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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR AIR COOLED HEAT EXCHANGERS

FIRST EDITION

JULY, 2005

THIS SPECIFICATION IS THE PROPERTY OF NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED TO THE OWNER. NEITHER WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF THE NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY

IN THE NAME OF GOD**FOREWORD**

By their very nature, technical standard specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such standard specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant standard specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the on going projects.

In response to the initiative of the Design Division of the Engineering and Construction Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design Division of the Engineering and Construction Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design Deputy of the Engineering and Construction Director of NIOEC for evaluation and consideration.

S. R. KASAEIZADEH


EXECUTIVE DIRECTOR

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) REMARKS RELATED TO EACH REVISION SHOW A BRIEF DESCRIPTION. THESE REMARKS SHALL BE INTERPRETED IN CONJUNCTION WITH THE REVISED TEXT MARKED BY REVISION NUMBERS.
- 3) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 4) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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1. SCOPE

1.1 This Specification covers the mechanical requirements for furnishing air cooled heat exchangers consisting of horizontal finned tube bundles supported on structural steel columns. Air passes across the tube bundles by forced draft fans located below the tubes and separately supported from the tubes. The plenum chamber between the fans and the tubes is enclosed by sheet steel. This Specification is intended to cover the minimum requirements for the design, fabrication and supply of air cooled exchangers consisting of coolers and condensers operating under pressure or vacuum. Where data presented on Data Sheets conflict with the requirements of this Specification, the individual Data Sheets shall govern.

1.2 Specific performance and design requirements shall be indicated by the Purchaser on Process Data Sheet.

1.3 The design, fabrication, test and inspection of air cooled heat exchangers shall conform to API Standard 661 "Air Cooled Heat Exchangers for General Refinery Services" and ASME Code Sect. VIII, Div. I "ASME Boiler and Pressure Vessel Code".

1.4 Order of Precedence

In the event of a conflict among the various documents, the order of precedence shall be as follows:

- The purchase order (including attachments) and variations thereon.
- The Data Sheets and drawings.
- This Specification.
- API 661 "Air Cooled Heat Exchangers for General Refinery Services".

If conflict is discovered between the items listed, it shall be the responsibility of the Vendor to call attention to the conflict.

2. REFERENCES

Throughout this Specification the following dated and undated standards/ codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this Specification.

For undated references, the latest edition of the referenced document (including any supplements and amendments) applies. For dated references, the edition cited applies.

The applicability of changes in dated references that occur after the cited date, shall mutually be agreed upon by NIOEC and the Vendor/Contractor.

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ASME Code Edition 2002 Sect. II

ASME Code Edition 2002 Sect. V

ASME Code Edition 2002 Sect. IX

- B1.1 “Unified screw thread” Edition 1989
- B1.20.1 “Pipe thread” Edition 1983
- B16.5 “Steel pipe flanges and flanged fittings” Edition 1996
- B16.20 “Metallic gasket for pipe flanges” Edition 1998
- B18.2.1 “Square and Hex Bolts and screw” Edition 1996
- B18.2.2 “Square and Hex Nut” Edition 1987
- B31.3 “Petroleum process piping” Edition 2002
- B36.10 “Welded and seamless wrought steel pipe” Edition 2000
- B16.47 “Large diameter steel flanges”

API (AMERICAN PETROLEUM INSTITUTE)

- API 661 “Air Cooled Heat Exchangers for General Refinery Services” Edition 2002
- API 640 “Tube dimensions for heat exchangers” Edition 1988

TEMA (TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION)

Edition 1999

AISC “AMERICAN INSTITUTE OF STEEL CONSTRUCTION”

S 310, S 326 Edition 1989

AGMA (AMERICAN GEAR MANUFACTURERS ASSOCIATION)

- 422.03 “Standard practice for Helical, herringbone speed reducers”

NIOEC-SP (NIOEC SPECIFICATIONS)

- [NIOEC-SP-60-02](#) “NIOEC Specification for Low Voltage Induction Motors”
- [NIOEC-SP-60-06](#) “NIOEC Specification for Electrical System Installation”
- [NIOEC-SP-47-10](#) “NIOEC Specification for Noise Control and Vibration”
- [NIOEC-SP-00-50](#) “NIOEC Specification for Design Criteria for Process and Mechanic”
- [NIOEC-SP-00-01](#) “NIOEC Specification for Civil Design Criteria.”
- [NIOEC-SP-80-02](#) “NIOEC Specification for Painting”
- [NIOEC-SP-00-10](#) “NIOEC Specification for Units”
- [NIOEC-SP-00-11](#) “NIOEC Specification for Site Conditions”

The official code symbol stamp per the applicable code will not be required, unless otherwise specified.

3. UNITS

International system of units (SI) shall be used in accordance with [NIOEC-SP-00-10](#), unless otherwise specified.

4. DEFINITION & THERMINOLOGY

4.1 “Employer” means: “National Iranian Oil Engineering & Construction Company”. (NIOEC)

4.2 “Purchaser” means: “National Iranian Oil Engineering & Construction Company”. When quoted in this Specification as per of a direct Purchaser order by NIOEC and “Contractor” where this Specification is part of contract documents.

4.3 “Vendor” means: The manufacturer from which the equipment is to be purchased.

4.4 Terminology used in the Specification are defined as follows:

- a)** Tube Bundle: Assembly of headers, tubes and frames.
- b)** Section – Assembly of two headers, finned tubes and side channels.
- c)** Unit: The air-cooled heat exchange equipment covered by one equipment number, comprising one or more sections, the bundles to perform one specific duty.
- d)** Bank: One or more sections including one or more units arranged in a continuous structure.
- e)** Forced Draft Type: Designed with tube bundles located on the discharge side of the fan.
- f)** Induced Draft Type: Designed with tube bundles located on the suction side of the fan.
- g)** Bare Tube Surface: Outside surface of prime tubes based on length measured between outside face of header tube sheets in square meters.
- h)** Finned Tube Surface: Total outside surface (exposed to air) based on length of tubes measured between outside face of header tube sheets in square meters.
- i)** Hydrogen Service: When partial pressure of hydrogen is 5 bar (74.p.s.i.a.), and greater.

5. PROCESS REQUIREMENTS

Process requirements for each exchanger will be given in a Process Data Sheet for Air Cooled Heat Exchangers; Vendor shall complete all Data Sheet similar to that shown in Appendices.

6. AIR COOLER RATING

- 6.1** Air Coolers shall be designed for summer and winter conditions. The summer and winter design air temperatures shall be specified in the job Specifications and shall generally be equal to the summer maximum and winter minimum recorded dry bulb temperatures.
- 6.2** For winter design conditions the minimum tube wall temperature shall be at least 8°C higher than pour point temperature for both normal and minimum design throughput.
- 6.3** Fouling resistance shown on the process Data Sheet shall be applied to the inside surface of the tube. The tube side fouling factor is net value and must be adjusted by proper outside to inside surface ratio.
- 6.4** All heat transfer surfaces and coefficients shall be based on total effective outside tube and fin surface.
- 6.5** When calculating heat transfer coefficients, the inside fouling and inside fluid film resistance shall be multiplied by the ratio of the total effective outside surface to the total effective inside surface.
- 6.6** The effective tube wall and fin metal resistance shall be included in calculating heat transfer coefficients.
- 6.7** Pressure drops shall not exceed the maximum allowed values specified. These indicate the total pressure drops across nozzles, headers and tubes.
- 6.8** Fouling factor in air side of exchangers shall be 0.0004 sq.m.-hr-°C/Kcal (0.00035 sq.m.K/W).
- 6.9** Combination of items over same fans should receive prior NIOEC approval.
- 6.10** An over design factor to be considered for the Air coolers as per clause No.2.8.9 of NIOEC-SP-00-50.

7. MATERIALS

- 7.1** Materials of construction conforming with killed carbon steel requirements when specified on Data Sheet shall generally be in accordance with the following ASTM classification as minimum requirement. Substitution for ASTM standards of materials conforming to DIN or other equivalent standard on an equal or better basis is acceptable upon proof by Vendor of the equivalence and upon receipt of written approval from Purchaser.

Tubes	-Steel ASTM A-179 (fully annealed)
Fins	-Aluminum ASTM B-209
Headers	-Cast Steel ASTM A-216
	-Fabricated Steel ASTM A-285 Gr. C, A-516
Structural Steel	-ASTM A-36
Nuts(for pressure Parts)	-Steel ASTM A-194 -2H
Bolts(for pressure Parts)	-Steel ASTM A-193-8-7or B.14
Header Plugs	-Steel ASTM A-105 Grade II

Material of nozzle neck	-ASTM A-106, A-105 or A-516.
Nozzle Flanges	-Steel ASTM A-105
Fan Blades	-Aluminum ASTM B-179 or fibre Glass reinforced plastic as per 8.8.

Mechanical properties of materials for minimum ambient temperature and necessary heat treatment shall also be taken into account.

7.2 Materials subject to internal or external pressure shall conform to the Specification given in Sect. II of ASME Code or ASTM Standard.

7.3 Where materials other than the above or alloys not covered by the appropriate codes are specified the Vendor shall obtain design data from the supplier of such material, verify all calculations and show source of data.

7.4 C-1/2 Moly materials are not permitted to be used for any application.

8. MECHANICAL DESIGN

8.1 General

8.1.1 Earthquake load shall be in accordance with civil design criteria [NIOEC-SP-00-01](#) (clause 2.10)

8.1.2 Wind load shall be in accordance with chapter 16 of U. B. C. as following:

- 1) Basic wind speed and exposure coefficient at site (NIOEC-SP-00-11).
- 2) Design wind pressure shall be in accordance with the chapter 16 of U.B.C. Volume 2 division III.
- 3) Snow load shall be considered as per [NIOEC-SP-00-11](#) (Site conditions).

8.1.3 Corrosion allowance for bundle headers shall be indicated on the Process Data Sheet. Corrosion allowance shall not be added to supports or non-ferrous parts. Corrosion allowance called for on the Specification sheets shall apply to headers but not to tubes. Corrosion allowance on internal partition plates or stiffeners shall be for each side exposed to process flow.

See also article 5.2 of [NIOEC- SP-00-50](#) "Design Criteria".

8.1.4 The maximum anticipated operating pressure, which shall include an allowance for variations in the normal operating pressure which can be expected to occur, will be indicated on the Air Cooler Specification Sheet.

8.1.5 Except for air coolers operating under a vacuum, the internal design pressure for mechanical calculation shall be as specified per design criteria in NIOEC-SP-00-50. Design pressures shall be indicated on the process Data Sheet.

8.1.6 The maximum anticipated process operating temperature will be indicated on the Process Data Sheet. Air coolers design temperature shall be as specified per design criteria in NIOEC- SP-00-50.