater than 100,000 – where n is the shaft speed in rpm and d_m is the mean bearing diameter – $(d + D)/2$ – in millimeters.

6.9.3 Polyamide or other synthetic materials shall not be used in rolling contact bearings.

6.9.4 Bearing housings serving as oil reservoirs shall be provided with constant level oilers. The recommended working oil level shall be accurately located and clearly marked on the outer surface of the bearing housing by permanent means.

6.9.5 Bearing housings shall be sealed against loss of lubricant and the entrance of water, steam, dust, or other contaminants.

6.9.6 Seals for bearing housings shall be of the labyrinth type.

6.9.7 Cooling of bearing housings by means of water jackets shall be employed when:

- handling fluids at a pumping temperature of 200°C or above,
- or when the lubricating oil temperature is likely to rise above 82°C, based on specified operating conditions and 34°C ambient temperature.

6.9.8 For pumps with driver power greater than 30 kW, the thrust bearing shall be either:


- double row angular contact ball bearing type,
- or duplex single row angular contact ball bearing type, back-to-back mounted.

6.9.9 Bearing cages of double row angular contact bearings shall be metallic. Bearing cages of duplex bearings shall be brass or bronze.

6.9.10 Bearing housing surfaces of all pumps shall be prepared for permanent accelerometer installation.

6.9.11 Bearing houses shall have a flat surface at least 1 in. (25 mm) in diameter for the location of magnetic-based vibration-measuring equipment.

6.9.12 For shaft diameters above 30 mm, “U” type labyrinth shall be used for bearing housing sealing.

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NOTE The sealing element referred to as "U" type labyrinth is a sealing element with two deflectors (internal and external) that obstruct air movement through the bearing housing.

6.10 Drivers

6.10.1 Pumps shall be driven by electrical motors, unless otherwise specified in the pump data sheets issued by OWNER.

6.10.2 A direct driver shall be used, no gearboxes shall be allowed.

6.11 Couplings

6.11.1 Pumps shall be connected to the driver by means of a flexible spacer type coupling. In case PACKAGER / MANUFACTURER duly justifies on technical proposal that the use of spacer is not suitable, it may be accepted by OWNER.

6.11.2 The coupling guard shall be made of a solid sheet of metallic, spark-resistant material and designed to withstand 900 N load in any direction, to protect all rotating parts between driver and driven equipment, preventing unintentional personnel access.

6.11.3 Flexible couplings with rubber parts shall not be used in classified area.

6.12 Baseplate

6.12.1 PACKAGER / MANUFACTURER shall install the pump and driver on a combined baseplate, providing adequate clearance for safety and maintenance.

6.12.2 PACKAGER / MANUFACTURER shall design the baseplate to ensure that the deformation caused by the movement of the UNIT structure is not transmitted to the base of the rotary assembly.

6.12.3 PACKAGER / MANUFACTURER shall design foundation considering the stiffness of the assembly, aiming to prevent vibration transmission to the adjoining equipment, living quarters, control rooms, and other environments in the UNIT.

6.12.4 The baseplate shall have a drain-pan with a valved drain opening of at least DN 40 (NPS 1½), located on the short side of the baseplate.

6.12.5 For pumps in corrosive duties, drain-pans shall be made of a corrosion-resistant material considering the pumped fluid properties.

6.12.6 PACKAGER / MANUFACTURER shall fully machine the mounting pads of the baseplate (flat surfaces to which the equipment is fixed) for proper alignment of the pump and driver, within levelling tolerances defined by ASME B73.1 for horizontal pumps or 0.4 mm per meter for vertical pumps.


6.12.7 If PACKAGER / MANUFACTURER has a specific requirement for levelling in the pump manual, it shall be applied instead.

6.12.8 PACKAGER / MANUFACTURER shall mount pumps directly on mounting pads of the baseplate without shims.

6.12.9 PACKAGER / MANUFACTURER shall machine mounting pads for drive-train components to allow for the installation of shims at least 0.12 in. (3 mm) thick under each component.

6.12.10 The PACKAGER shall furnish the drive train components mounted with a set of SS 316 shims (shim packs) at least 0.12 in. (3 mm) thick.

6.12.11 Shim packs used for alignment shall not be thicker than 0.5 in. (13 mm) nor contain more than 5 shims.

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6.12.12 All shim packs shall straddle the hold-down bolts and vertical jackscrews and extend at least 1/4 in. (5 mm) beyond the outer edges of the equipment feet.

6.12.13 PACKAGER / MANUFACTURER shall design the baseplate such that there are no pockets or cavities that can collect or hold liquids. All such pockets and cavities shall connect to the main drain connection or be sealed.

6.12.14 For pump PACKAGES with Low-Voltage motors, the baseplates shall be designed to be completely seal welded to the support structure. Intermittent welds are not allowed.

6.12.14.1 For pump PACKAGES with Low-Voltage motors, baseplates mounted with 3-point or multipoint mounting may be accepted under previous approval by BUYER.

6.12.15 For pump PACKAGES with Medium-Voltage motors, the baseplates shall be designed for 3-point or multipoint mounting.

6.12.16 PACKAGER / MANUFACTURER shall provide alignment blocks for the driver. They shall be welded to the baseplate and provided with jackscrews for movement of the driver in both directions on horizontal plane.

6.12.17 PACKAGER is responsible for the pre-alignment check performed in PACKAGER's facility, which shall be within 0.5 mm per meter of distance between flex planes (coupling hub and shaft end), for pumps with flexible spacer type coupling.

6.12.18 Tolerance for closed coupling type pumps shall be 0.02 mm.

6.12.19 Alignment report shall be included in PACKAGER's Databook.

6.13 Noise and Vibration Control

PACKAGER / MANUFACTURER shall perform noise and vibration control concerning human exposure according to I-ET-3010.00-1200-300-P4X-001 – Noise and Vibration Control Requirements.

6.14 Pressure Vessels

6.14.1 PACKAGER / MANUFACTURER shall design pressure vessels within pump PACKAGE in accordance with I-ET-3010.00-1200-540-P4X-001 – Requirements for Pressure Vessels Design and Fabrication.


6.14.2 PACKAGER / MANUFACTURER shall design all pressure vessels complying with the requirements of NR-13.

6.15 Special Tools and Spare Parts

6.15.1 PACKAGER / MANUFACTURER shall supply all special tools necessary for the installation, alignment, operation or maintenance of the equipment with the delivery of the PACKAGE.

6.15.2 PACKAGER / MANUFACTURER shall also provide spare parts required for NR-13 tests and those recommended by the Classification Society.

6.15.3 PACKAGER / MANUFACTURER shall detail all special tools and spare parts.

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6.15.3.1 The list of special tools and spare parts shall be detailed in the packing list and shall be consistent with the lists issued for the engineering documentation.

6.15.3.2 These items shall have an item number in the packing list, which shall match the item number fixed on the packing.

7 MATERIALS

7.1 PACKAGER / MANUFACTURER shall select materials according to API Std 610 Annexes G and H, unless otherwise specified in pump data sheets issued by OWNER.

7.2 PACKAGER / MANUFACTURER shall isolate dissimilar materials in contact with an electrolyte to avoid galvanic corrosion.

7.3 Austenitic SS pumps shall use SS 316 (UNS S31600) or SS 316L (UNS S31603) for all parts subjected to pressure or other mechanical loads.

8 ELECTRICAL

8.1 PACKAGER / MANUFACTURER shall manufacture and test all electrical equipment in compliance with Classification Society and IEC requirements.

8.2 Electrical equipment and material shall comply with requirements of I-ET-3010.00-5140-700-P4X-002 – Specification for Electrical Material for Offshore Units, I-ET-3010.00-5140-700-P4X-007 - I-ET-3010.00-5140-700-P4X-007 - Specification for Generic Electrical Equipment for Offshore Units and I-ET-3010.00-5140-700-P4X-009 - General Requirements for Electrical Material and Equipment for Offshore Units.

8.3 Electrical induction motors shall comply with requirements of I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units or I-ET-3010.00-5140-712-P4X-002 – Medium-Voltage Induction Motors for Offshore Units.

8.4 Concerning electrical system voltages and quantity of feeders for motors, panels and auxiliaries, pumps shall be fed according to definitions of I-ET-3010.00-5140-700-P4X-003 – Electrical Requirements for Packages for Offshore Units.

8.5 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.


8.6 Medium-voltage VSDs shall comply with I-ET-3010.00-5140-772-P4X-001 – Medium-Voltage Frequency Converter for Offshore Units. Low-voltage VSDs shall comply with I-ET-3010.00-5140-772-P4X-002 – Specification For Low-Voltage Frequency Converters, Soft-Starters And Inverters For Offshore Units.

9 CONTROLS AND INSTRUMENTATION

9.1 General

9.1.1 PACKAGER / MANUFACTURER shall ensure that the equipment is properly certified for the specified classification. For further information see FIELD INSTRUMENTATION specification [document supplied by OWNER].

9.1.2 PACKAGE automation type classification shall be according to AUTOMATION INTERFACE OF PACKAGE UNITS specification [document supplied by OWNER].

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

9.1.4 PACKAGER / MANUFACTURER shall design all sensors suitable for prevailing temperatures.

9.1.5 When applicable, PACKAGER / MANUFACTURER shall install field amplifiers, transducers, etc., according to the area classification and to protect them against mechanical damage.

9.2 Automation, Control and Instrumentation System Cabling

9.2.1 PACKAGER / MANUFACTURER shall clearly mark all wiring within the limits of the enclosure on the wire and at the terminal.

9.2.2 PACKAGER / MANUFACTURER shall furnish all cabling between the driver and the local gauge board. All cables and cable routes shall contain at least 20% of the extra capacity.

9.3 Alarms and Shutdown

PACKAGER / MANUFACTURER shall set the minimum alarm and shutdown functions as required on the P&IDs and matrix of cause and effect.

9.4 Monitoring Requirements

9.4.1 PACKAGER / MANUFACTURER shall supply pumps with driver power greater than 50kW with one radial accelerometer for each bearing housing. This vibration monitoring shall be compatible with the Data Acquisition Module (DAM), as described in I-ET-3010.00-5500-854-P4X-001 – Machinery Monitoring System (MMS).

9.4.2 Pump vibration sensor shall not be used for trip function.

9.4.3 Monitoring sensors for motors shall be in accordance with I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units or I-ET-3010.00-5140-712-P4X-002 – Medium-Voltage Induction Motors for Offshore Units.

9.4.4 PACKAGER / MANUFACTURER shall supply, install, configure, and connect all monitoring sensors to a junction box located on the pump skid.

9.4.5 MANUFACTURER shall provide complete documentation of the sensors installed in the equipment.


9.4.6 All monitoring sensors of P0 type PACKAGE UNITS shall be interconnected to the DAM (supplied by others).

9.4.7 PACKAGER / MANUFACTURER shall provide all data to be implemented by the MMS supplier for Monitoring System Configuration.

10 PAINTING AND COLOR

10.1 PACKAGER / MANUFACTURER paint system shall be according to I-ET-3010.00-1200-956-P4X-002 – General Painting.

10.2 PACKAGER / MANUFACTURER shall adopt color code in accordance with DR-ENGP-I-1.15 – Color Coding.

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11 NAMEPLATES

11.1 MANUFACTURER shall attach corrosion resistant SS 316 nameplates on main and auxiliary equipment in an accessible location, fastened with corrosion resistant pins.

11.2 The nameplate information shall include, as a minimum, the following items in Portuguese:

- Purchase order and item number;
- Manufacturer and year of build;
- Equipment serial number and type;
- Rated flow;
- Rated head;
- Casing hydrostatic test pressure;
- Maximum allowable working pressure (MAWP);
- Temperature basis for MAWP;
- Driver power rating and speed;
- Design code;
- Design temperature and pressure;
- Tag number.

12 TAG NUMBERING

12.1 PACKAGER / MANUFACTURER shall tag of all instrumentation, electrical, mechanical and piping items, including valves, according to I-ET-3000.00-1200-940-P4X-001 – Tagging Procedure for Production Units Design.

12.2 PACKAGER / MANUFACTURER shall supply tag plates with number and description in Portuguese.

12.3 PACKAGER / MANUFACTURER shall make all tag plates from SS 316 material.

12.4 PACKAGER / MANUFACTURER shall tag valves with the applicable number only.

12.5 PACKAGER / MANUFACTURER shall define tag numbers for remaining auxiliary equipment in detail design after approval of OWNER .

13 CERTIFICATION REQUIREMENTS

13.1 Class Certification

PACKAGER / MANUFACTURER shall supply a Classification Society Certificate of compliance with Rules requirements for the pump PACKAGE.

13.2 Material Certification


13.2.1 PACKAGER / MANUFACTURER shall obtain all necessary certification of the equipment.

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

14 INSPECTION, TESTING AND COMMISSIONING

14.1 Inspection

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

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

14.1.3 OWNER shall witness all pump Factory Acceptance Tests carried out at the MANUFACTURER's facilities.

14.1.4 SUPPLIER shall inform PACKAGER / MANUFACTURER regarding any specific commissioning conditions for the equipment, i.e., conditions in which the equipment will have to operate temporarily, including environmental conditions such as extreme ambient temperatures, if they are different from the conditions defined in the data sheet. The PACKAGE shall be designed to withstand such conditions.

14.2 Factory Acceptance Test (FAT)

14.2.1 SUPPLIER shall prepare a factory acceptance test / procedure (FAT) and submit for OWNER approval.

14.2.2 PACKAGER / MANUFACTURER shall carry out pump tests in accordance with ISO 5199 or ASME B73, according to the pump's governing standard, and this specification.

14.2.3 For the Factory Acceptance Test (FAT), the PACKAGER / MANUFACTURER shall make preliminary test to ensure that all parts of the equipment are operating satisfactorily prior to the arrival of the OWNER's representative.

14.2.4 SUPPLIER shall advise OWNER of the test schedule before the planned test dates.

14.2.5 When required, SUPPLIER shall arrange with the appointed Classification Society surveyor to witness FAT.

14.2.6 Each pump rotor, including spares if purchased, shall undergo a witnessed mechanical run test at the duty point in accordance with ANSI/HI 14.6. Minimum test duration shall be 60 minutes. During this run, MANUFACTURER shall record and approve records of vibration and temperature.

14.2.7 The vibration measurement shall be performed in the rated point and in minimum continuous stable flow conditions.

14.2.8 The acceptance criteria for vibration shall be according to ANSI/HI 9.6.4.

14.2.9 For the minimum continuous stable flow, the vibration shall not exceed 30 % of the value established for the rated flow.

14.2.10 The acceptance criteria for bearing temperature during Mechanical Running Test shall be as following:


14.2.10.1 For pressurized systems, the oil outlet temperature shall be less than 70 °C and bearing metal temperature (if bearing-temperature sensors are supplied) less than 93 °C. During shop testing, the bearing oil temperature variation shall not exceed 28 °C;

14.2.10.2 For ring-oiled, splash or flood systems, oil sump temperature shall be less than 82 °C. During shop testing, the bearing oil temperature variation shall not exceed 40 °C;

14.2.10.3 For grease systems, the bearing housing temperature shall be less than 90 °C. For shielded bearings, the temperature shall be less than 50 °C.

14.2.11 PACKAGER / MANUFACTURER shall carry out a witnessed performance test on one unit of each pump type. For pumps designed for parallel operation, a witnessed performance test shall be carried out on each pump unit according to item 6.4.6.

14.2.12 The performance test shall include a minimum of three (3) test points for constant speed pumps: one at shut off, of rated flow and one at the end of allowable operating region.

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14.2.13 For variable speed pumps, two additional points are required, one at the minimum continuous stable flow (beginning of allowable operating region) and one midway between minimum continuous flow and rated flow.

14.2.14 The test speed shall be within 3 % of the rated speed shown on the pump data sheet. Test results shall be corrected to real driver speed.

14.2.15 Performance parameters and respective tolerances shall be in accordance with ANSI/HI 14.6, grade 1B. Power and efficiency tolerances, in accordance with this standard, are mandatory.

14.2.16 Vibration and bearing housing temperature measurements are also required for the performance test and shall be recorded in the FAT report.

14.2.17 Vibration and temperature limits for the performance test shall be compatible with the limits defined for the mechanical run test.

14.2.18 If the developed head at the duty point is below the allowable margins, PACKAGER / MANUFACTURER shall abort the test and shall recommence at no further cost to OWNER after mutually agreed design changes have been implemented.

14.2.19 If the pump that fails test is part of a type (i.e. a group of pumps purchased for the same duty), all units shall be subject to witnessed performance test at no additional cost to OWNER, following modification.

14.2.20 Motors tests shall be in accordance with I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units or I-ET-3010.00-5140-712-P4X-002 – Medium-Voltage Induction Motors for Offshore Units.

14.2.21 Monitoring systems of P2 type PACKAGE UNITS and monitoring sensors of P0 type PACKAGE UNITS shall be tested on the FAT.

14.2.22 Acceptance of the FAT will not be considered as the final acceptance test of the equipment.

14.2.23 If it is found necessary to dismantle any equipment after a test for repair or replacement of components, the test shall be invalidated and repeated.

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

14.3 Commissioning


14.3.1 PACKAGER / MANUFACTURER shall provide any necessary support for installation and commissioning of the equipment either at a shore-based fabrication yard or on the UNIT, including monitoring systems of P0 and P2 type PACKAGE UNITS.

14.3.2 SUPPLIER shall inform PACKAGER / MANUFACTURER regarding specific commissioning conditions for the equipment, i.e., conditions in which the equipment will have to operate temporarily, if they are different from the conditions defined in the data sheet.

14.3.3 Unless otherwise specified by MANUFACTURER, pump nozzles shall be connected to the respective piping within a parallelism tolerance of 10 micrometers per centimeter of pipe flange outer diameter, up to a maximum of 750 micrometers.

14.3.4 Parallelism shall be measured on opposite points of piping flange face against pump nozzle gasket seat, both vertical and horizontal directions, for suction and discharge nozzles.

14.3.5 If piping flange outer diameter is smaller than 25 centimeters, parallelism tolerance shall be up to a maximum of 250 micrometers.

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14.3.6 After parallelism is checked, SUPPLIER shall check alignment between pump and driver, which shall be within 0.5 mm per meter of distance between flex planes (coupling hub and shaft end), for pumps with flexible spacer type coupling.

14.3.7 Tolerance for closed coupling type pumps shall be 0.02 mm.

15 PREPARATION FOR SHIPMENT

15.1 Marking

15.1.1 PACKAGER / MANUFACTURER shall adequately mark all items supplied to this specification against a certificate or relevant test documentation.

15.1.2 PACKAGER / MANUFACTURER shall mark in such way that it does not damage or impair the component.

NOTE: Marking may be done on the item itself or on its packing or nameplate.

15.1.3 OWNER shall reject items that cannot be identified.

15.1.4 Rejected items shall be recertified by carrying out all relevant testing, with prior approval of the OWNER.

15.1.5 As a minimum, PACKAGER / MANUFACTURER shall provide the following:

- Project number;
- Manufacturer's name;
- Purchase order number;
- Shipping weight;
- Item number;
- Classification Society surveyor's stamp.

15.2 Shipment Packing

15.2.1 PACKAGER / MANUFACTURER shall supply, test, flush, and preserve the PACKAGE and, if practical, already charge up with coolant and lubricants the equipment.

15.2.2 The preparation shall make the equipment suitable for 24 months outdoor storage from the time of shipment. The PACKAGE shall be protected from corrosion.

15.2.3 PACKAGER / MANUFACTURER shall treat and close off all open ends by plastic caps and taped.


15.2.4 PACKAGER shall submit the packing specification to the SUPPLIER for approval.

15.2.5 PACKAGER / MANUFACTURER shall pack in accordance with the requirements of the country to which the equipment is being shipped .

15.2.6 PACKAGER shall provide the procedures for unpacking, handling and installation, as well as repacking, and long-term storage requirements.

15.2.7 PACKAGER shall specify any limitations applicable to the transport and installation phase.

15.2.8 Unless otherwise advised, PACKAGER / MANUFACTURER shall check each item of equipment for its suitability to resist horizontal and vertical acceleration of 0.8g in any direction during sea transportation.

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16 REQUIRED DOCUMENTATION

16.1 PACKAGER / MANUFACTURER shall provide original documents in PDF format for all required documents.

16.2 Extracted figures from catalogue or manual, especially for the outline drawings of components such as couplings, mechanical seals and auxiliary equipment shall not be accepted.

16.3 Whenever required by OWNER, source files shall also be provided.

16.4 All documents required in this section shall be text searchable, including PDF files.

16.5 Before any document is issued by PACKAGER / MANUFACTURER, a document list shall be issued and approved by OWNER.

NOTE: This is required in order to guarantee the correct document numbering.

16.6 Drawings and diagrams shall use the symbols defined on I-ET-3000.00-0000-940-P4X-002 – Symbols for Production Units Design.

16.7 The following documents shall be provided during technical proposal by PACKAGER / MANUFACTURER in their preliminary version:

- General arrangement drawing;
- Cross section drawing;
- Datasheet;
- Performance curves, including Head, Power, efficiency and required NPSH versus flowrate.

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

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


EXAMPLE: B-5241501A/B – Inert gas seal pump – General Arrangement Drawing

16.9 If PACKAGER / MANUFACTURER issues documents which contain information valid for more than one pump tag, pump tag and service description shall be omitted and replaced by “Centrifugal Pumps”

EXAMPLE: Centrifugal pumps – Inspection and Test Plan.

16.10 The following documents shall be issued by PACKAGER / MANUFACTURER and approved by OWNER before FAT execution. Otherwise, OWNER shall not attend the FAT and shall not accept its execution:

- Piping and instrumentation diagram;
- General arrangement drawing;
- Cross section drawing with part list;
- Main and auxiliary equipment datasheets;
- Weight and center of gravity datasheet;
- Noise datasheet;
- Performance curves;
- Utility consumption list and heat dissipation;
- Inspection and Test Plan (ITP), including auxiliary equipment;
- Hydrostatic test procedure;
- Painting and insulation specification;
- FAT procedure.

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16.11 The following documents shall be issued by PACKAGER / MANUFACTURER and approved by OWNER before delivery of the PACKAGE. Otherwise, OWNER will not attend to the receiving inspection, and will not accept the PACKAGE:

- Nameplate drawings;
- Noise report;
- FAT report;
- Handling drawing for installation;
- Installation manual;
- Instruments and instrumented valves datasheets;
- Packing list;

16.12 The following documents shall be issued by PACKAGER / MANUFACTURER and approved by OWNER before issuance of the Databook. Otherwise, OWNER will not accept the Databook:


- Mechanical seal drawing;
- Coupling drawing;
- Outline drawings of auxiliary equipment;
- Operation and maintenance manuals for main and auxiliary equipment;
- List of spare parts for commissioning and start up;
- List of recommended spare parts for two years of operation;
- List of special tools;
- List of instruments and instrumented valves;
- List of set points, alarms and shutdown;
- Logic diagrams;
- Cause and effect charts;
- Loop diagram;
- Electromechanical panel drawing;
- Memory maps;
- Automation architecture;
- Interconnection wiring diagram;
- Calculation notes of control valves, PSVs and flowmeters;
- I/O List;
- HMI screen layout;
- Calibration certificates of instruments;
- Fabrication procedures of pressure vessels classified in NR-13;
- NDT procedures of pressure vessels classified in NR-13;
- Hydrotest reports for pressure vessels classified in NR-13;
- Hydrotest report of pumps;
- NDT reports;
- Material certificates;
- Heat treatment records;
- Databook index.

16.13 All documents for electric motors shall be according to I-ET-3010.00-5140-712-P4X-001 – Low-Voltage Induction Motors for Offshore Units and I-ET-3010.00-5140-712-P4X-002 – Medium-Voltage Induction Motors for Offshore Units.

16.14 PACKAGER / MANUFACTURER shall issue installation, operation and maintenance manuals in Portuguese.

NOTE: PACKAGER / MANUFACTURER may choose to issue one single manual with installation, operation and maintenance instructions.

16.15 Installation manual shall contain all recommendations for preservation during storage on erection stage. 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.

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16.16 Installation manual shall contain a list of all consumables to be used for erection, commissioning and start up.

16.17 Maintenance manual shall contain the specification of lubricant fluids and periodicity of replacement.

16.18 Maintenance manual shall contain instructions to assemble and disassemble each major piece of the equipment, such as mechanical seal, rotor and roller bearings.

NOTE: This information may be provided on a separate manual for the piece as well.

16.19 PACKAGER / MANUFACTURER may choose to include specific commissioning instructions on the operation manual, or to issue a separate document, such as a procedure, for commissioning instructions.

16.20 PACKAGER / MANUFACTURER shall confirm in these instructions if the pump can operate with water, for services which the operation fluid is not water.

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

16.22 General arrangement drawings shall contain the connection list, i.e., a list with all connection tie-in points of the skids, which shall have the following minimum information: Connection identification number (which shall be represented in the drawing), connection description, tie-in connection specification, that is, pressure rating, manufacturing standard, flange face type, connection nominal diameter and fluid.

16.23 PACKAGER / MANUFACTURER shall 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.

16.24 Mechanical seal drawings shall contain a list with all connections on the seal, including identification code (which shall be represented on the mechanical seal drawing), connection description and fluid. Mechanical seal drawings shall contain also a part list with identification number of the part, description of the part and material of each part.

16.25 Identification number of seal parts shall be different from the identification code of the connections.

NOTE: For example, identification codes can be letters and parts identified by numbers.

16.26 PACKAGER / MANUFACTURER shall inform either in the datasheet or in the performance curve the flow rates defining the preferred operation region and the allowable operation region of the equipment.

16.27 PACKAGER / MANUFACTURER shall inform the number of impeller vanes either in the datasheet or in the cross section drawing with part list.

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