



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

MATERIAL STANDARD
FOR
DOUBLE PIPE HEAT EXCHANGERS
NPCS-MS-HM-04
REVISION : 0

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1 GENERAL

1.1 SCOPE

- 1.1.1 This standard covers the minimum requirements for thermal and mechanical design & guarantee, materials, fabrication, workmanship, inspection, testing and supply of double pipe type heat exchangers.
- 1.1.2 The intent of this standard is to supplement, amend or limit the reference codes and standards mentioned below.
- 1.1.3 Exceptions or variations shown in the material/purchase requisition take precedence over requirements shown herein.
- 1.1.4 No variations from the material/purchase requisition, data sheets and this standard are permitted unless approved in writing by purchaser.
- 1.1.5 In case of any conflict between the various standard and codes, the matter shall be referred to purchaser for clarifications and the clarifications provided by purchaser shall be final and binding on vendor.
- 1.1.6 The compliance with this standard and accompanying data does not relieve the vendor from his own responsibilities and guarantees nor from any further contract obligations.
- 1.1.7 The approval of the work by the purchaser's inspector and/or his release of the equipment for shipment shall in no way release the manufacturer from or relieve the manufacturer of any responsibility for carrying out all of the provisions of this standard and/or the fulfillment of the guarantee, nor does the purchaser by such approval and/or release assume any responsibility whatever for such provisions and/or guarantee.
- 1.1.8 Process requirements for each exchanger will be given on the data sheet attached to requisition for Double Pipe Heat Exchangers, by purchaser.
Vendor shall complete all other data on these sheets.
- 1.1.9 Additional provisions for exchangers in hydrogen service are given under section 10.4.

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1.1.10 In case of conflict in various documentation, the following order of priority shall apply :

- a) Equipment data sheet
- b) Material/purchase requisition
- c) This standard
- d) Licensors standard specifications and drawings

1.2 REFERENCES (LATEST EDITIONS)

- 1.2.1 TEMA, Standards of Tubular Exchanger Manufacturers Association, Class 'R'.
- 1.2.2 ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Unfired Pressure Vessels.
- 1.2.3 ASME Boiler and Pressure Vessel Code, Section II, Material Specification.
- 1.2.4 ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualification.
- 1.2.5 ASME Boiler and Pressure Vessel Code, Section V, Non Destructive Examination.
- 1.2.6 ASTM Specification.
- 1.2.7 AWS-ASME Specification for Welding Electrodes.
- 1.2.8 ANSI-American National Standards Institute, INC., 816.5, Steel Pipe Flanges and Flanged Fittings and B16.11 Forged Steel Fittings, Socket-Welding and Threaded, (latest editions approved by ASME).

1.3 RESPONSIBILITIES

- 1.3.1 Conformance to the latest codes and legal requirements is the responsibility of the Vendor.
- 1.3.2 All equipments shall be furnished complete as shown on data sheets attached to requisition or as required by the purchase order and as herein noted, and shall include all necessary bolts, nuts and gaskets.

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1.3.3 Gaskets and external bolting shall be furnished by the vendor for all girth flanges and other openings which call for a blind flange or cover and interconnecting nozzles of stacked exchangers.

1.3.4 Vendor shall be responsible for supplying all labour, tools, equipment, utilities, insurance, etc., for the proper execution and completion of the work.

2 THERMAL DESIGN

2.1 The heat transfer area and heat transfer coefficients shall be based on the total effective outside tube and fin surface.

2.2 The effective tube wall and fin metal resistance shall be considered in calculating the heat transfer coefficient.

2.3 Fouling factor for cooling water shall be $0.00035 \text{ m}^2 \text{ }^\circ\text{C/W}$ unless otherwise specified on data sheet.

2.4 When multitube construction is used, the pitch layout shall be square. Triangular pitch layout is not permitted for bare tubes; for finned tubes triangular pitch may be used.

2.5 Do not use fins on multitube elements when shell side requires mechanical cleaning.

2.6 Where fins are allowed and required, they shall be longitudinal and may be attached to the outside of the inner tube or pipe either by welding or by mechanical bonding. Minimum thickness of the fins shall be 0.8 mm.

2.7 When parallel streams are required, vendor shall quote separate price for required manifolding. Price shall include gaskets and bolting where manifold joints to unit connections.

2.8 Minimum velocity requirements at mean temperature; water 1.5 m/s, hot oil 1 m/s. Bidder may increase water flow quantity to attain minimum velocity requirement decreasing of velocity requirements is not allowed.

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- 2.9 Maximum acceptable pressure drops indicated in the process data sheets shall be understood for fouled exchangers and as inclusive of the pressure drops through inlet and outlet nozzles. In case of alternate conditions these shall apply to the worst operating condition.
- 2.10 Designer shall guarantee pressure drops to include entrance & exit losses.
- 2.11 When the physical properties of the fluids (specific heat, density, viscosity, etc.) are to be taken from available literature, preference shall be given to maxwell's handbook and TEMA standards.

3 MECHANICAL DESIGN

3.1 GENERAL

- 3.1.1 All exchangers shall be designed and fabricated in accordance with TEMA Standard, latest edition, Class 'R' and Section II and V and VIII and IX of the ASME Boiler and Pressure Vessel Code, and ASTM Codes, latest edition. Design shall be accompanied by drawings sufficient to describe the details of construction. Nozzles, flanges, tapered pipe threads, pipe fittings, bolts, nuts and gaskets shall be in accordance with appropriate ANSI, ASTM and TEMA Codes, and-welding electrodes to AWS specifications.
- 3.1.2 Where equipment is mounted on concrete foundations, the anchor bolts shall be designed with the following allowable anchor bolt stresses:
- Tension : 110 N/mm²
 - Shear : 69 N/mm²
 - Allowable bearing stress on concrete : 1.5 N/mm²
- 3.1.3 Provide impingement protection in multitube sections, consistent with TEMA class "R" latest edition.
- 3.1.4 Tube elements shall be removable without cutting the shell or connecting piping, and without disconnecting the shell piping.

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3.1.5 One end of the tube element shall be free-floating for thermal expansion.

3.1.6 No internal screwed connections will be allowed.

3.1.7 All pipe and tubing used in construction of the exchangers shall be seamless.

3.1.8 Tubes shall be expanded in 2 grooves in tubesheet.

3.1.9 Lifting lugs designed for twice the component weight shall be provided.

3.1.10 Vent and Drain Connections

All high and low points on shell and tube side of an exchanger not otherwise vented or drained by nozzles shall be provided with 3/4" connections (plugged) for vent and drain.

3.1.11 Reinforcing plates of nozzles shall be provided with at least one Tell-tale hole 1/4" NPT, in the lowest area of the pad when the exchanger is in its normal operation position.
Seller shall state the Maximum allowable force and moments to be applied on each nozzle in different directions.

3.1.12 Carbon steel U-tubes shall be stress/relieved for U-bends up to 600 mm in accordance with ASME code; as a minimum the requirements of spot radiography shall be met.

3.1.13 All flanged nozzles 2" and larger shall be provided with one 3/4", 6000 lb ANSI coupling connection (plugged) unless in hydrogen service.

3.1.14 All flanged nozzles 4" or larger shall be provided with 1" horizontal blind connection.

3.1.15 Nozzles 2" and smaller shall be supported by two 30 mm x 6 mm ribs located 90" apart.

3.1.16 The length taken from the outside of the insulated barrel or head to the back of the flange shall exceed the bolt length.

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3.2 DESIGN PRESSURES AND TEMPERATURES

3.2.1 Minimum design temperature shall be 10% above operating temperature, or maximum operating temperature plus 28°C whichever is greater, but however not less than 65°C.

3.2.2 Minimum design pressure shall be 10% above the maximum operating pressure or maximum operating pressure plus 2 bar, whichever is greater.

3.3 CORROSION ALLOWANCE & MINIMUM WALL THICKNESS

3.3.1 Minimum corrosion allowance on steel pressure parts shall be 3mm except for tubes.

3.3.2 Wall thickness for elements and shell pipe shall be as follows:

3.3.2.1 When pipe is used for elements:

- Schedule 40 shall be minimum thickness for carbon and low alloy steels.
- Schedule 10 is minimum wall thickness permitted for copper alloy materials.

Vendors' recommended thickness for other materials will be acceptable.

3.3.2.2 Multitube elements shall be vendors' standard wall thickness *unless* design pressure *requires* otherwise.

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