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

NIOEC SP

NIOEC SPECIFICATION
FOR

PIPING MATERIAL PURCHASE METALLIC FITTINGS

SECOND EDITION

DECEMBER, 2017

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 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 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 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 ongoing projects.

In response to the initiative of the Design and Engineering 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 and Engineering 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 and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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INTRODUCTION

To satisfy the requirements of this NIOEC Specification, Iranian Petroleum Standard IPS-M-PI-150(2) Revision 2013 Part 1&3, with the considerations as specified hereinafter shall be strictly followed.

Articles introduction, scope, references, definitions and terminology, units, as mentioned in IPS-M-PI-150(2) shall be disregarded and following corresponding new articles (article 1 to 5) shall be considered.

1. SCOPE

This Specification covers minimum requirements for the procurement of pipe metallic fittings in sizes ½” through 48” used in oil refineries and pump stations and oil depots. For fittings above 48” manufacturer recommendation should be followed.

1.1. Fittings shall be manufactured according to the following standards except for supplements mentioned in the relevant paragraphs:

1.1.1. Wrought steel butt welding fittings as per ASME B 16.9 and MSS-SP-75.

1.1.2. Wrought stainless steel butt welding fittings as per MSS-SP-43 and ASME B 16.9.

1.1.3. Wrought steel butt welding short radius elbows and returns as per ASME B 16.28.

1.2. Forged threaded and socket-welding fittings as per ASME B 16.11 and MSS - SP- 83.

1.3. This Specification covers all requirements for enquiry or purchase order.

1.4. This Specification is intended to supplement the purchase description shown on the purchase requisition for specific requirements. If the purchase description differs from, or is in conflict with any requirements of this Specification, then the purchase description shall govern.

1.5. Resolution on cases not explicitly stipulated in this specification, or on cases where conflicts may arise among the requirements of the referenced / relevant IPS and international standards shall be made through written consent and approval of NIOEC.

1.6. Deviations from this specification will only be permitted in obtaining written approval from NIOEC.

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor/Contractor.

API (AMERICAL PETROLEUM INSTITUTE)

API 5L	“Specification for Pipe Line”-45 rd Edition (December 2012)
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ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

B 1.20.1	"Pipe Threads, General Purpose"
B 16.9	"Wrought Steel Butt Welding Fittings"
B 16.11	"Forged Steel Fittings (Socket Welding and Threaded)"

B 16.25	"Butt Welding Ends"
B 16.28	"Steel Butt Welding Short Radius Elbows"
B 16.34	"Valves-Flanged & Butt Welding"
B 31.3	"Process Piping"
B 36.10	"Welded and Seamless Wrought Steel Pipe"
B 36.19M	"Stainless Steel Pipe"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A 105	"Specification for Forgings, Carbon Steel, for Piping Components"
A 106	"Specification for Seamless Carbon Steel Pipe for High Temperature Service"
A123/A123M	"Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
A 181	"Specification for Forgings, Carbon Steel, for General-Purpose Piping"
A 182	"Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Services"
A 234	"Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures"
A 276	"Specification for Stainless and Heat Resisting Steel Bars and Shapes"
A 312	"Specification for Seamless and Welded Austenitic Stainless Steel Pipe"
A 333	"Specification for Seamless and Welded Steel Pipe for Low Temperature Service"
A 335	"Specification for Seamless Ferritic Alloy Steel Pipe for High Temperature Service"
A 350	"Specification for Forgings Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components"
A 351	"Specification for Steel Casting, Austenitic for High Temperature Service"
A 352	"Specification for Steel Casting, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service"
A 370	"Mechanical Testing of Steel Products"
A 387	"Specification for Pressure Vessel Plates, Alloy Steel Chromium Molybdenum"
A 400	"Practice for Steel Bars, Selection Guide, Composition and Mechanical Properties"

A 403	"Specification for Wrought Austenitic Stainless Steel Piping Fittings"
A 420	"Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service"
A 576	"Specification for Steel Bars, Carbon, Hot Wrought Special Quality"
A 694	"Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Services"
A 860	"Specification for Wrought High- Strength Ferritic Steel Butt-Welding Fittings"
B 161	"Standard Specification for Nickel Seamless Pipe and Tube"
B 165	"Standard Specification of Nickel-Copper Alloy (UNSN 04400) Seamless Pipe and Tube"
B 167	"Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Seamless Pipe and Tube"
B 407	"Standard Specification for Nickel -Iron-Chromium Alloys Seamless Pipe and Tube"
B 466	"Seamless Copper-Nickel Pipe and Tube"
B 467	"Welded Copper-Nickel Pipe"
E 92	"Standard Test Method for Vickers Hardness of Metallic Materials"
E 709	"Standard Guides for Magnetic Particle Testing"

BS (BRITISH STANDARD INSTITUTION)

BS 1600	"Specification for Dimensions of Steel Pipe for the Petroleum Industry"
BS 3799	"Steel Pipe Fittings, Screwed and Socket-welding for the Petroleum Industry"

EN (EUROPEAN NORMS)

BS EN 10204	"Metallic Products – Types of Inspection Documents"
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IPS (IRANIAN PETROLEUM STANDARDS)

IPS-M-PI-150	"Material Standard for Flanges and Fitting"
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ISO (INTERNATIONAL STANDARD ORGANIZATION)

ISO 10474	"Steel and Steel Product, Inspection Documents" Type 5.1 B&C
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ISO 8501	"Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness"
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MSS (MANUFACTURERS STANDARDIZATION SOCIETY)

MSS-SP-25	"Standard Marking System for Fittings, Flanges and Unions"
MSS-SP-43	"Wrought Stainless Steel Butt Welding Fittings"
MSS-SP-75	"High Test Wrought Butt Welding Fittings"
MSS-SP-83	"Steel Pipe Unions Socket Welding and Threaded"
MSS-SP-95	"Swage (d) Nipples and Bull plugs"
MSS-SP-97	"Forged Carbon Steel Branch Outlet Fittings"

MIL (US MILITARY STANDARD)

MIL-C-15726 F	"Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod and Wire"
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NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

MR 0175/ISO 15156	"Standard Material Requirement Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment"
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NIOEC-SP (NIOEC SPECIFICATIONS)

NIOEC-SP-00-10	"NIOEC Specification for Units"
NIOEC-SP-50-04	"NIOEC Specification for Piping Material Specification"
NIOEC-SP-50-27	"NIOEC Specification for Identification of Piping Material"
NIOEC-SP-50-64	"NIOEC Specification for Pipeline and Piping Material"
NIOEC-SP-90-52	"NIOEC Specification for Packing and Packages"

NIOEC- SIP (SHOP INSPECTION PROCEDURE)

NIOEC-SIP-50-10	"NIOEC Shop Inspection Procedure for Pipe, Fitting and Flange"
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3. UNITS

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

4. DEFINITIONS AND TERMINOLOGY

For the Purpose of this part of the Standard, the following definitions and terms shall hold.

Killed Steel: Thoroughly deoxidized steel for example by addition of aluminum or silicon, in which the reaction between carbon and oxygen during solidification is suppressed.

5. ABBREVIATIONS

HAZ: Heat Affected Zone

HV 10: Hardness Vickers 10

SSC: Sulfide Stress Cracking

GHSC: Galvanically Induced Hydrogen Stress Cracking

NDT: Nondestructive Test

6. MODIFICATIONS TO IPS-M-PI-150-PART1

This modification revises the below listed articles of the referenced standard as follows:

7. INSPECTION AND TESTING (Addition)

7.4 The manufacturer shall submit certificates for chemical composition, physical properties and any particular certificates (such as sour services) together with details of any tests and heat treatments applied.

7.5 Unless otherwise specified in the purchase requisition, the Manufacturer shall provide inspection certificates or test report in accordance with EN10204 Type 3.2. The certification shall include NIOEC Purchase Order number and shall be signed by the Supplier's authorized personnel.

7.6 The frequency, extent and authorized inspectors for of all required tests and inspections (stipulated in the purchase requisition, product specification, design code and project specifications) shall be in accordance with the pertinent NIOEC-SIP-50-10.

11. PROTECTION (Addition)

11.1 All items shall be provided with mill's standard coating for corrosion prevention during transportation.

11.2 Packing shall be in accordance with NIOEC-SP-90-52 "Specification for Packing and Packages", contained within the enquiry/purchase order documentation.

11.3 All bevels of fittings are to be suitably protected to avoid damage during transportation.

11.4 Details are to be provided by the Supplier within his shipping certification.

11.5 All austenitic stainless steel fittings shall be protected from exposure to chloride containing environment such as salt water or salt spray during shipment or storage.

12. COLOR CODING & MARKING(Addition)

12.1 Unless otherwise specified herein the location, style, symbols, abbreviations, color coding, etc., of all markings shall be accordance with NIOEC-SP-50-27.

7. MODIFICATION TO IPS-M-PI-150-PART3

This modification revises the below listed articles of the referenced standard as follows:

6. SECTION A: FACTORY-MADE WROUGHT BUTTWELDING FITTINGS (FOR ON-PLOT PIPING SYSTEMS)(substitution)

6.1. Material (Addition)

6.1.1. All carbon steels, including normalized steels, used for fittings shall have a maximum carbon content of 0.23%.

The carbon equivalent of these materials, calculated using the formula:

$$C_E = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

shall be less than 0.42 (check analysis).

If the content of alloying elements other than C or Mn is unknown, the formula to be used shall be:

$$C_E = C + \frac{Mn}{6}$$

and, in this case, the carbon equivalent shall be less than 0.40 (ladle analysis).

6.1.2. All carbon steels materials of thicknesses greater than 12.7 mm (½ inch) must be mechanically impact tested at -29°C (- 20°F) in accordance with ASME B 31.3 (paragraph 323.3).

6.1.3. All carbon steel materials for services at lower temperatures (i.e., below minus 29°C) shall undergo toughness testing in accordance with the requirements of their reference codes and standards.

6.1.4. For seamless fittings specified as SOUR or NACE, the sulfur content shall not exceed 0.01%.

6.1.5. The hardness of all carbon steel & low alloy steel fittings shall be as per NACE MR 0175/ISO 15156.

6.1.6. Seamless and Welded Copper and Copper Alloy fittings to ASTM B446 and B467 shall be annealed.

6.1.7. All materials and fabrication for sour service shall comply with NACE standard MR0175/ISO 15156.

6.1.8. Stress relieving shall be as per ASME B31.3 & NACE MR0175/ISO 15156.

6.1.9. Austenitic stainless steel fittings shall undergo an annealing heat treatment in accordance with the corresponding ASTM standards.

6.1.10. All austenitic stainless steel forging shall be 100% liquid penetrate examined as per ASTM A961 supplementary requirements S56, with acceptance criteria to ASME B16.34 ANNEX D.

6.2. Substitutions (Addition)

6.2.1. Exception for following materials, any substitution of material, including wall thicknesses increasing, is not permitted without NIOEC approval.

6.2.1.1. Type 316 stainless steel fittings in place of Type 304.

6.2.1.2. Type 304L stainless steel fittings in place of Type 304, provided that the minimum tensile and yield strength is equal to or greater than that specified for Type 304.

6.2.1.3. Type 316L stainless steel fittings may be substituted for Type 316, provided that the minimum tensile and yield strength is equal to or greater than that specified for Type 316.

6.2.2. Fittings with weld seams shall not be permitted without NIOEC approval.

6.3. Dimensions (Addition)

- 6.3.1. The thickness of carbon steel and low alloy steel fittings must be in accordance with the standards API 5L or ASME B36.10M.
- 6.3.2. The thickness of stainless steel fittings must comply with the standard ASME B36.19M, except that tolerance only for fittings in schedule 10S shall be in accordance with MSS SP 43.
- 6.3.3. The dimensions of forged, threaded or socket-welding fittings of the 3000# and 6000# series shall comply with the standard ASME B16.11. Dimensions of the Swage Nipples and Unions shall be as per MSS-SP-95 and MSS-SP-83 respectively and threading shall be as per ASME B1.20.1 (NPT).
- 6.3.4. The dimensions of butt-welding fittings shall be in accordance with the standard ASME B16.9, except that tolerances for stainless steel fittings in schedule 10S shall be in accordance with MSS-SP-43.
- 6.3.5. Dimensions of short radius elbow to be in accordance with ASME B16.28.
- 6.3.6. The dimensions of weldolet, sockolet, threadolet and similar fittings shall be as per MSS-SP-97 Standard.
- 6.3.7. For fittings if diameters greater than the limits set by the standards ASME B16.9 and MSS-SP-43, the Supplier must submit a dimensioned document and calculations notes to the NIOEC for approval.
- 6.3.8. Fittings shall be in wrought/forged material and in seamless/welded construction as specified. Fittings made from block forgings and machined to the required dimensions are not acceptable. Cast fittings are not acceptable.
- 6.3.9. Weld repair of seam welded fittings is only permitted on seam welds.

6.4. Ends (Addition)

- 6.4.1. All butt-welding fittings shall have ends beveled in accordance with ASME B16.25.
- 6.4.2. The ends of socket-welding, fittings, including sockolet shall comply with the standard ASME B16.11.
- 6.4.3. The ends of threaded fittings, including threadolet shall be in accordance with the standard ASTM B16.11, and shall be threaded as per ASME B1.20.1 (NPT).
- 6.4.4. Threaded area of galvanized fitting shall not be covered with zinc layer.

6.5. Manufacture (Addition)

- 6.5.1. All fittings up to 1 1/2" in diameter, of the 3000 # and 6000 # series, shall be forged. Fittings machined from bars are not acceptable.
- 6.5.2. Seamless fittings 2" and above in diameter shall be forged or extruded. Following these operations which may be performed on seamless tubular elements, the thickness of the fitting must be within the tolerance required by the reference standards.
- 6.5.3. Any beveling of the ends of the fitting shall be performed by machining. Flame cutting is not permitted.

6.5.4. Copper-Nickel Alloy fittings shall be supplied as per ASTM B466 and B467.

6.6. Production Tests (Addition)

- 6.6.1. The scope of witnessing and certification for non-destructive and other testing and examination shall be as stated in inspection and test plan enclosed with purchase requisitions.
- 6.6.2. All fittings shall be tested in accordance with their applicable ASTM, ASME, MSS, BS or other referenced code or standards and, where required for sour service, in accordance with NACE MR0175/ISO 15156.
- 6.6.3. All galvanized components shall be visually inspected to ensure the internal passages and bolt holes are not blocked or restricted.
- 6.6.4. Where impact testing is specified in the enquiry and purchase order document, or by the applicable ASTM Standards, it shall be Charpy V-notch tested in accordance with ASTM A370.
- 6.6.5. The test fluid used for hydrostatic testing shall be hydraulic oil or an emulsion of water with soluble oil to prevent rust. The chloride content of the test fluid for stainless and alloy steel only shall not exceed 50 ppm.
- 6.6.6. Following testing, all components are to be thoroughly dried prior to preparation for packing and shipping.
- 6.6.7. In addition to normal inspection documentation and inspection shall be provided prove the identities of all materials of construction and to establish that the correct heat treatment has been applied so that the finished product complies fully with this Specification.
- 6.6.8. All NDT shall be carried out after the final heat treatment using procedures approved by the Inspector.
- 6.6.9. Each fitting shall first be blast cleaned to SA 2½ (ISO 8501) or SA 3 and examined internally and externally for surface faults which shall conform to the limitations of section 10 of API Specification 5L.
- 6.6.10. Any internal longitudinal weld bead shall be ground flush for a distance of 100 mm (4 in) from the end of the fitting.
- 6.6.11. The following faults disclosed by radiography are unacceptable:
 - a) Cracks or incomplete penetration or fusion of any size.
 - b) Porosity exceeding 1% of the weld area in any 50 mm length of weld.
 - c) Any slag inclusion exceeding 3 mm long or 1.5 mm wide.
 - d) Slag inclusions exceeding 6 mm total length in 100 mm of weld.
- 6.6.12. Repairs to welded seams shall be limited to two per fitting, shall not exceed 5% of the seam length, and shall be carried out prior to final normalizing heat treatment.
- 6.6.13. Body repairs by welding shall not be permitted.
- 6.6.14. Cracks shall not be repaired and shall be cause for rejection. The cause of cracking shall be investigated, and established to the satisfaction of the Inspector.
- 6.6.15. Each fitting shall be examined for laminations, using an ultrasonic method approved by the Inspector covering a band at least 25 mm wide at each end of the fitting.