



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

MATERIAL STANDARD
FOR
AIR COOLED HEAT EXCHANGERS

NPCS-MS-HM-03

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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, packing and supply of air cooled 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 purchase specification 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 standards 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.

1.2 REFERENCES (LATEST EDITIONS)

- API-661 "Air-Cooled Heat Exchangers For General Refinery Services. Also refer annexure-I for supplementary requirements.
- ASTM Specifications.
- ASME Boiler and pressure Vessel Code Section VIII, Division 1, Unfired Pressure Vessels.
- AWS-ASME Specifications for Welding Electrods.

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- ANSI American National Standards Institute Inc., B 16.5, steel pipe Flanges and Flanged fittings and B 16.11, Forged Steel Fittings, socket Welding and threaded. (Latest Editions Approved by ASME).
- Material supplied by fabricator shall be inspected in accordance with relevant provision of ASME Boiler & Pressure Vessel Code Sec. II.
- ANSI B.31.3 Petroleum refinery piping, latest edition.
- AISC Latest edition for structural steel .

2 DESIGN

2 1 GENERAL REQUIREMENTS

2 1.1 Materials are specified in the purchase specification in general terms. Required materials shall conform, or be equal, to the ASME Specifications given in API-661. Cast iron shall not be used.

2 1.2 Designer of exchanger unit shall be responsible for furnishing equipment that is free of over stressing for any loading within the specified maximum loading.

2 1.3 Supplier shall check as part of his responsibility any design information issued by the purchaser. Any comment and/or reservations shall be stated at the bidding stage. Modifications and/or variations which may prove necessary during the order phase for ensuring the full reliability and efficiency of the equipment and/or adjusting the design to suit the purchase/equipment specification, the design codes, local regulations or to suit the technical and fabrications facilities of the supplier shall be his responsibility and liability and shall in all cases be submitted in writing for the purchaser's approval.

1.4 The supplier shall obtain the necessary approvals and have the required testing carried out by the inspection authorities, if any.
Air cooled heat exchangers shall be designed and made in accordance with references (Latest editions) as specified in Clause 1.2.



- 2.1.5 In general, tube to tubesheet joints shall be expanded . All tubesheet holes and the grooving in them shall conform to **API-661** and the following supplements. Grooves shall be square edged and concentric. When heat treatment of tubesheet is required, final tube hole sizing shall be attained by reaming after heat treatment.
- 2.1.6 The tube-to-tubesheet joint shall be welded, if one or more of the following apply:
- a) The design temperature is $<-10^{\circ}\text{C}$ or $>300^{\circ}\text{C}$
 - b) The design pressure exceeds $30 \text{ (kg/cm}^2\text{)g}$
 - c) Where the high reliability of the joint is required, because of lethal substance, Product quality, hazards of inter -mixing, etc.
 - d) When asked for in equipment data sheet.
- 2.1.7 When welding of tube to tubesheet is required, after welding, the tubes shall be light expanded into the tube holes. The light expansion shall imply minimum 5% tube thinning. The procedure and details of welding shall be submitted to the purchaser for approval .
- 2.1.8 Tubes shall be expanded into the tubesheet for a length equal to four tube outside diameters or the tubesheet thickness minus 3mm, whichever is smaller. In addition for tubesheets with thickness in excess of four tube diameters, expand one diameter at the air side face of the tube sheet minus 3mm . In no case shall the expanded portion extend beyond the air side face of the tubesheet. The expanding procedure shall provide substantially uniform expansion throughout the expanded portion of the tube without a sharp transition to the unexpanded portion.
- 2.1.9 For those combinations of tube and tubesheet materials and size of tubes for which torque values for optimum values and expansion procedure of tubes in tubesheet have not been established by vendor to the satisfaction of the inspection authority, vendor will carry out mock-up tests for establishing the expansion procedure including optimum torque values.
- 2.1.10 Tube sheets, for economic or other justifiable reason, may be clad and faced type.



2.2 CONNECTION ON NOZZLES

- 2.2.1 Provide one 1 1/2" flanged connection and one 3/4", 6000 lb coupling in all main nozzles of exchangers nominal size 4" and above, and one 3/4", 6000 lb coupling on nozzles size 2" NB to below 4" NB.
- 2.2.2 For connections size 3" NB and smaller, minimum 300 lb class rating flanges shall be used.
- 2.2.3 Slip on flanges are not permitted.
- 2.2.4 Integral reinforced nozzles are required to be provided.

2.3 SPECIAL APPLICATIONS

Sour Gas, Caustic Service:

The sour gas service is defined as a service in which the process stream contains water saturated with H_2S at a partial pressure in excess of 0.01 (kg/cm²)g. For such services, the following requirements shall also apply:

- a) C.S. material shall be killed steel manufactured to fine grain practice.
- b) Maximum Brinell Hardness number applied to base metal and heat affected zone shall be as follows:

* Carbon Steel	(P1)	200 BHN
- Carbon-Mo	(P3)	225 BHN
- Low-Alloy Steels	(P4,P5,P6)	225 BHN

The hardness shall be ensured in weld procedure and a random check by portable machine such as Telebrineller may be used for verification.

- c) All pressure parts shall be post-weld heat-treated.
- d) A71 pressure retaining welds shall be 100% x-rayed.

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3 MATERIALS

3.1 TUBING

3.1.1 All tubing shall be seamless.

3.1.2 Tube gauge/thickness Specified is the required minimum wall thickness, unless specified otherwise.

3.1.3 Wall thickness for integral fin tubes shall be measured from the bottom of the groove.

3.1.4 Tubing shall be in the fully heat treated conditions as received from the mill. Heat treatment may be annealing, normalizing or normalizing and tempering as per the ASTM Specification used.

3.2 BOLTING AND FLANGE CLOSURES

Bolting shall consist of continuously threaded bolts conforming to ASTM A-193-B7 with nuts in accordance with ASTM A-194-2H unless otherwise specified. Vendor of exchanger unit shall guarantee tightness compatibility of their closure designs. This especially, pertains to closures where designer amalgamates components having different thermal expansion properties.

3.3 GASKETS

3.3.1 Manufacturer shall furnish the gaskets for all flanged joints of exchangers.

3.3.2 Copper gaskets are not permitted when fluids contain H₂S or amines.

3.3.3 Gasket of header, if bolted type, shall have confined joint.

3.4 PLATES

3.4.1 C.S. boiler quality plates shall be to SA- 515 or better.

3.4.2 The carbon content of C.S. boiler quality plates shall not exceed 0.23% .

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3.5 FORGINGS

3.5.1 Flanges shall be forged weld neck type.

3.5.2 The carbon content of C.S. forgings shall not exceed 0.23%.

3.6 PIPES

3.6.1 The pipes shall be seamless.

3.6.2 The C.S. boiler quality pipes shall be SA-106 or better.

3.6.3 The carbon content of C.S. in BQ pipes shall not exceed 0.23%.

3.7 CLADDING

Use of clad materials for economical and other reasons may be considered.

a) Cladding shall be integrally and continuously bonded to the base metal.

b) Cladding shall not be counted for the strength it adds to tubesheet/other pressure parts.

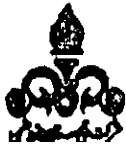
c) When other parts in contact with the same fluid are specified as "Killed Steel", the base metal of the clad or faced tubesheet/other pressure parts shall also be killed steel.

3.8 MATERIALS FOR NON-PRESSURE PARTS

3.8.1 C.S. materials for non-pressure parts welded to pressure parts shall be of boiler quality.

3.8.2 C.S. material for non-pressure parts not welded to pressure parts shall be SA-283/tested quality or equivalent.

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4

DESIGN & DRAWING APPROVAL

4.1

The supplier shall submit the mechanical design calculations and the fabrication drawings for purchaser approval.

The approval by purchaser shall not relieve the vendor from his responsibility of complying with requirements of requisition and the respective codes.

The fabrication drawings shall be made to scale in accordance to, NPCS-ES-GN-03 for sizes, and show the following:

- a) Overall size of the equipment and assembly.
- b) The size, orientation and location of nozzles.
- c) The sketch showing tube layout indicating pass partitions, orientation, location, etc.
- d) Bundle layout giving all locations & details of components like tube supports, side frames, etc.
- e) Details of plenum, fan/motor fixing arrangement.
- f) Loadings for the foundation design.
- g) Bundle weight, empty weight and operating weights of air cooled exchanger.
- h) Complete details of fan, motor and drive mechanism.
- i) Details of Supporting Structure.
- j) Details of Parts.
- k) Part nos. with material specifications, quantity, size, weight, etc.; including spares.
- l) Testing plan indicating the tests to be conducted on welds/materials and assemblies such as NDT tests/hydrotest/pneumatic test and destructive tests, etc.
- m) Weld lines orientation and location of weld profiles and sizes.
- n) Edge preparation and method employed .
- o) Brand name of electrodes with equivalent AWS specifications.
- p) Welding procedures to be employed .

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- q) Name plate location and details.
- r) Tolerances.
- s) Code certification and stamping requirements as indicated in the purchase order.
- t) Any other information or instructions to ensure compliance of shop procedures with code requirements and these specifications along with the addenda.
- u) Purchaser's order number and fabricator's shop order number, client's name, location of plant, item number etc.
- v) Design calculations for all components of air cooler including structures.

4.2 The supplier shall not proceed with the fabrication of the **equipments**, unless the design and drawings are approved by purchaser.

4.3 DEVIATIONS

In general no deviations from NPC Standards and specifications shall be permitted. This does not preclude possible innovations or improvements on the part of the supplier, based on available facilities. Such deviations must be clearly pointed out as a separate paragraph entitled "DEVIATIONS" in the supplier's documents, so as to avoid any confusion to clarify the points in minimum possible time. It shall be taken for granted that except for the deviations pointed out under the "DEVIATIONS" paragraph all other technical requirements shall be adhered to, by the supplier. No deviation shall be incorporated, unless it has been approved in writing by purchaser. 1% is in supplier's own interest to get the written approval of purchaser for all deviations before accepting the Purchase order. No deviations shall be entertained or approved after the order has been accepted by the supplier.

Delay in supply of the equipment, on account of such deviations being not entertained or approved by purchaser shall be contractor's liability.

In case there are no deviations required by the supplier quotation under the "DEVIATIONS" paragraph shall read as "EQUIPMENTS SHALL BE SUPPLIED AS PER PURCHASER'S SPECIFICATIONS, CODES, ETC., IN ALL RESPECTS". It shall be presumed that supplier has understood very clearly the purchase requirements and shall fully comply with them.