

DEP SPECIFICATION

AIR-COOLED HEAT EXCHANGERS
(AMENDMENTS/SUPPLEMENTS TO ISO 13706:2011)

DEP 31.21.70.31-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design, manufacture and supply of air-cooled heat exchangers. This DEP does not apply to 'air-heated' applications where ambient air is to be used as a heating medium.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2014. Refer to (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies air-cooled heat exchange equipment and services to perform the duties specified by the Contractor.

NOTE: The terms Supplier and Manufacturer as used in this DEP are synonymous with the term **Vendor** (as used in ISO 13706) depending on the context in which the term is used.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalized term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced clause number is shown in brackets (). Other documents referenced by this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2014.

Section/Clause	Change
All	Non-technical updates for requirement quality improvement
7.2.1.12, Item 1	DEM1 statement clarified further to eliminate the need for a note.
7.2.1.13, Item 1	DEM1 statement clarified further to eliminate the need for a note
7.2.1.13, Item 3	DEM1 statement clarified further to eliminate the need for a note
7.2.10.19	Converted the DEM1 statement into a stand-alone clause.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

PART II GENERAL REQUIREMENTS**2.1 GENERAL**

1. Part III of this DEP is written as amendments and supplements to ISO 13706. Wherever reference is made to ISO 13706, it shall be understood to mean ISO 13706 as amended/supplemented by this DEP.
2. For ease of reference, the clause numbering of ISO 13706 has been used throughout Part III of this DEP.
 - a. API 661 is identical in form and content to ISO 13706:2011, therefore if API 661 is used then all statements in this DEP that refer to ISO 13706 apply equally to API 661.
3. Clauses in ISO 13706 which are not mentioned in this DEP shall remain valid as written.
4. Unless specified otherwise in this DEP, all occurrences of the word "should" in ISO 13706 shall be replaced with the word "shall".

2.2 SELECTION OF TYPE OF AIR-COOLED HEAT EXCHANGER

1. Forced draught or induced draught horizontal air-cooled heat exchangers shall be applied, so that several exchangers can be grouped into one bank.
2. Vertical, "V" frame and "A" frame or "roof" type air-cooled heat exchangers are not covered by ISO 13706 or this DEP; these exchangers may be selected only with the agreement of the Principal.



PART III AMENDMENTS AND SUPPLEMENTS TO ISO 13706**3 Terms and definitions**

Add new terms:

3.34 very toxic (substances)

Substances that are very hazardous for the environment or human health. For this DEP the term “very toxic” includes Very toxic – acute, chronic, and environment categories unless otherwise specified. Refer to DEP 01.00.01.30 Gen. Part III for further information regarding toxic fluid classification.

3.35 wet hydrogen sulphide service, sour service

services, as defined by the Contractor on the equipment data sheet, which normally contain dissolved H₂S in a free water phase and can result in environmental cracking of carbon steel materials

3.36 fabricated transitions

nozzle diameter transitions that are fabricated by rolling and welding of plate

4 General**4.1**

Replace first sentence of this clause with:

1. Tube bundles shall comply with the specified pressure design code and the applicable requirements in DEP 31.22.00.31-Gen., based on the specified vessel category.
2. When specified by the Contractor, auxiliary heating coils shall comply with the specified pressure design code and the applicable requirements in DEP 31.22.00.31-Gen., based on the specified vessel category
3. Refer to Appendix D of DEP 31.22.00.31-Gen. for the requirements for tube bundles constructed from Cr-Mo steels.

Add new clauses 4.8 through 4.14:

4.8

1. Air cooled exchanger designs shall not exceed a total air side static pressure drop of 0.2 kPa (0.8 in H₂O) without the approval of the Principal.
 - a. In no case shall the air side static pressure drop exceed 0.25 kPa (1.0 in H₂O).

4.9

1. Air cooled exchanger designs shall not be less than three (3) tube rows deep or have nominal air face velocities less than 2.0 m/s (400 ft/min) without the approval of the Principal.

4.10

1. Single-pass air cooled steam condensers shall not be used.

4.11

1. With respect to air-cooled heat exchangers handling a two-phase mixture at their inlet:
 - a. such exchangers should be designed to minimize the flow mal-distribution amongst the tubes of each of the tube passes;
 - b. at least one inlet nozzle shall be provided for every 2 m (6.5 ft) of bundle width;
 - c. the use of one tube row per pass should be utilized for mixed component condensing services, unless approved by the Principal;
 - d. if the equipment data sheet specifies any phase to be corrosive (e.g., air cooled exchangers with continuous water wash), the design of such equipment and the water distribution system shall be subject to the review and approval of the Principal;
 - e. for systems with a corrosive phase, there shall be only one tube row per pass, at least one inlet nozzle shall be provided per metre (3 ft) of bundle width, and, if multiple tube bundles are required, the total number of tube bundles shall be evenly divisible by a power of 2 (i.e., 1, 2, 4, 8, 16...).

Alternate configurations can only be provided when approved by the Principal.

4.12

1. In exchangers with condensing duty, the passes for the condensing phase shall extend over the full width of the tube bundle.
 - a. Outlet nozzle sizing shall be sufficient to prevent flooding of the bottom row of tubes.
 - b. For multiple tube pass total condensers, the last tube pass shall be designed as a single tube row.

4.13

1. The use of tube inserts, such as twisted tape turbulators, static mixers, or similar devices, shall be subject to the approval of the Principal.

4.14

1. When specified by the Contractor, the Supplier shall provide the natural draft performance of the exchanger with design ambient temperature.

This analysis often is used to determine relief valve requirements during power failure conditions.

5 Proposals

5.1

Replace this clause with:

1. The Manufacturer's proposal shall include a set of completed requisition and data/requisition sheets, as required by (Annex B) of this DEP and the inquiry requisition.
2. The Manufacturer may submit their standard equipment data sheet form with the proposal, if it contains all of the information included in DEP 31.21.70.93-Gen.
3. The Manufacturer should ensure that its proposal is based upon a completed checklist from (Annex B) as supplied by the Contractor.

5.10

Add to this clause:

1. The general design and layout of a hot air recirculation system should be submitted for review by the Principal prior to order placement.

Add new clauses 5.11 and 5.12:

5.11

1. The proposal and data sheet shall include a description of partial row/pass arrangement or non-uniform design features.

5.12

1. The proposal shall identify whether the exchanger or any component is a "first-time use".

- a. Such designs shall be subject to the approval of the Principal.

"First-time use" includes any design or component for which less than two years of successful operation at two separate installations can be demonstrated, with supporting data and references to be provided to the Principal upon request.

6 Documentation

6.1 Approval information

6.1.1

Replace the second sentence of this clause with:

1. These documents shall be submitted for Contractor approval:

Add to this clause:

- u. location and type of grease fittings;
 - v. power transmission system selection documentation.

6.1.2

Add to this clause:

1. Details shall be provided for all automatically or manually (mechanical) actuated devices including levers and linkages.

6.1.3

Replace this clause with:

1. Calculations required by the pressure design code shall be performed and submitted for Contractor approval of the design of pressure components, including header boxes, tubes, and tube joints.
2. Sufficient detail shall be supplied for any non-standard pressure boundary components, such as swage-type transition nozzles, along with calculations for the following:
 - a. allowable vacuum rating in the corroded condition at design temperature (note: this rating shall be shown on the nameplate);
 - b. maximum allowable pressure (MAP) in the new and cold condition, and the maximum allowable working pressure (MAWP) in the hot and corroded condition;
 - c. the retirement thickness for each pressure retaining component, with both the new and retirement thicknesses shown on the header drawing, with the limiting component identified;
 - d. nozzle load confirmation calculations;
 - e. restraint relief calculations.

6.1.4

Replace this clause with:

1. Weld maps, all proposed welding procedures and qualifications (including tube-to-tubesheet welding procedures and qualifications), and all supporting test results such as impact tests, hardness tests, corrosion tests, as applicable, shall be submitted for the Contractor approval prior to fabrication.

6.1.6

Replace this clause with:

1. The Supplier shall submit the Inspection and Test Plan (ITP) for review and approval.
2. Surveillance requirements identified by the Contractor shall be incorporated into the Supplier's ITP.

Add new clause:

6.1.7

1. The Supplier shall provide a priced recommended spare parts list for both of the following:
 - a. start-up and commissioning;
 - b. two years normal operation.

6.2 Final records

6.2.2

Replace the first sentence of this clause with:

1. The Supplier shall furnish the following information in the format and quantity as specified by the Contractor.

Replace clause l) with:

- l. fan performance characteristic curves showing the operating point, shaft power consumption, stall point, and maximum pitch setting for full motor load with summer design air temperature
 - i. For variable speed fans: the fan performance curves shall also include the fan and motor speed for design air flow with the maximum pitch setting, along with the fan and motor critical speeds;

Add to this clause:

- q. as-built shop drawings showing details of headers and tube bundles, including actual metal thickness and locations (see clause 10.1.21), internal header dimensions, pass partitions, stiffeners, and tube layout;
- r. as-built shop drawings for any auxiliary heating coils;
- s. location and type of grease fittings;
- t. number of exchangers or components required;
- u. location and dimensions of walkways, platforms, ladders, stairways, drivers, and fans;
- v. allowable vacuum rating;
- w. recommended lubrication requirements and tightening torque for header plugs;
- x. surface finish for flange faces of removable cover plate or bonnet headers;
- y. gasket detail drawings;
- z. calculations required by the pressure design code, including nozzle load confirmation, restraint relief and any finite element analysis as may be required;
- aa. certified motor drawing and completed motor data sheet for each size and type of motor.

7 Design

7.1 Tube bundle design

7.1.1 General

Add to this clause:

7.1.1.1

1. The width of the tube bundle should be chosen based on the transportation and handling limitations identified by the Contractor.

7.1.1.4

Add to this clause:

1. Tubes shall be adequately supported by either tube support boxes, aluminium lockbars, aluminium wiggle strips, support rings or collar zinc supports.
 - a. For austenitic stainless steel or high nickel alloy tubes, aluminium supports shall be used.

7.1.1.7

Replace this clause with:

1. The last pass of tubes in multi-pass condensers shall be sloped 10 mm per m (1/8 in per ft) in the direction of flow.
2. Multi-pass condensers that have the following attributes shall have the tubes in each pass, including any sub-cooling pass, sloped 10 mm per m (1/8 in per ft) in the direction of flow:
 - a. operate in vacuum service; or
 - b. have a separate aqueous phase and a minimum ambient temperature less than 0 °C (32 °F); or
 - c. contain very toxic fluids; or
 - d. are expected to operate partially flooded, as specified by the Contractor on the equipment data sheets.

7.1.1.11

Replace this clause with:

1. Unless otherwise specified on the equipment data sheet, exchangers shall be capable of withstanding a steam-out temperature of 150 °C (300 °F) under full vacuum without damage.

This temperature need not be considered for fin selection.

Add new clauses 7.1.1.13 through 7.1.1.16:

7.1.1.13

1. Winterization requirements shall be defined by the Contractor and specified on the equipment data sheets.
2. Refer to (7.2.1.11) through (7.2.1.15) for additional requirements.

7.1.1.14

1. Tube bundles shall be designed for full vacuum if required by DEP 31.22.00.31-Gen.

7.1.1.15

1. Refer to DEP 31.22.00.31-Gen. for the requirements for determining the need for a creep analysis for tube bundles operating at high temperatures.

7.1.1.16

1. Bowed tubes shall not be used.

7.1.2 Heating coils

7.1.2.3

Replace this clause with:

1. The tube pitch of the heating coils shall not exceed 3.75 times the nominal tube diameter of the heating coil.

Add new clause:

7.1.2.6

1. For the supplementary heating coil or steam space heater sizing, the required bundle pre-heat temperature shall be at least 10 °C (18 °F) above the critical process temperature defined on the datasheet.
 - a. The bottom of the enclosure shall be assumed to be 5 °C (9 °F) above the critical process temperature.
2. A surface heat loss term for the floor for piperack-mounted Type 3 coolers shall be included.
 - a. Calculations in Annex C.12, Heat Losses shall be amended accordingly.

7.1.5 Corrosion allowance

7.1.5.1

Replace this clause with:

1. The corrosion allowance for headers and nozzles shall be as specified by the Contractor on the equipment data sheet.
 - a. No corrosion allowance shall be provided for gaskets or gasket contact surfaces.
2. The available tube side corrosion allowance for tubes shall be calculated and submitted to the Contractor for approval.
 - a. In no case shall the calculated available corrosion allowance for tubing be less than 0.5 mm (0.0197 in) for carbon and low alloy ferritic steels, and 0.25 mm (0.006 in) for high alloy tubes.

Add new clause:

7.1.5.4

1. Corrosion-resistant lining or cladding shall not be applied without the approval of the Principal.

7.1.6 Headers

7.1.6.1 General

7.1.6.1.3

Replace the first sentence of this clause with:

1. The need for restraint in single or multi-pass bundles shall be investigated regardless of the fluid temperature difference between the inlet and outlet of the tube bundle, and include any maximum cooling condition at design flow coincident with the minimum ambient air temperature (or minimum plenum temperature set-point for exchangers provided with Type 3 air side designs).
2. For air-cooled heat exchangers designed for maximum process cooling, or with process control devices that are set to fail to a maximum cooling mode, the need for restraint relief shall be evaluated at a 60% process flow rate condition, unless a higher turndown has been specified.

7.1.6.1.5

Replace this clause with:

1. The lateral velocity in the header of the inlet and outlet tube passes shall not exceed either the velocity in the respective nozzles or the adjoining tube velocity.

7.1.6.1.6

Add to this clause:

1. When expanded tube-to-tubesheet joints are used, with or without additional tube end welding, the minimum tubesheet thickness shall be 25 mm (1 in) for carbon or low alloy steel, and 22 mm (7/8 in) for high alloy steel and other materials.

7.1.6.1.7

Add to this clause:

1. Drain holes shall be provided in pass partition plates to facilitate drainage.
2. The location, size, and number of drain holes are to be indicated on the fabrication drawings and subject to the approval of the Contractor.

7.1.6.1.8

Add to this clause:

1. The use of manifold and billet type headers are not covered by ISO 13706:2011 or this DEP and shall only be used with the agreement of the Principal.

Add new clause:

7.1.6.1.9 Header type selection

1. Plug headers shall be used in hydrogen and very toxic services.
2. Plug headers shall be used for all other services, including those that may require occasional mechanical cleaning, except for the following cases:
 - a. removable cover plate headers shall be used for non-hydrogen, "not very toxic" (refer to Part III of DEP 01.00.01.30-Gen.) services where mechanical cleaning will routinely be required;
 - b. the design pressure for their application shall be less than 3,000 kPa (ga) (435 psig) and design process inlet temperatures shall be less than 204 °C (400 °F);
 - c. in cases where heavy fouling or corrosion is anticipated and will require frequent mechanical cleaning or repairs, a removable cover plate header should be considered regardless of the above selection criteria;
 - d. the header construction and the gasket selection/seal construction shall be subject to approval of the Principal.
3. Headers containing fluid streams with a high fouling propensity, typically with a fouling resistance equal to or greater than 0.00017 m².K/W (0.001 hr-ft²-°F/Btu), or whose fouling cannot be removed by chemical cleaning, shall have construction details which allow for mechanical cleaning.
4. Instead of a rear-end header, U-bends (180° elbows) may be used where suitable and where mechanical cleaning is not required.

7.1.6.2 Removable cover plate and removable bonnet headers

7.1.6.2.1

Add to this clause:

1. The maximum nominal bundle width for removable cover plate headers shall be 3.7 m (12 ft) unless shipping restrictions dictate the use of smaller bundle widths.
2. In addition, the mechanical design of the header box may not consider any strengthening effect due to the bolted cover plates.

7.1.6.2.2

Replace this clause with:

1. Removable bonnet-type headers shall not be used, unless specified by the Principal.

7.1.6.2.3

Replace this clause with:

1. Bolted joints shall be designed with through bolt construction and confined gaskets, in accordance with Figure 4(b).
2. Gasket contact surfaces on cover plates and matching header box flanges shall be machined.
 - e. The surface finish shall be compatible with the type of gasket specified.
3. Bolting material shall be suitable for the specified operating conditions and comply with DEP 31.22.00.31-Gen.

7.1.6.2.7

Replace this clause with:

1. The minimum nominal diameter for through bolts shall be 19 mm (3/4 in).
2. The diameter of the bolt holes shall not be less than the nominal bolt diameter plus 3 mm (1/8 in).

Add new clause:

7.1.6.2.12

1. The gasket contact surfaces of header box flanges and cover plates in carbon and low alloy steel materials shall be provided with a 3 mm (1/8 in) machining allowance.

7.1.7 Plugs for tube access

7.1.7.1

Add to this clause:

1. If two-part plugs have been specified on the equipment data sheet, the plug construction shall be as shown in Standard Drawing S 21.076.
 - a. The material of the gasket compressor part of the two-piece plug shall be equivalent to the material of the header box.
 - b. For ease of removal, the gasket compressor part should be provided with a blind M10 (3/8 in) threaded hole at least 15 mm (5/8 in) deep.
 - c. The gasket compressor and plug shall be provided with sealing holes of at least 3 mm (1/8 in) diameter, and the plug be provided with an M10 (3/8 in) threaded hole for this purpose.
 - ii. This threaded hole shall be fitted with a plug (hand tight only) after the successful hydrotest.

7.1.7.8

Replace this clause with:

1. Threads of plugs with nominal diameter of 40 mm (1½ in), or smaller, shall be 12 UNF.
 - a. For conventional shoulder plug designs, the threaded length of each plug in the plug sheet should be at least equal to the diameter of that plug.
2. If the cover plate thickness is not sufficient to meet above requirement for conventional shoulder plugs, and for all two-piece plug designs, the Supplier shall submit thread length verification calculations for approval by the Contractor.

7.1.8 Gaskets

7.1.8.1

Replace this clause with:

1. Plug gaskets shall be of the solid-metal type.
2. The material of the plug gasket shall be the same type as that of the plug, unless otherwise specified by or approved by the Principal.
3. The plug gasket hardness shall be a minimum of 20 HV lower than that of both the plug and plug-sheet materials.
 - a. Gasket hardness shall be tested on a representative sample of the gaskets, after all forming and/or annealing operations.
4. Alternate gasket types, including grooved metal graphite covered gaskets, may only be used when approved by the Principal.

7.1.8.2

Replace this clause with:

1. Plug gaskets shall be formed by cutting (e.g., laser or water cutting).
2. Plug gaskets shall be flat and free of burrs.

7.1.8.4

Replace this clause with:

1. The tongue-and-groove joint construction type of Figure 4(a) shall not be used.

7.1.8.5

Replace this clause with:

1. If not specified by the Contractor on the equipment data sheet, the type of gasket used for confined joints as indicated in Figure 4(b) shall be selected from those listed in Table 2a.

Table 2a Type of gaskets

Type	Description	Minimum Width mm (in)	Minimum Thickness mm (in)
1	Grooved gasket, AISI 316 (L) or Ti with graphite tape, minimum 0.5 mm thick (Grooved Metal, Graphite Covered)	12.7 (0.5)	3.2 (0.125)
2	Metal reinforced expanded graphite (Corrugated Metal Graphite)	9.5 (0.375)	1.6 (0.0625)
3	Flat double metal-jacketed (soft iron), graphite filled	12.7 (0.5)	3.2 (0.125)
4	Flat double metal-jacketed (stainless steel), graphite filled	12.7 (0.5)	3.2 (0.125)

2. The arithmetic average roughness, Ra, of the gasket contact surfaces shall be 3.2 μm (128 μin) to 6.3 μm (256 μin) for gasket types 1 and 2, and 0.8 μm (32 μin) to 1.6 μm (64 μin) for gasket types 3 and 4.

The selection of gaskets depends on the design temperature and pressure, and the corrosivity of the fluid to which the flange and gasket are exposed.

3. The service conditions to which air-cooled heat exchangers are exposed are described in ISO 13706:2011 Table A.5.
4. The type of gasket used, with account being taken of design pressure, design temperature, and service condition, shall be selected in accordance with the design criteria in Table 2b.

Table 2b Selection of type of gasket

Service condition	Design temperature °C	Design pressure bar (ga)	Preferred types	Alternative type
I	-200 to 0	31.0 max.	2, 4	-
	1 to 150	31.0 max.	2, 3	1
	151 to 240	31.0 max.	2, 3	1
	241 to 450	31.0 max.	2, 3	1
II	0 to 150	31.0 max.	2, 3	1
	151 to 240	31.0 max.	2, 3	1
	241 to 450	31.0 max.	2, 4	1
III	330 to 450	31.0 max.	2	1
IV	0 to 450	31.0 max.	2	1
V VI VII	0 to 50		2, 3	1
VIII		-	¹⁾	-
1) See the data/requisition sheet or as agreed between Contractor and Manufacturer.				

Service condition	Design temperature °F	Design pressure psig	Preferred types	Alternative type
I	-330 to 32	450 max.	2, 4	-
	33 to 300	450 max.	2, 3	1
	301 to 464	450 max.	2, 3	1
	465 to 845	450 max.	2, 3	1
II	32 to 300	450 max.	2, 3	1
	301 to 464	450 max.	2, 3	1
	465 to 845	450 max.	2, 4	1
III	626 to 845	450 max.	2	1
IV	32 to 845	450 max.	2	1
V VI VII	32 to 125		2, 3	1
VIII		-	¹⁾	-
1) See the data/requisition sheet or as agreed between Contractor and Manufacturer.				

7.1.8.6

Replace this clause with:

1. The non-confined gasket joint construction type of Figure 4(c) shall not be used.

7.1.8.9

Replace this clause with:

1. See clause (7.1.8.5) for gasket selection.

Add new clause:

7.1.8.10

1. Gaskets containing asbestos shall not be used.

7.1.8.11

1. For grooved metal graphite covered gaskets, the gasket width/height ratio shall be greater than or equal to 4.

7.1.9 Nozzles and other connections

7.1.9.2

Add to this clause:

1. The minimum nozzle size shall be DN 50 (NPS 2).
2. Nozzles or connections of DN 50 (NPS 2) size shall be of the integral forged nozzle (i.e., long-weld neck) type.

7.1.9.3

Replace this clause with:

1. All connections, including auxiliary connections such as vents and drains, shall be flanged.

7.1.9.6

Add to this clause:

1. For austenitic stainless steel and other high alloy nozzles, DN 80 (NPS 3), or smaller, shall be minimum schedule 80S.

7.1.9.7

Add to this clause:

1. The flange facing shall match that of the connecting piping, and as specified by the Contractor on the equipment data sheet.

7.1.9.8

Replace clause d) with:

- d. Fabricated transitions shall not be used except where specifically exempted by (7.1.9.9, Item 4).

Fabricated transitions are defined as transitions that are fabricated by rolling and welding of plate.)

Transitions that are formed from seamless pipe are acceptable.

Replace this clause e) with:

- e. Cast transitions shall not be used.

7.1.9.9

Replace this clause with:

1. For nozzle sizes up to and including DN 100 (NPS 4), only circular nozzles shall be used.
2. For nozzles greater than DN 100 (NPS 4), an oval (swaged) transition piece shall only be used as a means of reducing the header depth.
 - a. The velocity through oval nozzles shall not exceed the velocity through the circular nozzles that are being replaced.
3. The cold working process shall not be used to form swaged (oval) nozzle transitions.
4. For duplex stainless steel, Inconel, or Incolloy nozzle construction, rolled and welded plate may be used for the forming of oval transition pieces only for nozzles DN 200 (NPS 8) and larger, provided the weld is subjected to 100% radiography and 100% liquid penetrant examination after forming and after any required heat treatment.

7.1.9.12

Replace this clause with:

1. If a thermowell connection is required, the connection shall be located on the connecting pipe, unless otherwise specified.

7.1.9.13

Replace this clause with:

1. If a pressure gauge connection is required, the connection shall be located on the connecting pipe unless otherwise specified.

7.1.9.15

Replace this clause with:

1. When specified, flanged multi-purpose service connections shall be installed on the header.

These connections can be used for flushing/washing out, steaming out, chemical cleaning, pressure testing, venting, and draining.

 - a. There shall be top and bottom connections as close as possible to both ends of each header, i.e. a total number of four per header, and shall be DN 50 (NPS 2) size.
 - b. For header boxes of width less than 1.5 m (5 ft), two connections per header may be provided.

When multi-purpose nozzles are provided, these may serve as vents and drains, such that additional vent and drain connections need not be provided.
 - c. For hydrogen service and for very toxic service, multi-purpose service connections shall not be used, unless agreed by the Principal.

7.1.9.18

Replace this clause with:

1. Flanged auxiliary connections, if any, shall be closed with gasketed blind flanges of the same rating and flange facing as the process nozzles.
 - a. For headers of carbon steel materials, the gaskets shall be AISI 316L SS spiral-wound graphite-filled with inner and outer rings.
 - b. For all other header materials, the gasket shall be in accordance with the connecting piping class, and be specified by the Contractor on the equipment data sheet.
 - c. Bolting material shall be suitable for the specified operating conditions and comply with DEP 31.22.00.31-Gen.

7.1.9.19

Add to this clause:

Vents and drains need not be installed in inaccessible areas of split header boxes (i.e. on the top/bottom plates of header box sections which are stacked upon each other).

1. Vents and drains shall be DN 50 (NPS 2), raised face, integrally forged (i.e., long weld neck) type, with the same flange rating and facing as the process nozzles and be provided with blind flanges.

Add new clauses 7.1.9.22 through 7.1.9.26:

7.1.9.22

1. Weld neck flanges shall have the same bore as the nozzle necks.

7.1.9.23

1. The use of lap joint stub-end type nozzles for the service conditions allowed by DEP 31.22.00.31-Gen..

7.1.9.24

1. The inside corners of all nozzles shall be rounded to a minimum radius of 3 mm (1/8 in) to remove any sharp edges.

7.1.9.25

1. ASME Class 400 flanges shall not be used.

7.1.9.26

1. Nozzles shall be self-reinforced without any use of reinforcing pads, either for pressure retention or to resist externally applied moments and forces.