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

NIOEC SP

NIOEC SPECIFICATION
FOR
FIRED HEATERS

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

REVISION INDEX

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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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0	JULY, 2005	K.FARROKHI	M.H.ZAKER	M.R.FARZAM	M.A.A.SAJEDI
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1. SCOPE

- 1.1** This Specification describes the general requirements for supplying horizontal and vertical direct-fired heaters (called “furnaces” for brevity). The requirements outlined herein are supplementary to the specifications listed on the individual fired heater Data Sheets. In the event of a conflict among the various documents, the order of precedence shall be as follows:

Fired Heater Data Sheets

Fired Heater Specification NIOEC-SP-45-03

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

- 1.2** This Specification covers, All structural steel, Refractories, Burners, Tubes, Fittings and Hangers, Stacks and Breaching, Dampers, Stair ways, Ladders and platforms, Roofs, Tube rollers and other special tools.

The following are not covered by the specification, but the requirements are covered in the listed reference specifications.

Civil	(See NIOEC-SP-44-01)
Concrete foundations	(See NIOEC-SP-10-01)
Lighting	(See NIOEC-SP-60-06)
Piping	(See NIOEC-SP-50-01 to NIOEC-SP-50-18)
Instrumentation	(See NIOEC-SP-70-01 for details)
Painting	(See NIOEC-SP-80-02)
Fireproofing	(See Drawing Standard NIOEC-SD-1002-4 Sheets)
Noise	(See NIOEC-SP-47-10)
Earthquake	(See NIOEC-SP-00-01)

1.3 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 560 “Fired Heaters for General Refinery Service”.

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 the company and the Vendor/Contractor.

- 2.1** The design, fabrication, test & inspection of fired heaters shall conform to API 560, Edition 2001 & API 530, Edition 1996.

2.2 Other References

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ASME code Sec. I	“Boiler and pressure vessel code”	Edition 2002
ASME code Sec. III	“Nuclear vessel code”	Edition 2002
ASME code Sec. VIII Div.1		Edition 2002
ASME code Sec. IX		Edition 2002
ASME code B16.5	“Steel Pipe Flanges and Flanged Fittings”	Edition 1996
ASME code B31.3	“Chemical Plant and Petroleum Refinery Piping”	Edition 2002

AISC (AMERICAN INSTITUTE OF STEEL CONSTRUCTION)

Edition 2000

UBC (UNIFORM BUILDING CODE)

Edition 1997

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

NIOEC-SD (NIOEC STANDARD DRAWINGS)

Drawing No. NIOEC: SD-1002-4 sheets

NIOEC-SP (NIOEC SPECIFICATIONS)

NIOEC-SP-45-07	“NIOEC Specification for Refractory Linings”
NIOEC-SP-45-14	“NIOEC Specification for Refractory Linings Procedure for Fired Heaters”
NIOEC-SP-70-01	“NIOEC Specification for Instrumentation”
NIOEC-SP-80-02	“NIOEC Specification for Painting”
NIOEC-SP-47-10	“NIOEC Specification for NOISE”
NIOEC-SP-00-50	“NIOEC Specification for Design Criteria for Process & Mechanic”
NIOEC-SP-10-01	“NIOEC Specification for Concrete Foundations”
NIOEC-SP-60-07	“NIOEC Specification for Lighting”
NIOEC-SP-50-01 to NIOEC-SP-50-18	“NIOEC Specification for Piping”
NIOEC-SP-00-10	“NIOEC Specification for Units”

Code Stamp

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

2.3 Approval of Vendors drawings shall not relieve the Vendor from responsibility in performance of the equipment specified herein.

2.4 Furnace structural steel work shall preferably be fabricated in Iran.

3. UNITS

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

4. DEFINITIONS & TERMINOLOGY

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 part of a direct purchase 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 A fired heater is an exchanger that transfers heat from the combustion of fuel to fluids contained in tubular coils within an internally insulated enclosure.

4.5 “Contractor” means: The person, firm, company or consortium whose tender has been accepted by the Employer or legal successors in title to such person.

5. SYMBOLS & ABBREVIATIONS

NIOEC	National Iranian Oil Engineering & Construction Company
IPS	Iranian Petroleum Standard
API	American Petroleum Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
ASME	American Society of Mechanical Engineers
AISC	Standard Specification for the design Fabrication and Erection of Structural steel for Buildings
UBC	Uniform Building Code “International Conference of Building Officials”

6. DESIGN

6.1 Thermal Design

6.1.1 General

6.1.1.1 Calculated and guaranteed actual efficiencies shall be as shown on the Data Sheets and shall be based on design duty, fuel lower heating value, and 15% excess air for fuel gas or 30% excess air or fuel oil.

6.1.1.2 The average radiant heat flux specified on the Data Sheets is defined as the quotient of total heat absorbed by the radiant tubes divided by the total outside circumferential tube area inside the firebox, including any fitting inside the firebox. The rows of convection tubes exposed to direct radiant shall be considered as being in the radiant section and the maximum radiant heat absorption rate shall apply to these tubes, irrespective of whether extended surface elements are used or not.

6.1.1.3 The maximum radiant heat flux density is defined as the maximum heat rate to any portion of any radiant tube. The rate shall be calculated for the front 60° of the tube surface. This density is not to be considered an operating average flux density for any given length of tube surface.

6.1.2 Process design conditions are shown on the individual Fired Heater Data Sheets.

6.1.3 Vendor shall specify the amount of excess air and stack temperature when operating at the guaranteed efficiency.

6.1.4 Determination of the tube lengths shall be based on the following criteria where

L_r = Total effective length of radiant tubes

D = Pitch circle of diameter tubes

L_c = Total effective length of convection tubes

6.1.4.1 Maximum L/D values for Vertical Cylindrical Heaters based on design heat absorption rates shall be:

L_r/D = 2 for design heat absorption rate up to 3 MW (10 MM BTU/hr)

L_r/D = 2.5 for 3-6 MW (10-20 MM BTU/hr)

L_r/D = 2.75 for over 6 MW (20 MM BTU/hr)

6.1.4.2 For horizontal tube heaters L_r = L_c

For horizontal end firing L_r = L_c = 15m (50 ft) max

6.1.5 Determination Of Minimum firing Distances

Refer to table 12 Section 10 of API-560 (Min. clearance for forced draft and induced draft operation). For horizontal tubes, the vertical distance from heater floor to bottom tube shall not be less than 610 mm.

7. MECHANICAL DESIGN

All furnaces of the same type shall be designed as far as practical to use the maximum of interchangeable parts (heater tubes, tube headers, supports, etc.). Thus, an inventory of spare parts will be kept to a minimum.

Mechanical details shall be designed, fabricated and tested in accordance with the applicable codes and standards, latest edition, as listed below.

7.1 Materials

Materials shall be according to the following specifications, or approved equivalent. Unless otherwise specified on individual Data Sheets the following Materials Specification shall be used.

7.2 Materials Specification

Steel Piping Materials

Tubes

- Carbon steel ASTM A106 Gr B
- C-1/2Mo A335 Gr PI
- 1-1/4 Cr-9Cr Molly A335 Appl. Grade, A213 Appl. Grade
- Chrome-Nickel A312, A376 Appl. Grade
- Tubes in a hydrogen free environment subject to H₂S corrosion should have materials selected according to "High temperature sulfidic corrosion in hydrogen free environment" by NACE. Fins or studs (Where permitted).
- Tip temp. up to 468°C(875°F) carbon steel.
- Tip temp. up to 620°C(1150°F) 11-13Cr(Min)
- Tip temp. over 620°C(1150°F) 18-8 S.S.

Steel Piping Materials

- ASTM. Latest edition

Welded Fittings

- ASTM. Latest edition

Cast Fittings

- ASTM. Latest edition

Steam Coils

- Per ASME Power Boiler Code, Section 1, Edition 2002

Columns, Beams, Structural Shapes & Refractory

- Carbon Steel ASTM A-36 or equivalent, Latest edition

Protected Eng. Tube Sheets Steel Plate Enclosure

- Carbon Steel ASTM A283, Grade C or equivalent,

Bolts(for high temperature service)

- Alloy Steel ASTM A-193 or equivalent, ASTM, quenched and tempered alloy steel bolts for structural steel joint, latest edition

Tube Support Casting Bolting

- ASTM A-320 B8 or equivalent, latest edition