	TECHNICAL SPECIFICATION		Nº: I-ET-3010.00-1200-456-P4X-001	
	CLIENT: SRGE		SHEET: 1 of 39	
	JOB: -			
	AREA: -			
SRGE	TITLE: REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION		INTERNAL	
			ESUP	

MICROSOFT WORD / V. 2013 / I-ET-3010.00-1200-456-P4X-001_E.DOCX

INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
A	REVISED WHERE INDICATED
B	REVISED WHERE INDICATED
C	REVISED WHERE INDICATED
D	REVISED WHERE INDICATED
E	GENERAL REVISION UPDATED WITH IOGP S-749 (2023) REQUIREMENTS

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	MAR/26/21	JAN/03/22	OUT/27/22	DEC/07/22	FEB/28/23	MAI/16/24			
DESIGN	ESUP	EEA	EEA	EEA	EEA	EEA			
EXECUTION	U3CI	U3CI	UPVY	CJX4	U3CI	CJX4			
CHECK	U5IC	U5IC	U3CI	U3CI	UPVY	CJW2			
APPROVAL	U32N	U32N	U32N	U32N	U32N	U32N			

INFORMATION IN THIS DOCUMENT IS PROPERTY OF PETROBRAS, BEING PROHIBITED OUTSIDE OF THEIR PURPOSE.
FORM OWNED TO PETROBRAS N-0381 REV.L.



TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
AREA:	-	SHEET 2 of 39
TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
		ESUP

SUMMARY

OBJECTIVE.....	4
SECTION I – COMPLEMENTARY REQUIREMENTS TO IOGP S-749 AND API 667.....	5
1 SCOPE.....	5
2 NORMATIVE REFERENCES.....	5
3 TERMS, DEFINITIONS, AND ABBREVIATION TERMS	8
4 GENERAL	10
5 PROPOSAL INFORMATION REQUIRED	11
6 DRAWINGS AND OTHER DATA REQUIREMENTS.....	12
7 DESIGN.....	15
8 MATERIALS.....	23
9 FABRICATION	25
10 INSPECTION AND TESTING	26
11 PREPARATION FOR SHIPMENT.....	31
ANNEX A.....	33
ANNEX B.....	35
SECTION II – IOGP S-749L (1.0) INFORMATION REQUIREMENTS FOR PLATE-AND-FRAME HEAT EXCHANGERS (API).....	39
SECTION III – IOGP S-749D (1.0) PROCUREMENT DATA SHEET FOR PLATE-AND-FRAME HEAT EXCHANGERS (API).....	39



TECHNICAL SPECIFICATION

Nº: I-ET-3010.00-1200-456-P4X-001

REV. E

AREA: -


SHEET 3 of 39

TITLE: REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION

INTERNAL
ESUP

WORKING GROUP RESPONSIBLE FOR CURRENT REVISION

NAME	DEPARTMENT	KEY
Alexandre Esteves e Cunha	SRGE/ESUP/EEA/EEAT	CJW2
Daniela Gomes Schmidt	SRGE/ESUP/EEA	CJX4
Igor Soares Carvalho	SRGE/ESUP/EEA/EEAT	U5IC
Lucas Jean Vicente Su	SRGE/ESUP/EEA/EEAT	F0Q8
Ricardo Luiz Fernandes de Carvalho	SRGE/ESUP/EEA/EEAT	U3CI

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 4 of 39
			INTERNAL
			ESUP

OBJECTIVE

This Specification establishes the technical requirements for the execution of the design of engineering, materials, fabrication, inspection, testing and certification of all Plate Heat Exchangers to be supplied to PETROBRAS FPSOs. This specification complements:


- API 667;
- IOGP S-749 and its amendments¹;

¹Quality requirements of IOGP S-749Q shall be replaced by Exhibit VII (Directives for Quality Management System), I-ET-3010.00-1200-972-P4X-001 - MANUFACTURING SURVEY INSPECTION, and I-ET-3010.00-1200-978-P4X-001 – TRACEABILITY.

This technical specification is written as an overlay to IOGP S-749 (version 1.0, December 2023), matching the same numbers of section and subsections, which are reproduced in the following items. If a section (or subsection) of IOGP S-749 or API 667 is modified, this specific section is identified inside a box with: **Add** (add to section or add new section), **Replace** (part of or entire section) or **Delete**. Otherwise, if no supplementary or modification is required, the section (or subsection) of IOGP S-749 specification or API 667 is mandatory.

In addition to the requirements of this technical specification, **SELLER** shall follow all the requirements of the Exhibit I (SCOPE OF SUPPLY), as well as Exhibit III (DIRECTIVES FOR PRODUCT DEVELOPMENT), Exhibit IV (DIRECTIVES FOR PRODUCT FABRICATION), Exhibit V (DIRECTIVES FOR ACQUISITIONS), Exhibit VI (DIRECTIVES FOR PLANNING AND CONTROL), Exhibit VII (DIRECTIVES FOR QUALITY ASSURANCE SYSTEM) and Exhibit VIII (DIRECTIVES FOR COMMISSIONING PROCESS).

The requirements herein listed are applicable to all players performing such related activities within the scope of this unit, including s, manufacturer, main **SELLER**, sub **SELLERS**, suppliers, sub suppliers, integrators, constructors, and all technical personnel involved. Within the scope of this document, they are all referred to as being a **SELLER**.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	SHEET 5 of 39	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

SECTION I – COMPLEMENTARY REQUIREMENTS TO IOGP S-749 AND API 667

1 SCOPE

Add to section

The use of gasketed plate heat exchangers is not acceptable for heating or cooling gas.

2 NORMATIVE REFERENCES

Add new section 2.0 heading before first paragraph

2.0 CODES AND STANDARDS

Add to first paragraph

The following publications are referred to in this document, the PDS (IOGP S-749D) or the IRS (IOGP S-749L) in such a way that some or all of their content constitutes requirements of this specification.

Replace NACE MR0103 with

ANSI/NACE MR0103/ISO 17945, Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments.

Replace NACE MR0175 with

ANSI/NACE MR0175/ISO 15156 (all parts), Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production.

Add to section

API 579-1/ASME FFS-1, Fitness-For-Service

ASME, Boiler and Pressure Vessel Code, (BPVC) Section IX, Welding, Brazing, and Fusing Qualifications

ASME, Boiler and Pressure Vessel Code, (BPVC) Section VIII, Division 1, Rules for Construction of Pressure Vessels

ASME, Boiler and Pressure Vessel Code, (BPVC) Section VIII, Division 2, Rules for Construction of Pressure Vessels: Alternative Rules

ASTM A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless-Steel Parts, Equipment, and Systems

ASTM A578/A578M, Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications

AWS D1.1, Structural Welding Code – Steel


EN 10160, Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)

EN 10204, Metallic products — Types of inspection documents

EN 13445, Unfired pressure vessels

IOGP S-715, Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments

ISO 10474, Steel and steel products — Inspection documents

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	SHEET 6 of 39	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

ISO 12944 (all parts), Paints and varnishes — Corrosion protection of steel structures by protective paint systems

ISO 15607, Specification and qualification of welding procedures for metallic materials — General rules

PD 5500, Specification for unfired pressure vessels

Add to List


ASME BPVC Sec II	Materials
ASME BPVC Sec V	Non-Destructive Examination
ASME B 16.47	Large Diameter Steel Flanges (NPS 26 Through NPS 60)
ASME B 16.5	Pipe Flanges and Flanged Fittings (NPS ½ Through NPS 24)
ASTM B850	Standard Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement
ASTM D471	Standard Test Method for Rubber Property-Effect of Liquids
ABNT NBR 6123	“Forças devidas ao Vento em Edificações” (Brazilian Technical standard for wind load calculation)
ISO 34	Rubber, Vulcanized or Thermoplastic – Determination of Tear Strength
ISO 37	Rubber, Vulcanized or Thermoplastic – Determination of Tensile Stress-strain Properties
ISO 48-2	Rubber, Vulcanized or Thermoplastic – Determination of Hardness (hardness between 10 IRHD and 100 IRHD)
ISO 815-1	Rubber, Vulcanized or Thermoplastic – Determination of Compression Set Part 1: At ambient or elevated temperatures
ISO 1817	Rubber, Vulcanized or Thermoplastic – Determination of the Effect of Liquids
ISO 2781	Rubber, Vulcanized or Thermoplastic – Determination of density
ISO 21457	Petroleum and natural gas industries – Materials selection and corrosion control for oil and gas production systems

Add new sections

2.1 CLASSIFICATION SOCIETY

SELLER shall perform the work in accordance with the requirements of the Classification Society.

SELLER is responsible submit to the Classification Society the documentation in compliance with stated Rules.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 7 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			INTERNAL
			ESUP

Add new section

2.2 GOVERNMENT REGULATION

- | | |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------|
| NR-13 | “Caldeiras, Vasos de Pressão, Tubulações e Tanques Metálicos de Armazenamento” (Boilers, Pressure Vessels, Piping and Metal Storage Tanks) |
| NR-37 | “Segurança e Saúde em Plataformas de Petróleo” (Safety and Health in Oil Platforms) |

Note: Government codes, regulations, ordinances, or rules applicable to the equipment in Brazil shall prevail over the requirements of this specification, including reference codes and standards, only if more stringent.

Add new section


2.3 REFERENCE DOCUMENTS

- | | |
|-------------------------------|------------------------------------------------------------------------------|
| DR-ENGP-I-1.15 | COLOR CODING |
| I-ET-3010.00-1200-540-P4X-001 | REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION |
| I-DE-3010.00-5140-700-P4X-003 | GROUNDING INSTALLATION TYPICAL DETAILS |
| I-ET-3010.00-1200-251-P4X-001 | REQUIREMENTS FOR BOLTING MATERIALS |
| I-ET-3010.00-1200-956-P4X-002 | GENERAL PAINTING |
| I-ET-3010.00-1200-431-P4X-001 | THERMAL INSULATION FOR MARITIME INSTALLATIONS |
| I-ET-3010.00-1200-955-P4X-001 | WELDING |
| I-ET-3010.00-1200-940-P4X-002 | GENERAL TECHNICAL TERMS |
| I-ET-3010.00-1200-970-P4X-003 | REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION |
| I-ET-3010.00-1200-970-P4X-004 | NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS |
| I-ET-3010.00-1200-970-P4X-013 | COMPLIANCE WITH NR-13 AND SPIE REQUIREMENTS |

Add new section

2.4 CONFLICTING REQUIREMENTS

In case of conflicting requirements between this technical specification and the referred applicable standards, the most stringent requirement shall prevail. In case of conflicting information between this Specification and other specific **PETROBRAS**’ document, a formal technical query shall be issued to **PETROBRAS**, seeking clarification.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 8 of 39
			INTERNAL
			ESUP

Replace Section 3 title with

3 TERMS, DEFINITIONS, AND ABBREVIATION TERMS

Add new section 3.0 heading before first paragraph

3.0 ADDITIONAL ABBREVIATED TERMS

CAS conformity assessment system

EPDM ethylene propylene diene monomer

FKM fluoroelastomer

FFKM perfluoroelastomer

HBW Brinell hardness with tungsten ball

HNBR hydrogenated nitrile butadiene rubber

IRS information requirements specification

NBR nitrile butadiene rubber

NDE nondestructive examination

PDS procurement data sheet

PMI positive material identification

PN nominal pressure

QRS quality requirements specification

TRS technical requirements specification


Add new NOTE

NOTE Terms and definitions are also established in I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

Add new term 3.22

3.22 austenitic stainless steel

Stainless steel whose microstructure at room temperature consists predominantly of austenite.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	SHEET 9 of 39	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

Add new term 3.23

**3.23
carbon equivalent (CE)**

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

with chemical element concentration expressed in mass fraction percent.

NOTE Definition sourced from the International Institute of Welding.

Add new term 3.24

**3.24
carbon steel**

Alloy of carbon and iron that contains up to 2 % mass fraction carbon, up to 1.65 % mass fraction manganese and residual quantities of other elements, except those intentionally added in specific quantities for deoxidation, usually silicon/aluminum.

Add new term 3.25

**3.25
low-alloy steel**

Steel that contains a total alloying element content of less than 5 % mass fraction or steels whose chromium mass fraction is less than 10.5 % and more than that specified for carbon steel.

Add new term 3.26

**3.26
utility service**

Process operation consisting of only demineralized water, steam, potable water, sea water, cooling tower water, refrigerant (all phases), glycol/water solutions, lubricating oil, diesel oil, air, inert gases or any combination thereof.

NOTE Plate-and-frame heat exchangers in utility service typically form part of an equipment package or skid for which the consequences of failure can be lower than for plate-and-frame heat exchangers in non-utility service.

Add new term 3.27


**3.27
Intermediate reinforcement plate**

A plate inserted into the plates set to provide greater rigidity to the assembly.

Add new term 3.28

**3.28
purchaser**

Also identified as Buyer, it is defined as the Company that is buying the FPSO, PETROBRAS.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 10 of 39
		INTERNAL	ESUP

4 GENERAL

Add new section 4.0 before first paragraph

4.0

Compliance with the requirements of this Technical Specification or other specifications shall in no case reduce or eliminate **SELLER's** responsibility, who will always bear full responsibility for the thermal and mechanical design and fabrication of the heat exchangers.

SELLER shall design and fabricate the heat exchangers for a minimum lifetime of 30 years.

4.1

Add to second sentence

except where modified by this specification

Replace first sentence

The selected pressure design code shall be ASME BPVC Section VIII Division 1.

4.7

Replace first sentence with

Materials and welds in sour service or wet hydrogen sulfide service shall comply with ANSI/NACE MR0175/ISO 15156 (all parts) or ANSI/NACE MR0103/ISO 17945, as specified.

4.10

In second sentence, replace "subject to the agreement of the purchaser" with

as specified in 4.11

Add new section

4.11 Screening and Evaluation Method for Fatigue Analysis

4.11.1


The screening and evaluation method for fatigue analysis shall be in accordance with the specified pressure design code.

4.11.2

Where the selected pressure design code is ASME BPVC, Section VIII, Division 1, the screening and evaluation method for fatigue analysis shall be in accordance with ASME BPVC, Section VIII, Division 2.

4.11.3

Where the specified pressure design code does not include a screening and evaluation method for fatigue analysis, the method described in EN 13445, PD 5500, API 579-1/ASME FFS-1 or ASME BPVC, Section VIII, Division 2, shall be applied.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 11 of 39 INTERNAL ESUP

5 PROPOSAL INFORMATION REQUIRED

Add new paragraph before 5.1

In cases where the **PETROBRAS** provides data sheets, basic drawings showing the arrangement or other specific documents for the heat exchanger, the thermal design shall comply with those documents. Any discrepancies or alternatives suggested will only be accepted after expressly **PETROBRAS** approval.

5.2

Replace section with

For components that are not described in this specification, the specified design code or purchase order documentation, details of the design method, construction and assembly shall be provided with the proposal.

5.5

Add new NOTE

NOTE Gasket material selection is covered in 7.8.6.

Add new NOTE

NOTE **SELLER** shall select the gasket material to ensure 3 years of continuous operation under operating pressure and temperature conditions, as stated in item 7.8.7.

5.6

Add to section

And any additional foundation details of the movable plate support for installation of the initial plate pack size and for installation with extended plate pack.

5.9

Delete "When specified by the purchaser"

Replace list sub-item a- 4) with


number of effective plates for each operational case shown on Process Data Sheet or any other issued inquire/purchase documents.

Add to list sub-item b-4

The hot fluid inlet and the cold fluid outlet shall be placed at the equipment upper part. The hot fluid outlet and the cold fluid inlet shall be placed at the equipment lower part.

Replace list sub-item c-9-i with

- i) flow configuration shall be countercurrent (hot fluid versus cold fluid);

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 12 of 39
			INTERNAL
			ESUP

5.10

Add new NOTE

NOTE Fouling margins, wall shear stress and the associated pressure drop multiplier are covered in section 7.4.

Add to Section

SELLER shall assure that the pressure drop at the connections and port holes will not result in unbalanced flow distribution within the plate heat exchanger, for both fluids. To achieve a well-balanced flow distribution, the developed pressure drop at the heat exchange surface of the plates shall be at least 75% of the total pressure drop for each fluid, unless otherwise approved by **PETROBRAS**. **SELLER** shall present, for both fluids, the pressure drop distribution among the connections, port holes and heat exchange surfaces in the thermal hydraulic calculation report.

5.11

Add to Section

The maximum flow velocity (m/s) at fluid entrance and exit shall not exceed $150/\sqrt{\rho}$ where ρ is the mean specific mass of the fluid in kg/m^3 .

5.12

Add to Section

Carbon steel nozzles or studded openings in the fixed cover plate in contact with the process fluid shall be clad with the same material as the plate pack, especially when plate pack material is a titanium alloy. There is a concern about hydrogen embrittlement of titanium alloys due to galvanic corrosion. A corrosion allowance of 3 mm or suitable internal coatings may be used as alternatives only after written **PETROBRAS** approval.

6 DRAWINGS AND OTHER DATA REQUIREMENTS

6.1 Outline Drawings and Other Supporting Data


6.1.1

Add after first sentence of list item g)

as plate space for withdrawal maintenance requirements

Replace item o) with

Gasket location on the plates (see Figure 6), gasket groove pressing depth in the plates, gasket materials, attachment method (see item 7.8.2), glue type, type of elastomer, Manufacturer, and model / part number.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 13 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

Add new list item u)

u) maximum allowable working pressure for new-and-cold and hot-and-corroded conditions.

Add new list item v)

v) arrangement of the heat transfer plates in the plate pack and detailed data to allow the plate and gasket assembly and disassembly in the field.

6.1.3

Replace section with

The vendor shall inform and include on the scope of supply all tools needed for the assembly and maintenance of the plate-and-frame heat exchanger, as well as any accessory equipment to guarantee the exchanger performance, safety, and satisfactory continuous operation.

Add new section

6.1.6

SELLER shall submit a complete calculation report (thermal and mechanical) for **PETROBRAS'** review, approval, and record. The design calculation reports shall comply with the specified design code. The SI unit system shall be used, except for nozzles and pipe diameters, which must follow the imperial system.

6.2 Information Required After Outline Drawings Are Reviewed

6.2.2

Delete "If specified by the purchaser"

6.2.3

Delete "If specified by the purchaser"

6.2.4

Delete "If specified by the purchaser"

6.3 Reports and Records


6.3.1

In list item d), replace "mill" with

material

In list item k), add new sub-items

4) torque fastening procedures (torque sequence, controlled or manual, bolt numbering and torque value) shall be informed on the equipment's manual.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	SHEET 14 of 39	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

- 5) all necessary information of the equipment, regarding installation, startup, shutdown, operation, maintenance (disassembly and assembly), transportation, etc.
- 6) plate bundle compression procedure, providing the length of the bundle and the accommodation time at each stage of the closing and opening sequences.
- 7) all information written also in Portuguese language.

Add new list item

- l) gasket certification, containing the tests results of Table 2.

Add new section

6.4 Certification

6.4.1

SELLER through the independent certifying authority shall be responsible for obtaining and to supply all necessary certification of the equipment, related to the materials, inspections, tests, and qualification activities detailed in the approved Quality Plan.

6.4.2

Material certificates shall be provided for all materials, showing the chemical analyses and test results required by the specifications of each material.

6.4.3

Gaskets' certifications shall contain the information of tests included in Table 2. Gasket batches shall be identifiable for traceability.

6.4.4


Plates' certificates shall include information that ensures its traceability. Each plate shall be stamped with information that ensures its traceability to its certificate.

6.4.5

For all heat exchangers, a Classification Society certificate shall be supplied to obtaining all necessary certification of the equipment. **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.

6.4.6

Qualification and certification for procedures and personnel shall be in accordance with I-ET-3010.00-1200-970-P4X-003 – REQUIREMENTS FOR PERSONNEL QUALIFICATION AND CERTIFICATION.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 15 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

7 DESIGN

7.1 General

Add new section

7.1.4

During the pressure test, the general primary membrane stress in pressure parts shall not exceed the limit specified by the design code or 95 % of the specified minimum yield strength of the material, whichever is less.

Add new section

7.1.5

Pressure-retaining components shall withstand the most severe combination of specified design pressure and coincident design temperature.

Add new section

7.1.6

SELLER shall design the equipment for the full range of process conditions as specified in the provided data sheets or other issued inquire/purchase documents.

Add new section

7.1.7

The mechanical design of the equipment shall ensure that instantaneous and non-continuous flows up to 11 % higher than the design flow of the equipment are supported, for both sides, in the event of failure of the control valve.

Add new section

7.1.8

The equipment supplied shall be suitable for the environment and range of ambient conditions, defined in METOCEAN DATA [document supplied by **PETROBRAS**].

Add new section


7.1.9

The necessary design data and information on motion requirements are given in MOTION ANALYSIS [document supplied by **PETROBRAS**].

Add new section

7.1.10

Wind loads shall be calculated as per I-ET-3010.00-1200-540-P4X-001 - REQUIREMENTS FOR PRESSURE VESSELS DESIGN AND FABRICATION.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 16 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

Add new section

7.1.11

In addition to the Code described loads and loads due to vessel motion described in MOTION ANALYSIS [document supplied by **PETROBRAS**], the following design loads shall be considered where relevant:

- Equipment transportation and erection loads
- Nozzle loads as described in this specification
- Thermal loads
- Wind load
- Weight load

7.2 Design Temperature

7.2.1

Replace section with

The maximum design temperature of plate heat exchangers shall consider the temperature of the hottest fluid. The minimum design temperature shall be higher than the minimum design metal temperature. The maximum design temperature to be used for dimensioning and material selection shall be limited to 150 °C. For hydrocarbon service, the maximum operation temperature shall be limited to 100 °C, for both fluids.

7.3 Design Pressure

Delete "Unless otherwise specified or approved by the purchaser"

Add to section

No part of the heat exchanger shall be designed for differential pressure. In addition, the MANUFACTURER shall provide the safe operating boundary for the selected heat exchanger.

The maximum design pressure of gasketed plate heat exchangers shall be limited to a pressure of 20 bar(g) for the entire temperature range. Both sides of the equipment shall meet the defined maximum design pressure.

The maximum operating pressure, including any fluctuations, shall not exceed 80% of the design pressure.


7.4 Fouling Margin

Add to section

When the maximum solid particle size is not specified, the solid particle size used as the basis for design shall be 1 mm (0.04 in.).

Add to section

If not specified, the fouling margins, minimum wall shear stresses and associated pressure drop multiplier shall be in accordance with Table A.1.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 17 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

Add to section

The pressure drop multiplier over the calculated pressure drop in the clean condition shall be used to calculate the pressure drop in the fouled condition for the specified design and rating cases.

7.6 Components

7.6.1

Replace list section a) with

a) the thickness of heat transfer plates after being pressed shall be sufficient to meet design conditions including suitability for handling without damage and to limit the risk of misalignment from plate deformation. For services with hydrocarbon, the nominal thickness before pressing shall not be less than of 0.8 mm. For sea water service, the minimum thickness shall be 0.7 mm. For other services with a plate number above 200 or plates in titanium, the minimum thickness of heat transfer plate shall be 0.7 mm.

For auxiliary package exchangers (e.g., Lubricant Oil Cooler) the minimum thickness shall not be less than 0.6 mm.

See A.3.4 for additional information on minimum heat transfer plate thickness.

Delete "unless approved by the purchaser" and add new sentence at the end of list section c)

Whenever the number of contiguous heat transfer plates exceed the limit of 400 plates, an intermediate reinforcing plate, structurally connected to fixed and movable covers through additional demountable structural bars, shall be provided for the heat exchanger. The minimum thickness of this intermediate reinforcing plate shall be 1/3 (one third) of the fixed cover. Intermediate reinforcing plate material and port holes lining shall be the same of fixed cover. The intermediate reinforcing plate shall be supplied with a movable support with rollers connected to the carrying bar with a construction like the one used in the movable cover.

Replace list section g) with

g) stiffeners shall not be used on end plates to meet the specified design conditions.

Add new list section h)

h) Plate dimensions shall contribute to increase equipment rigidity, as well as facilitate maintenance. The maximum plate dimensions shall be 770 mm in width and 2500 mm in height, taking from nozzle centerlines.


Add new list section i)

j) For sea water or hydrocarbon services, heat transfer plates shall be made of titanium.

7.6.2

Add new list section e)

e) For sea water service, movable cover shall be provided with 4 (four) port holes for cleaning purpose. The diameter of these "cleaning" port connections shall be the same as process connections. In addition, one port filter, manufactured with titanium, to be installed in sea water inlet connection shall be foreseen.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 18 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

7.6.3

Add to list section a)

in utility service and at least 19 mm (3 /4 in.) in non-utility service;

Add new sentence before list section d)

d) Tie bolts and nuts shall be the cathodic side when connected to other materials, due to galvanic corrosion possibility. This can be accomplished by using integral material or suitable coatings according to I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS.

7.6.4

Add new list section d)

d) Heat transfer plates shall be fully supported from the top carrying bar and only guided by the bottom bar with (reinforced) slots integral with the plate. The guides on the carrying bar and bottom guide bar for the plates shall be AISI 316.

7.6.5

Add to section

The bolt holes on the mounting foot plate located at the movable cover end shall be slotted to allow for free thermal expansion of the unit.

Add to the end of section

Mounting feet shall also be designed to withstand dynamic forces, as stated in MOTION ANALYSIS [document supplied by **PETROBRAS**].

7.6.6

Delete “If specified by the purchaser” and Add to the end of section

Shroud protection shield shall be fabricated of stainless-steel type 316. The shroud shield shall not obstruct installation of the foundation bolts.

7.6.8

Delete “If specified by the purchaser” and Replace the last two sentences with


The drip tray shall extend throughout all the exchanger, at least 25mm (1”) beyond the shroud cover.

7.7 Connections

7.7.1

Replace section with

Connections shall be either studded or flanged design. For flanged designs, the attachment of the nozzle neck to the cover shall be welded, set-in type, lined / overlaid with the same material as the plate pack, as details a) and e) of Figure 4.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 19 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

7.7.2

Replace last sentence with

The required flange design code shall be ASME B16.5. Flanges, their respective faces and gaskets, shall be according to PIPING SPECIFICATION FOR TOPSIDE or PIPING SPECIFICATION FOR HULL [documents supplied by **PETROBRAS**], even for flanges not connected to piping, when the requirements shall comply with the piping specifications applicable to the heat exchanger to which they are connected.

In order to not exceed the pressure versus temperature curves of ASME B16.5, and for stiffness issues, flanges shall be specified in class 300.

7.7.5

Replace "if agreed by the purchaser" with

in utility service and only if specified

7.7.7

Replace API 667 and IOGP section with

For nozzle welded to cover plates, it shall be set-in type and shall not protrude beyond the inside surface of the cover plate. The inside corners of solid nozzles and weld overlaid nozzles shall be rounded to a minimum radius of 3 mm (1/8 in.). Reinforcing pads shall not be used for nozzles.

7.7.8

Add to section

Stud bolts and nuts of the studded connection shall be included in the scope of supply of heat exchanger.

7.7.9

Replate section with

Plate-and-frame heat exchangers shall be designed for single pass arrangement, with all process connections located on the fixed cover. The unit shall be vented and drained through the process connections.

For auxiliary package heat exchangers (e.g., Lubricant Oil Cooler), multi-pass design may be accepted, subject to the approval of **PETROBRAS**. For multi-pass units, plates shall be provided with drain holes and Vendor shall follow API 667 item A.3.5.

7.7.13

Delete "the purchaser shall specify if " from first sentence

Add to section

Tell-tale holes shall be filled with grease after pressure testing.

7.7.17

Replace API 667 Table 1 and Delete IOGP item

Table 1 - Allowable Forces and Moments on Connections at the Fixed Cover

Nominal Size		PN 50 (ASME Rating 300)			
		F		M	
DN	(NPS)	N	(lbf)	N•m	(lbf•ft)
≤ 50	≤ (2)	1,367.5	(307.5)	402.5	(295)
80	(3)	2,402.5	(540)	1,230	(907.5)
100	(4)	3,140	(705)	1,937.5	(1,430)
150	(6)	5,107.5	(1,147.5)	4,200	(3,097.5)
200	(8)	7,212.5	(1,622.5)	7,157.5	(5,277.5)
250	(10)	9,427.5	(2,120)	10,835	(7,992.5)
300	(12)	11,735	(2,637.5)	15,280	(11,270)
350	(14)	14,117.5	(3,175)	20,540	(15,150)
400	(16)	16,572.5	(3,725)	26,665	(19,667.5)
450	(18)	19,087.5	(4,290)	33,712.5	(24,865)
500	(20)	21,660	(4,870)	41,732.5	(30,780)

NOTE: When the nozzle flange rating is increased based on the selected code requirements in combination with Table 1 loads, Table 1 load values used should be those corresponding to the original flange rating.

Add new section

7.7.18

Localized stress on nozzles and covers resulting from concentrated loads on nozzles or on structural attachments shall be evaluated using a recognized industry standard or a method referred to in the selected pressure design code (e.g. finite element analysis in accordance with ASME BPVC, Section VIII, Division 1, Mandatory Appendix 46, ASME BPVC, Section VIII, Division 2 or EN 13445-3).

Add new section


7.7.19

Radius or profiling at nozzle connections shall not reduce the clad thickness below the specified minimum value.

Add new section

7.7.20

If the flanges on nozzles are different from the specification of the piping connected to the heat exchanger, according to PIPING SPECIFICATIONS FOR TOPSIDE or PIPING SPECIFICATIONS FOR HULL [documents supplied by **PETROBRAS**], as applicable, a mating flange, including bolts and gasket, shall be included in **SELLER's** scope of supply.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 21 of 39
			INTERNAL
			ESUP

Add new section

7.7.21

Studs, bolts, tightening bolts and nuts shall follow material, coating and all other requirements stated in I-ET-3010.00-1200-251-P4X-001 – REQUIREMENTS FOR BOLTING MATERIALS. Hardened steel washers shall be provided under all rotating nuts.

7.8 Plate Gaskets

7.8.2

Replace section with

Gaskets shall be glued to the heat transfer plates, regardless of any other mechanical fixing. See A.3.10 for additional information on the use of glued gasket fixing. The requirement for adhesive glue application may be disregarded only for small-sized exchangers (nozzle diameter smaller than 80 mm).

7.8.6

Replace API 667 and IOGP section with

For gasket materials SELLER shall consider only: NBR, HNBR or FKM. Gasket selection shall take account operating conditions, fluid compositions, the specified process application and the design pressure.

SELLER shall present all reports and certificates demonstrating the approval in all qualification tests as per Table 2. These documents are intended to be valid for a maximum period of (3) three years.

Regardless the temperature limits established in the gasket certification, the operation temperature limit shall be considered: 80 °C for NBR and 100 °C for HNBR. The service temperature range of the selected glue can dictate the maximum operating temperature rather than the gasket material.


Replace Table 2 - Maximum Operating Temperature Limits for Common Gasket Materials with

Table 2 - Required Qualification Tests for Gasket Materials

Qualification Tests (NBR, HNBR and FKM)			
Test	Standard	Acceptance Criteria	Applicable Notes
Hardness	ISO 48-2	75 to 85 IRHD (HNBR) 72 to 85 IRHD (NBR)	(1)
Tensile strength	ISO 37	> 15 MPa	(2)
Elongation at rupture	ISO 37	> 150 %	(2)
Compression set test	ISO 815-1	< 25% (in 24 h); < 50% (in 72 h); and < 60% (in 336 h).	(3) (4) (5)
Tear strength	ISO 34-1	> 20 kN/m.	(8)
Liquid immersion test	ISO 1817	For hydrocarbon services: Max. hardness variation: +3/-12 units. Max. volume variation: +18%. For water services: Max. volume variation: +5 % (max.)	(4) (6) (7) (10)

NOTES:

- 1) Hardness shall be determined using "N" method and shall be measured in IRHD (International Rubber Hardness Degrees).
- 2) Dumb-bell type 1 test pieces shall be used. As alternative, the test pieces may be sections of gaskets with geometry corresponding to that used in the exchanger.
- 3) Test temperature shall be 150 °C for hydrocarbon services and higher value between 100 °C and design temperature for non-hydrocarbon services. For sample removal, cooling, and measurement the "A" method shall be used. The compression set device removed from the oven shall be immediately released from compression on a wooden bench and allowed to rest for 30 minutes before dimensions measured.
- 4) For the compression set and liquid immersion tests, the test pieces shall be sections with 50 mm length of gaskets with geometry corresponding to that used in the exchanger.
- 5) For the compression set test, the applied compression shall always be 25%, even if the sample hardness is greater than 80 IRHD.
- 6) Test temperature: 100 °C. Measurements after 72 hours immersed. Test specimens shall have 100% of their superficial area in contact with the liquid.
- 7) For the immersion tests, for hydrocarbon services if the liquid is not supplied by PETROBRAS, the reference oil IRM 903 of ASTM D471 shall be used. For water services, distilled water shall be used as the test fluid.
- 8) The tests shall be conducted at room temperature.
- 9) To verify the results, PETROBRAS may request samples of the elastomers.
- 10) For heat exchanger operating with other fluids than hydrocarbon and water, tests shall be performed at 100 °C and volume and hardness variation need to be previously agreed with PETROBRAS. Fluid test shall be the same or similar of operating fluid.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 23 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

Add new section

7.8.7

SELLER shall select the gasket material to ensure 3 years of continuous operation under operating pressure and temperature conditions.

Add new section

7.8.8

Only peroxide cured gaskets shall be accepted. No other type of curing system is accepted.

Add new section

7.8.9

There is a concern about corrosion of titanium alloys due to halogens released by gasket materials (especially FKM gaskets), **SELLER** shall be aware of it and shall guarantee for gasket material selected that it is not possible to occur at design and operation temperatures.

8 MATERIALS

8.1 General

8.1.1

Add before first sentence

SELLER shall refer to MATERIAL SPECIFICATION FOR HEAT EXCHANGERS [document supplied by **PETROBRAS**] for the material selection of the plate heat exchangers. Only if the material selection is not specified by **PETROBRAS**, **SELLER** shall define the complete heat exchanger's material considering the minimum design lifetime, the premises establishes in Technical Specification Material Selection Philosophy for Detailed Design Sheet [document supplied by **PETROBRAS** and requirements of ISO 21457.

8.1.4

Add after first sentence

SS 316, 3 mm thick. Nameplates shall be attached on each equipment, in an accessible location, fastened with corrosion resistant pins.

Add new section

8.1.5

The material for grounding lugs shall be austenitic stainless steel.

Add after first sentence

SELLER shall provide grounding installation for equipment and structures according to GROUNDING INSTALLATION TYPICAL DETAILS - I-DE-3010.00-5140-700-P4X-003.

Add new section

8.1.6

The maximum allowable carbon equivalent (CE) for carbon steel pressure-containing parts requiring welding shall be in accordance with Table 3 or the specified value, whichever is lower.

Add new Table 3

Table 3—Maximum Allowable Carbon Equivalent (CE)

Plate Thickness		Maximum Allowable CE
<i>t</i>		
mm	in.	
$t \leq 50$	$t \leq 2$	0.43
$50 < t \leq 100$	$2 < t \leq 4$	0.45
$t > 100$	$t > 4$	0.48

Add new section

8.1.7

The use of asbestos or materials containing asbestos is prohibited.

Add new section

8.1.8

All materials exposed to hydrocarbons containing H₂S shall comply with ISO 15156.

Add new section

8.1.9

Heat transfer's plates made of carbon steel shall not be accepted.

8.2 Requirements for Carbon Steel in Sour or Wet Hydrogen Sulfide Service


8.2.2

Delete "that are used in the formula to calculate the carbon equivalent (CE) as defined by NACE MR0175 (all parts) or NACE MR0103" from second sentence

8.2.3

Add new NOTE

NOTE Maximum allowable CEs for carbon steel pressure-containing parts requiring welding are covered in 8.1.6.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 25 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

9 FABRICATION

9.1 Welding

9.1.1

In first sentence, replace "pressure design code" with

ASME BPVC Section IX.

Replace "unless otherwise specified by the purchaser" with

welding shall also be performed in compliance with and I-ET-3010.00-1200-955-P4X-001 – WELDING.

9.1.3

Delete "except when approved by the purchaser"

Add before first sentence

Only full penetration welds are permitted for nozzles and flanges.

9.1.5

In first sentence, replace "micro-hardness" with

hardness

Replace second sentence with

Hardness testing and hardness testing acceptance criteria shall be in accordance with ANSI/NACE MR0103/ISO 17945 or ANSI/NACE MR0175/ISO 15156 (all parts).

Add new section

9.1.6

Butt welds on the primary pressure boundary shall be full penetration type.

Add new section

9.4 Coating and Painting

9.4.1


The external surface of carbon steel and low-alloy steel pressure-containing and structural components shall be coated.

9.4.2

Surface preparation and coating shall be in accordance with the specified painting specification.

Add after first sentence

I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 26 of 39
			INTERNAL
			ESUP

Add new section

9.4.3

Color code adopted shall comply with DR-ENGP-I-1.15 – COLOR CODING.

Add new section

9.5 Thermal Insulation

When personnel protection insulation is required, it shall ensure a temperature below 60° C on the outside surface, according to I-ET-3010.00-1200-431-P4X-001 – THERMAL INSULATION FOR MARITIME INSTALLATIONS.

10 INSPECTION AND TESTING

10.1 Quality Control

Replace section with

10.1.1

Inspections and tests shall be according to API 667, ASME Code (all applicable parts), and I-ET-3010.00-1200-970-P4X-004 – NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS.

As a minimum, at least, the following tests will be carried out:

- Hydrostatic test as per codes.
- UV light box test or fluorescent penetrant test on 10% of heat transfer plates after forming.
- Liquid penetrant examination on liner welds.
- Visual examination on 100% of heat transfer plates and on 100% of welds, internal and externally.
- Liquid penetrant or magnetic particle on 100% of lifting attachments.
- Volumetric examination on full penetration welds of all pressure retaining parts.
- Positive materials identification (PMI) on 10% of heat transfer plates.
- Dimensional inspection (width between midlines of the gasket installation grooves, height between hooks, distance between nozzles and depth of gasket housing) at 6 different points, as shown in Figure 8, on 5% of heat transfer plates.

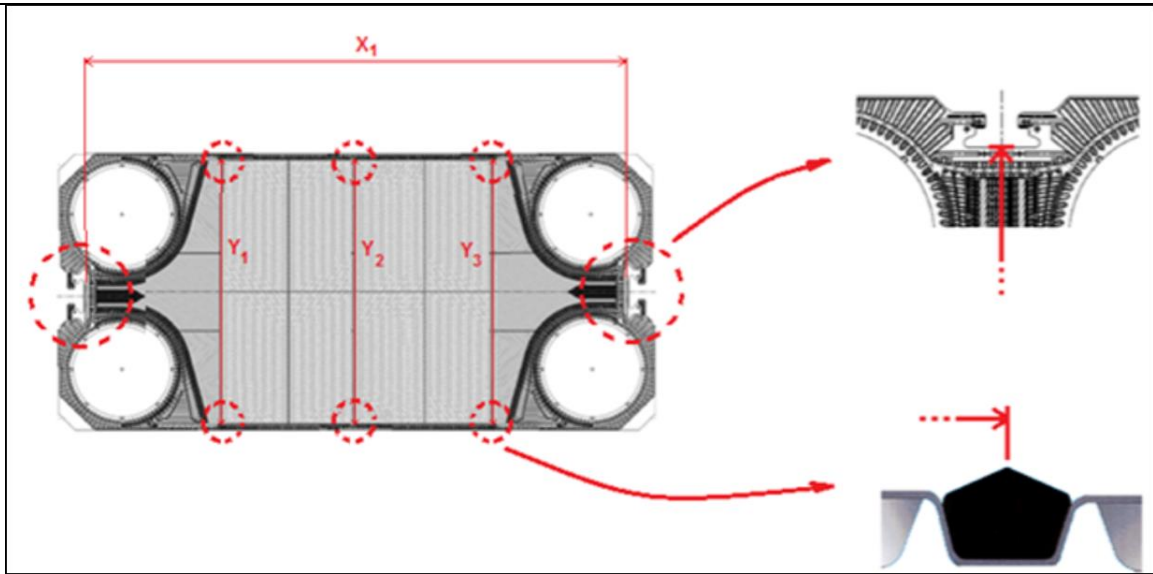


Figure 8—Visual Inspection points

10.1.5

Delete "If specified by the purchaser" from first sentence

10.1.8

In list section a), replace "At least one spot-radiograph shall be made of each accessible" with

Volumetric examination (radiographic or ultrasonic examination) shall be performed on 100% of full penetration.

In list section d), replace "NACE MR0175 (all parts) or NACE MR0103" with

ANSI/NACE MR0175/ISO 15156 (all parts) or ANSI/NACE MR0103/ISO 17945


Add new section

10.1.12

Positive material identification (PMI) shall be carried out on alloy components including cladding, weld overlay, alloy bolting and alloy plates.

Add after first section

At least 10% heat transfer plates shall be submitted to PMI. The PMI shall be carried out with equipment capable to identify the specified type of material in accordance with established procedure. The equipment shall not make burn marks to the pipe material. The PMI shall be done prior the welding to identify the materials which will be welded.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 28 of 39
			INTERNAL
			ESUP

Add new section

10.1.13

In sour service and wet hydrogen sulfide service, butt welds shall be subjected to 100 % volumetric examination.

Add new section

10.1.14

Where 100 % volumetric examination is specified, the complete length of butt welds, nozzle neck weld seams and nozzle-to-flange joint welds shall be examined.

Add new section

10.1.15

Pressure-retaining plates with a nominal thickness greater than or equal to 50 mm (2 in.), excluding the thickness of cladding or weld overlay if present, shall be ultrasonically examined in accordance with the specified standard.

Add new section

10.1.16

Magnetic-particle or liquid-penetrant examination shall be performed on lifting attachment final welds.

Add new section

10.1.17

Weld overlay, clad restoration welds and internal attachment welds shall be subjected to 100 % liquid penetrant examination.

Add new section

10.1.18

Weld-overlaid surfaces shall be examined with the liquid-penetrant method after final machining.

Add new section

10.1.19

The test acceptance criteria for liquid penetrant inspection of weld overlay shall be in accordance with the specified design code, except on gasket sealing surfaces where no indications are acceptable.

Add new section


10.1.20

Defects in weld overlay shall be repaired.

Add new section

10.1.21

On surfaces where the final weld overlay or clad layer has been partially removed, a copper sulphate test in accordance with ASTM A380/A380M shall be performed.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 29 of 39
			INTERNAL
			ESUP

Add new section

10.1.22

If not specified by the pressure design code, the extent of magnetic-particle and liquid-penetrant examination shall be in accordance with ASME BPVC, Section VIII, Division 2.

10.2 Hydrostatic Testing

10.2.5

Replace section with

The water temperature for hydrostatic testing shall be as specified or recommended in the selected pressure design code.

Replace section 10.3 title with

10.3 Nameplates and Markings

10.3.1

Replace IOGP and API item with

Nameplate shall be in Portuguese language and permanently mounted on a T-shaped bracket (see Figure 7) welded to the fixed cover of the plate-and-frame heat exchanger. Nameplate's material and thickness shall be in accordance with item 8.1.4.

10.3.2

Replace IOGP list item g) with

g) hydrostatic test;

Add new list section h)

h) All Code and Classification requirements;

Add new list section i)

i) Tag number;

Add new list section j)

j) Maximum allowable working pressure;

Add new list section k)

k) Operating temperature and pressure;

Add new list section l)

l) Thermal duty, volume, etc;

Add new list section m)

TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
AREA:	SHEET 30 of 39	
TITLE:	INTERNAL	
	ESUP	

m) Service;

Add new list section n)

n) Empty, operational test weight.

Add new note

NOTE The technical data shall be filled out in the units indicated in the drawing (SI and metric).

Add new section

10.3.3

Welds between the nameplate bracket and the exchanger cover plate shall be continuous fillet welds all around.

Add new section

10.3.4

The thickness of the nameplate bracket material shall not be less than 5 mm (1 /5 in.).

Add new section

10.3.5

The nameplate bracket projection from the cover plate shall not be less than 100 mm (4 in.).

Add new Figure 7

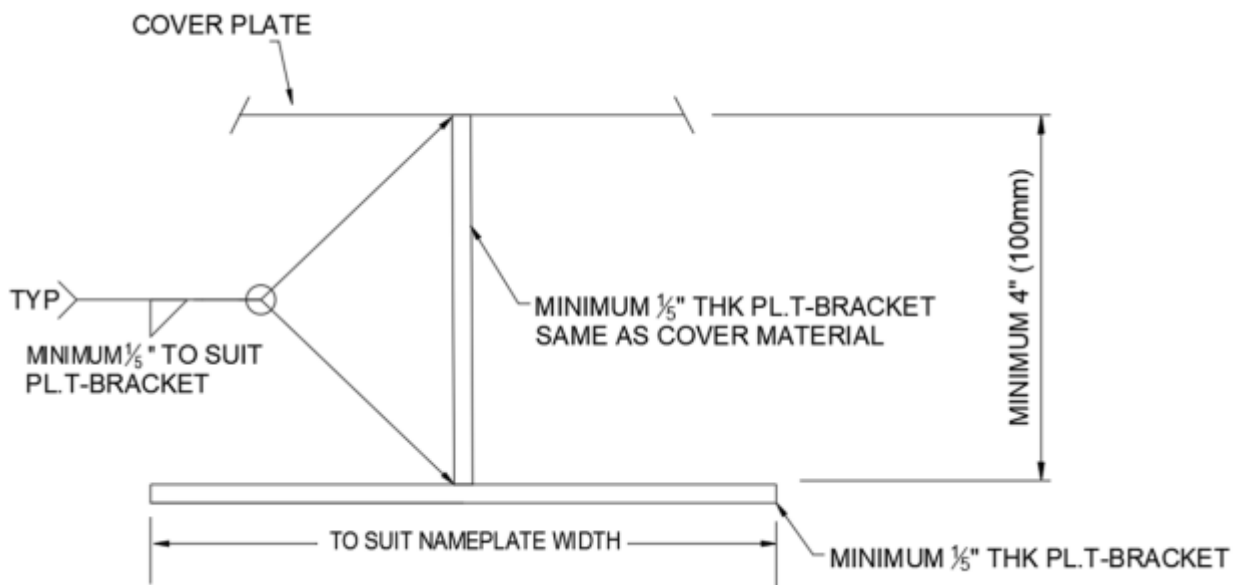



Figure 7—Typical T-shaped Nameplate Bracket

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 31 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	
			ESUP

Add new section

10.3.6

Pressure-retaining components that have received post-weld heat treatment shall be permanently marked with the text "POST-WELD HEAT TREATED – DO NOT BURN OR WELD".

Add new section

10.3.7

All safety signs shall be in the Portuguese language.

11 PREPARATION FOR SHIPMENT

11.7

Add after "(e.g. painting)"

for shipping

Add new section

11.11

When desiccant bags are specified, they shall be located in the bottom portion of the plate-and-frame heat exchanger in either nozzles or ports.

Add new section

11.12

When the plate-and-frame heat exchanger is purged with dry air and desiccant bags are inserted, the quantity and location of the desiccant bags shall be recorded in the handling, shipping, storage and preservation procedure.

Add new section

11.13 Markings for Shipment

11.13.1

Markings on the exterior of the packing shall include the tag number, shipping weight and purchase order number.

11.13.2


Markings for the tag number, shipping weight and purchase order number on the exterior of the packing shall have a character height of at least 75 mm (3 in.).

11.13.3

Markings on the exterior of the packing not specified in 11.13.1 shall have a character height of at least 25 mm (1 in.).

11.13.4

Markings shall be in a contrasting color relative to the background.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	SHEET 32 of 39
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	INTERNAL
			ESUP

Add new section


11.14 Commissioning

11.14.1

An Initial Service Safety Inspection shall be performed on heat exchangers once the Unit itself has been erected to its final location.

11.14.2

SELLER will be required to provide any necessary support for installation and commissioning of the equipment at the construction yard or offshore.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 33 of 39
			INTERNAL
			ESUP

Annex A

(informative)

Recommended Practice

A.1 General

Add to second sentence of first paragraph

, except where "should" is replaced with "shall", which changes the recommendation to a requirement.

A.1.1 Sour or Wet Hydrogen Sulfide Service—Guidance to 4.7 and 4.8

In first sentence of first paragraph, replace "NACE MR0103" with

ANSI/NACE MR0103/ISO 17945

In third sentence of first paragraph, replace "NACE MR0103" with

ANSI/NACE MR0103/ISO 17945

In first sentence of second paragraph, replace "NACE MR0175 (all parts)" with

ANSI/NACE MR0175/ISO 15156 (all parts)

In first sentence of third paragraph, replace "NACE MR0175 (all parts)" with

ANSI/NACE MR0175/ISO 15156 (all parts)

A.3 Design

A.3.2 Fouling Margin—Guidance to 7.4

A.3.2.1

Delete "recommended" from third sentence of first paragraph

In fourth sentence of first paragraph, replace "should" with

shall

In fifth sentence of first paragraph, replace "should" with

shall

A.3.2.3

Delete "recommended" from first sentence of first paragraph



Replace Table A.1 title with

Table A.1—Targets for Fouling Margins, Wall Shear Stress, and Pressure Drop Multiplier

Replace Table A.1 with

Fluid Name ^{b, e}	Fouling Margin	Wall Shear Stress in Clean Condition (Minimum)	Pressure Drop Multiplier for Fouled Condition
	%	Pa	
Demineralized water	5	d	1.10
Potable water	10	30	1.20
Cooling tower water	15	50	1.25
Untreated seawater ^g	15	75	1.30
Filtered and chlorinated seawater ^g	10	50	1.20
Produced water	20	75	1.30
Lubricating oil, diesel oil	10	30	1.20
Crude oil and process streams—average fouling tendencies	15	50	1.30
Hydrocarbon gas, condensate and clean/purified process streams	10	30	1.20
Crude oil and process streams—dirty/contaminated with high fouling tendencies ^{a, f}	25	50	1.30
Amine/sulfinol solutions	15	50	1.25
Steam, air	5	d	1.10
Glycol/water solutions	10	30	1.20
Condensing process streams	10	c	c
Evaporating process streams	c	c	c
Refrigerant—all phases, inert gases	5	d	1.10

- ^a If the shear stress for the process fluid can achieve 75 Pa (0.01088 psi), the fouling margin may be set to 20 %.
- ^b For streams subject to vapor break-out, the specified shear stress shall be achieved in the all-liquid region.
- ^c To be agreed between the purchaser and vendor.
- ^d No minimum requirement. The calculated actual wall shear stress shall be provided.
- ^e When the specified fluid name is not listed in this table, values for the fouling margin, the wall shear stress in clean condition (minimum) and the pressure drop multiplier for fouled condition for the specified fluid name shall be proposed based on the vendor's selected plate-and-frame heat exchanger model.
- ^f Impurities and natural components in crude oil that are believed to contribute to fouling include corrosion products, solids, minerals in water, waxes, naphthenates, salts, asphaltenes exceeding their solubility limit, and thermal decomposition or autoxidation products from reactive constituents. Degraded corrosion and scale inhibitors can also contribute to fouling.
- ^g The maximum skin temperature shall not exceed the local scale formation temperature (e.g. calcium carbonate, calcium sulfate, magnesium hydroxide).

Annex B

(informative)

Plate-and-Frame Heat Exchanger Checklist
Replace Table B.1 with
Table B.1—Checklist

Subsection	Requirement	Item		
4.1	Pressure design code.	State required code.		
4.2	Structural welding code.	State required code.		
4.6	Applicable local regulations.	State required regulations		
4.7	Is the unit subject to sour or wet hydrogen sulfide service on the hot side?	Yes	No	
	Is the unit subject to sour or wet hydrogen sulfide service on the cold side?	Yes	No	
4.8	Are requirements for sour or wet hydrogen sulfide service to be applied where carbon steel is lined?	Yes	No	
4.9	Is cyclic design service required? If yes provide detailed information.	Yes (provide requirements)	No	
5.9	Vendor to provide data to allow thermal verification.	Yes	No	
6.2.2	Copies required of applicable welding procedure specifications, welding procedure qualifications and weld map.	For review	For record	a
6.2.3	Copies required of mechanical design calculations including for supports, lifting and pulling devices.	For review	For record	a
6.2.4	Specify if information about quality control system required, and if quality control plan required.	Yes (clarify requirements)	No	
6.3.1	Specify the format documentation. And quantities for the listed final documentation	Provide requirements.		
7.2.1	Specify a maximum design temperature and a minimum design metal temperature (MDMT) for hot and cold sides.	Complete on datasheet.		
7.4	Specify fouling margin (see Table A.1) ^b .	Complete on datasheet.		
7.6.6	Specify if shroud required to protect against spray leaks.	Yes	No	
7.6.7	Specify if a fire-protection shroud is required and, if so, level of protection required.	Complete on datasheet.		
7.6.8	Specify if drip tray required.	Yes	No	
7.7.2	Specify if studded or flanged connections required. If flanged, specify required design code.	Complete on datasheet.		
7.7.3	Specify the flange gasket facings or the studded port liner facings.	Complete on datasheet.		
7.7.7	Specify if nozzles welded to cover plates to be set-on or set-in.	Complete on datasheet.		
7.7.13	Specify for alloy lined flanged connections if a threaded tell-tale hole to be provided.	Yes	a	
8.2.3	Specify maximum allowable carbon equivalent and/or restrictions on other residual elements and micro-alloying elements for carbon steel components in sour or wet hydrogen sulphide service.	Complete on datasheet.		



Table B.1—Checklist (continued)

Subsection	Requirement	Item	
10.1.1	Specify extent of non-destructive testing of the heat transfer plates.	Complete on datasheet.	
10.1.3	Specify NDE for semi-welded heat transfer plate pairs by vacuum or helium leak test or eddy current test.	Complete on datasheet.	
10.1.5	Specify if set-on nozzle attachments are to be ultrasonically examined.	Yes	a
10.1.6	Specify if all carbon steel plate in sour or wet hydrogen sulphide service shall require UT lamination check?	Yes	No
11.9	Specify if inert gas purge and fill is required?	Yes	No
10.2.8	Are there additional requirements for equipment drying or preservation?	Yes	No
10.2.9	Specify if paint or other coatings may be applied over welds, and any installed liners, prior to the final pressure test.	Yes	No
11.7	Specify if there are requirements for surface preparation and protection (e.g. painting).	Complete on datasheet.	
11.9	Specify if inert gas purge and fill is required?	Yes	No

Annex B Plate and Frame Heat Exchanger Checklist is an adaptation of API 667; Plate-and-Frame Heat Exchangers; Table B.1, © 2022 American Petroleum Institute, and is used with permission.



Add Table B.1 Continuation


Table B.1 Continuation—Plate-and-Frame Heat Exchanger Checklist

Subsection	Requirement	Item	
5.10	Specify the allowable pressure drop in fouled/dirty condition.	Complete on datasheet.	
7.4	Specify the maximum solid size.	Complete on datasheet.	
7.4	Specify the concentration of solids (% volume).	Complete on datasheet.	
7.4 / Table A.1	Specify the fluid name (see Table A.1 for typical fluid names).	Complete on datasheet.	
7.4 / Table A.1	Specify the minimum wall shear stress requirement in clean condition (see Table A.1).	Complete on datasheet.	
7.4 / Table A.1	Specify the pressure drop multiplier for fouled/dirty condition (see Table A.1).	Complete on datasheet.	
7.6.3	Specify if the plate-and-frame heat exchanger is in utility service.	Yes	No
7.7.17	Specify the connection loads/moments: a) Table 1 for onshore applications; b) Table 1 values multiplied by 2.5 for offshore applications; or c) specified actual loads.	Complete on datasheet.	
7.8.2	Specify the gasket attachment method (glued or clip-on).	Complete on datasheet.	
7.8.6	Specify the gasket material (see Table 2).	Complete on datasheet.	
8.2.2	Specify the material certificate type.	Complete on datasheet.	
10.1.1	Specify the type of NDE to be performed on the heat transfer plates after forming (light box testing, liquid-penetrant testing, none, other).	Complete on datasheet.	
10.1.10	Specify if hardness testing of the heat-affected zone of pressure-retaining welds in carbon steel components is required, if not required by the selected pressure design code.	Yes	No
10.1.11	Specify the depth from the machined/finished weld overlay surface at which chemical analysis shall be carried out.	Complete on datasheet.	
10.1.12	Specify the extent of PMI required to be performed on alloy materials, (100 % of plates and welds, 10 % of heat transfer plates and 100 % of welds, none).	Complete on datasheet.	
10.1.15	Specify the acceptance criteria for ultrasonic examination of material (ASTM A578/578M acceptance level A supplementary requirement S1, EN 10160 class S2E3).	Complete on datasheet.	
10.3.2	Specify if code stamping is required.	Yes	No

NOTE Table B.1 Continuation was independently formulated by the International Association of Oil & Gas Producers (IOGP) and is not a part of API Standard 667, First Edition, Table B.1.

^a The checklist option has been deleted and is not valid based on amendments made by this specification to API 667.

^b The reference to Table A.1 has been added independently by IOGP and is not a part of API Standard 667, First Edition, Table B.1.

	TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-1200-456-P4X-001	REV. E
	AREA:	-	
	TITLE:	REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION	SHEET 38 of 39
			INTERNAL
			ESUP

Bibliography

Add to start of Bibliography

The following documents are informatively cited in the text of this document, API 667, the PDS (IOGP S-749D) or the IRS (IOGP S-749L).

Add to Bibliography

[8] API Specification Q1, Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry

[9] API Specification Q2, Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries

[10] API Standard 660 *, Shell-and-Tube Heat Exchangers

[11] ISO 3166-1, Codes for the representation of names of countries and their subdivisions — Part 1: Country code

[12] ISO 9001, Quality management systems — Requirements

[13] ISO 10005, Quality management — Guidelines for quality plans

[14] ISO 10209, Technical product documentation — Vocabulary — Terms relating to technical drawings, product definition and related documentation

[15] ISO 19901-5, Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight control during engineering and construction

[16] ISO/IEC 17000, Conformity assessment — Vocabulary and general principles

[17] ISO/IEC Directives, Part 2, Principles and rules for the structure and drafting of ISO and IEC documents

* Cited in IOGP S-749J only.



TECHNICAL SPECIFICATION

Nº: I-ET-3010.00-1200-456-P4X-001

REV. E

AREA: -

SHEET 39 of 39

TITLE: REQUIREMENTS FOR PLATE HEAT EXCHANGER DESIGN AND FABRICATION

INTERNAL

ESUP

SECTION II – IOGP S-749L (1.0) INFORMATION REQUIREMENTS FOR PLATE-AND-FRAME HEAT EXCHANGERS (API)



Info%20Reqs%2

SECTION III – IOGP S-749D (1.0) PROCUREMENT DATA SHEET FOR PLATE-AND-FRAME HEAT EXCHANGERS (API)



Procurement%2