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IOGP S-749, Supplementary Specification to API Standard 667 for Plate-and-frame Heat Exchangers, First Edition, December 2023

ADDENDUM 1

This addendum (Version 1.01) replaces Edition 1.0 published in December 2023.

NOTE: In addition to the updates listed below, minor editorial/typographical amendments may have been made.

List of updates

Section	Description
7.7	New section 7.7.20 added
8.1	New sections 8.1.7 and 8.1.8 added
9	New section 9.5 added
10.1	Title added to 10.1.12 section heading Section 10.1.12 * renumbered to 10.1.12.1 New sections 10.1.12.2 and 10.1.12.3 added New section 10.1.22 amended
Table B.1 Continuation	Row 10.1.12 amended
Bibliography	Reference "IOGP S-619:2022" added (applicable to IOGP S-749J only) and subsequent reference numbering updated
* Section number from Edition 1.0.	

International Association of Oil & Gas Producers

SPECIFICATION
IOGP S-749

February 2026
Version 1.01

ADDENDUM 1 TO FIRST EDITION (DECEMBER 2023)

Supplementary Specification to API Standard 667 for Plate-and-frame Heat Exchangers

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.01	February 2026	Addendum 1
1.0	December 2023	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

Table of Contents

List of Tables

List of Figures

Introduction

The purpose of the IOGP S-749 specification documents is to define a minimum common set of requirements for the procurement of plate-and-frame heat exchangers in accordance with API Standard 667, First Edition, March 2022, Plate-and-Frame Heat Exchangers, for application in the petroleum and natural gas industries.

The IOGP S-749 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-749: Supplementary Specification to API Standard 667 for Plate-and-frame Heat Exchangers

This specification defines technical requirements for the supply of the equipment and is written as an overlay to API Standard 667, following the API Standard 667 clause structure. Clauses from API Standard 667 not amended by this specification apply as written. Modifications to API Standard 667 defined in this specification are introduced by a description that includes the type of modification (i.e. Add, Replace or Delete) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-749D: Procurement Data Sheet for Plate-and-frame Heat Exchangers (API)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-749L: Information Requirements for Plate-and-frame Heat Exchangers (API)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-749Q: Quality Requirements for Plate-and-frame Heat Exchangers (API)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the PDS or in the purchase order.

The specification documents follow the editorial format of API Standard 667 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) API Standard 667.

2 Normative References

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*

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*

Replace Section 3 title with

3 Terms, Definitions, and Abbreviated 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 term 3.22

3.22
austenitic stainless steel
Stainless steel whose microstructure at room temperature consists predominantly of austenite.

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/aluminium.

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.

4 General

4.1

Add to second sentence

except where modified by this specification

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.

5 Proposal Information Required

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.

5.10

Add new NOTE

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

6 Drawings and Other Data Requirements

6.1 Outline Drawings and Other Supporting Data

6.1.1

Add to start of list item o)

gasket location on the plates (see Figure 6), gasket groove pressing depth in the plates,

Add new list item u)

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

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"

6.3 Reports and Records

6.3.1

In list item d), replace "mill" with

material

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.

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.

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

Delete "unless approved by the purchaser" from list section c)

Replace list section g) with

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

7.6.3

Add to list section a)

in utility service and at least 19 mm ($^{3}/_{4}$ in.) in non-utility service

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.

7.7 Connections

7.7.5

Replace "if agreed by the purchaser" with

in utility service and only if specified

7.7.7

Add new list section d)

d) Reinforcing pads shall not be used for nozzles.

Add new list section e)

e) Set-on nozzles shall be used in sour service or wet hydrogen sulfide service.

Add new list section f)

f) Set-in nozzles shall not protrude beyond the inside surface of the cover plate.

Add new list section g)

g) The inside corners of solid nozzles and weld overlaid nozzles shall be rounded to a minimum radius of 3 mm ($^{1}/_{8}$ in.).

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

In first sentence, replace “listed in Table 1, unless otherwise specified by the purchaser” with

in accordance with one of the following, as specified:

a) Table 1 for onshore applications;

b) Table 1 values multiplied by 2.5 for offshore applications;

c) specified actual loads.

Add to 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

Flanged nozzles DN 40 (NPS 1½) and DN 50 (NPS 2) shall be long weld neck flanges or fabricated from seamless pipe with a minimum nominal wall thickness of schedule 160 or schedule 80S as applicable.

7.8 Plate Gaskets

7.8.6

In first sentence, replace "operating conditions and fluid compositions"

operating conditions, fluid compositions, the specified process application and the design pressure

Add after first sentence

Gasket material recommendations shall be accompanied by supporting data evidencing their suitability for the specified design conditions and parameters.

Add new NOTE

NOTE Examples of supporting data include laboratory test reports, field test reports, other test reports, customer references, past track records and product datasheets.

Add after first sentence

When data supporting the suitability of the selected gasket for the specified operating temperature cannot be provided, the gasket material selection shall be in accordance with the operating temperature limits specified in Table 2.

Add new Table 2

Table 2—Maximum Operating Temperature Limits for Common Gasket Materials

Gasket Material	Maximum Operating Temperature [a]	
	°C	°F
Natural rubber, neoprene	100	215
Nitrile butadiene rubber (NBR)	110	230
Ethylene propylene diene monomer (EPDM)	140	285
Hydrogenated nitrile butadiene rubber (HNBR)	150	300
Silicone	175	350
Peroxide-cured EPDM	150	300
Fluoroelastomer (FKM)	200	390
Perfluoroelastomer (FFKM)	230	450

[a] For glued-type gaskets, the service temperature range of the selected glue can dictate the maximum operating temperature rather than the gasket material.

8 Materials

8.1 General

Add new section

8.1.5

The material for grounding lugs shall be austenitic stainless steel.

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
t		
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

Achieving the specified minimum design metal temperature without impact testing by using a reduced stress ratio method shall not be permitted.

Add new section

8.1.8

The use of non-impact tested materials allowed by ASME *BPVC*, Section VIII, Division 1, UG-20 (f) shall not be permitted.

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.

9 Fabrication

9.1 Welding

9.1.3

Delete "except when approved by the purchaser"

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 new section

9.5 Tolerances

Manufacturing tolerances shall be such that nominally identical parts and units are interchangeable.

10 Inspection and Testing

10.1 Quality Control

10.1.5

Delete "If specified by the purchaser" from first sentence

10.1.10

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

10.1.12.1

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

10.1.12.2

The PMI extent shall be 100 % of alloy components and weld overlay except for plates.

10.1.12.3

For PMI on alloy heat transfer plates, a minimum sample of 2 % shall be examined.

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.

Add new section

10.1.22

The extent of magnetic-particle and liquid-penetrant examination of attachment nozzle welds (nozzle-to-flange and nozzle-to-cover) shall be as follows:

a) for utility services, if not specified by the pressure design code, in accordance with ASME *BPVC*, Section VIII, Division 2;

b) for non-utility services, 100 %.

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 "attached" with

mounted on a T-shaped bracket (see Figure 7) welded

10.3.2

Replace list item g) with

g) hydrostatic or pneumatic test pressure, as applicable, and

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

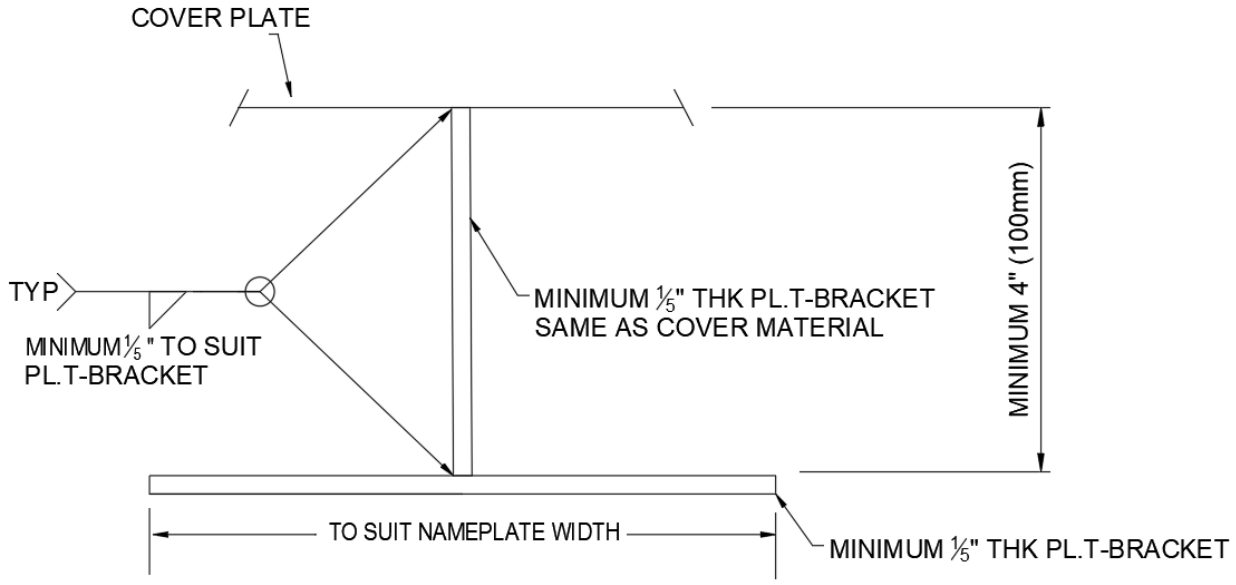

Figure 7—Typical T-shaped Nameplate Bracket

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".

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.

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
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

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 heat transfer plates.	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.

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).

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

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* Cited in IOGP S-749J only.

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