MATERIAL STANDARD

FOR

FLANGES AND FITTINGS

SECOND EDITION

JANUARY 2013

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

0. INTRODUCTION

This Standard consists of Three Parts as follows:

Part I: General requirements

Part II: Steel Pipe Flanges and Orifice Flanges

Part III: Steel Pipe Fittings

Throughout this Standard where a reference standard(s) is supplemented, the clause or section numbering of reference standard(s) has been used in each paragraph. Numberings which are not noted in the reference standard(s) are related to clause or section added to the reference standard(s).

1. GENERAL DEFINITIONS

Throughout this Standard in supplementing reference standard(s) the following definitions shall hold:

Sub. (Substitution)	The supplemented standard clause is deleted and replaced by a new clause.
Del. (Deletion)	The supplemented standard clause is deleted without any replacement.
Add. (Addition)	A new clause with a new number is added.
Mod. (Modification)	Part of the supplemented standard clause is modified and/or a new statement or comment is added to that clause.

"COMPANY": Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company etc.

"PURCHASER": Means the "Company" Where this standard is part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract documents.

"VENDOR" and **"SUPPLIER"**: Refers to firm or person who will supply and/or fabricate the equipment or material.

"MANUFACTURER": The party that manufactures or produces flange(s) and / or fitting (s) covered by this Standard.

"INSPECTOR": The representative of the Purchaser who is entrusted with inspection of products and production records and observance of production operations and quality control tests.

"WILL": Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

"MAY": Is used where a provision is completely discretionary.

"SHOULD": Is used where a provision is advisory only.

"SHALL": Is used where a provision is mandatory.

PART I

GENERAL REQUIREMENTS

CONTENTS: PAGE No.

1. GENERAL

1.1 Scope

This part of standard covers general requirement(s) for purchasing flanges and fittings specified in part two and three.

Note 1:

This is a revised version of this standard, which is issued as revision (1)-2006. Revision (0)-1997 of the said standard specification is withdrawn.

Note 2:

This is a revised version of this standard, which is issued as revision (2)-2013. Revision (1)-2006 of the said standard specification is withdrawn.

1.2 Conflict Requirements

The flanges and fittings offered by the vendor shall be in compliance with the requirement(s) of this Standard. If requirement(s) of this Standard differs from or is in conflict with other purchasing documents, the vendor shall clearly indicate points of conflict and request the Company for clarification and comments.

The Company's comments shall be fully considered and incorporated in the final specifications.

In case that no comment(s) is given by the Company, the followings will take precedence in the order of priority as indicated hereunder:

a) Purchase order.

b) This Standard specifications.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

API (AMERICAN PETROLEUM INSTITUTE)

API Spec. 6A	"Specification for Valves and Wellhead Equipment"
API 5L	"Specification for Line Pipe"

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

B 1.20.1	"Pipe Threads, General Purpose"
ANSI B 16.1	"Cast Iron Pipe Flanges and Flanged Fitting, Class 25, 125, 250, and 800"
B 16.5	"Pipe Flanges and Flanged Fittings"
ANSI B 16.11	"Forged Steel Fittings, Socket-Welding and Threaded"
B 16.20	"Ring Joint Gaskets and Grooves for Steel Pipe Flanges"
B 16.21	"Non-Metallic Flat Gaskets for Pipe Flanges"

B 16.36	"Orifice Flanges"
B 16.47	"Large Diameter Steel Flanges"
B 16.9-2001	"Factory Made Wrought Steel Butt Welding Fittings"
B 16.25	"Butt Welding Ends"
B 31.1-2004	"Power Piping"
B 31.3-2004	"Process Piping"
B 36.10	"Welded and Seamless Wrought Steel Pipe"
Section IV	"Heating Boilers"
Section VIII	"Rules for Construction of Pressure Vessels"
Section IX	"Welding and Brazing Qualifications"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A 105	"Specification for Forgings, Carbon Steel, for Piping Components"
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 350	"Specification for Forgings Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components"
A 387	"Specification for Pressure Vessel Plates, Alloy Steel Chromium Molybdenum"
A 694	"Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Services"
A 106	"Specification for Seamless Carbon Steel Pipe for High Temperature Service"
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 351	"Specification for Steel Casting, Austenitic for High Temperature Service"
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 515	"Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher Temperature Service"

A 516	"Specification for Pressure Vessel Plates, Carbon Steel for Moderate and Lower Temperature Service"
A 576	"Specification for Steel Bars, Carbon, Hot Wrought Special Quality"
B 164	"Specification for Nickel-Copper Alloy, Rod, Bar and Wire"
E 92	"Test Method for Vickers Hardness of Metallic Materials"

BS (BRITISH STANDARD INSTITUTION)

BS 131 Part 2	"The Charpy V-Notch Impact Test on Metals"
BS 1501	"Steels for Pressure Purposes: Plates"
BS 1502	"Specification for Steels for Fired and Unfired Pressure Vessels: Sections and Bars"
BS 1503	"Specification for Steel Forging (Including Semi finished Forged Products) for Pressure Purposes"
BS 1600	"Specification for Dimensions of Steel Pipe for the Petroleum Industry"
BS 2600	"Radiographic Examination of Fusion Welded Butt Joints in Steel"
BS 2910	"Methods for Radiographic Examination of Fusion Welded Circumferential Butt Joints in Steel Pipes"
BS 2926	"Specification for Chromium and Chromium-Nickel Steel Electrodes fro Manual Metal Arc Welding"
BS 6072	"Method for Magnetic Particle Flaw Detection"
BS 1133	"Packaging Code"
BS 3799	"Steel Pipe Fittings, Screwed and Socket-welding for the Petroleum Industry"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	"Engineering Standards for Units"
IPS-C-PI-270	"Construction Standard for Welding of Transportation Pipeline"
IPS-M-PI-190	"Material and Equipment Standard for Line Pipe"

ISO (INTERNATIONAL STANDARD ORGANIZATION)

ISO 10474	"Steel and Steel Product, Inspection Documents"
	Type 5.1 B&C

MIL (US MILITARY STANDARD)

MIL-C-15726 E	"Copper Nickel Alloy Rod, Flat Products (Flat Wire, Strip, Sheet, Bar and Plate) and Forgings"

MSS (MANUFACTURERS STANDARDIZATION SOCIETY)

SP-44	"Steel Pipeline Flanges"
SP-43	"Wrought Stainless Steel Butt Welding Fittings"
SP-75	"Specification for High Test Wrought Butt Welding Fittings"
SP-83	"Steel Pipe Unions, Socket Welding and Threaded"
SP-95	"Swage (d) Nipples and Bull Plugs"

SP-97 "Integrally Reinforced Forged Branch Outlet Fittings-Socket Welding, Threaded, and Buttwelding Ends"

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

MR 0175/ISO 15156 -2003

MR 0103 "Material Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments"

SIS (STANDARDIZERINGS KOMMISSIONEN I SVERIGE)

SIS 055900 "Swedish Standards Institution Practice-Surface Preparation Standard for Painting Steel Surface"

3. DEFINITIONS AND TERMINOLOGY

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

3.1 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.

4. ABBREVIATIONS

HAZ	"Heat Affected Zone"
HV 10	"Hardness Vickers 10"
SSC	"Surfide Stress Cracking"
GHSC	"Galvanically Induced Hydrogen Stress Cracking"

5. UNITS

This standard is based on international system of units (SI), as per IPS-E-GN-100 except otherwise specified.

6. MARKING

6.1 Marking Methods

Marking shall be applied as per MSS SP-25.

6.2 Marking shall not be applied to internal surfaces, highly stressed parts and weld preparation surfaces.

6.3 Marking by stamping shall be applied prior to heat treatment and stress relief.

6.4 Each component shall be marked with identification numbers or symbols which enable the cast or melt number and heat treatment to be traced.

6.5 Each flange and fitting shall be marked as a minimum with the following information:

- Purchase order and item number
- This standard
- Specification and material grade
- Heat number
- Size

- Wall thickness or schedule number
- Design pressure or class
- When sour service conditions are specified, the flanges and fittings shall be stamped "NACE".

7. INSPECTION AND TESTING

7.1 The Purchaser or his appointed inspector shall be given access to those parts of the manufacturer's works engaged on the production of fittings for Company, to inspect the materials being processed at any stage of manufacture. The Purchaser may reject any materials or components which in his opinion do not conform with this Specification.

7.2 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.

7.3 Certificates

Certificates which shall be granted to purchaser shall include but not limited to the followings:

a) Codes and standards compliance certificates;

b) Certificate of shop inspection;

c) Welding procedure and welder qualifications;

d) Non-destructive test certificates;

e) Certified reports giving chemical analysis and mechanical properties of steel;

f) Hydrostatic test certificates;

g) Certified dimensions and sectional drawings.

8. PRESERVATION

8.1 Unless otherwise specified, after final testing, all flanges and fittings shall be internally and externally dried, and internally coated with grease or sealant.

8.2 All machined or threaded surfaces shall be protected from corrosion with a rust preventive material which shall not become fluid and run off at a temperature less than 82°C

8.3 Unless otherwise specified by purchaser, materials such as bronze and stainless steel flanges and fittings shall not be painted or coated.

8.4 Particular attention shall be given to protection of Austenitic stainless-steel flanges and fittings from Chloride attack in salt contaminated atmospheres.

9. IDENTIFICATION

All flanges and fittings shall be identified by marking with color marks and code numbers as and if specified in the order.

10. DISPATCH (Add.)

10.1 Requirements for packaging, handling and labeling shall be specified in the purchase order.

PART II

STEEL PIPE FLANGES AND ORIFICE FLANGES

CONTENTS: PAGE No.

1. SCOPE

This Part of the Standard covers minimum requirements for the procurement of steel flanges in sizes DN 15 (NPS ½) through DN 1500 (NPS 60), also orifice flanges and gaskets. The flanges shall be manufactured according to the following standards except for supplement thereof.

a) Flanges DN 15 (NPS ½) to DN 600 (NPS 24) as per ASME B 16.5 (2009).

b) Flanges DN 650 (NPS 26) to DN 1500 (NPS 60) as per series A of ASME B 16.47 (2006).

c) Orifice flanges as per ASME 16.36 (2009).

Note 1:

Cast material and bronze flanges are not covered by this standard.

Note 2:

Insulating flanges are not covered by this standard.

6. SECTION A: PIPE FLANGES AND FLANGED FITTINGS SIZES DN 15 (NPS ½) Through DN 600 (NPS 24)

1. SCOPE

This Section is supplement to reference standard ASME B 16.5.

1.10 Those flanges which are not covered by ASME B.16.5 shall be calculated in accordance with ASME Section VIII Division 1. **(Add.)**

5. MATERIAL

5.1 General

Add to the end of this clause:

Forging to other standards may be used only subject to the approval of the Purchaser. Slip-on flanges made from plate shall not be used except for low pressure duties and for reducing flanges and then only subject to the approval of the Purchaser.

Note: Columns related to castings in Table 1A shall be omitted. (Mod.)

5.1.5 In Figs. 12, 13 and 14, if t_1, t_2 or sum $t_1 + t_2$ exceeds 0.5t, the material of the flange shall be substituted by a material with higher yield strengths (e.g. ASTM A 694). Flange material with yield strengths 331 MPa (48 ksi) and higher shall be killed steel (A 350 Gr LF-1 or Gr LF-2). **(Add.)**

5.1.6 All flanges shall be furnished in a heat-treated condition. Heat treatment shall consist of normalizing, normalizing and tempering, or quenching and tempering. **(Add.)**

5.1.7 The following limitations shall apply to all materials:

a) The maximum carbon content for forgings by ladle analysis shall be 0.23% and 0.20% for non-sour and sour services accordingly.

b) The maximum sulfur content for forgings by ladle analysis shall be 0.01% and 0.003% for non-sour and sour services accordingly.

c) The manufacturer shall ensure on a basis of regular production checks that the carbon equivalent (CE) by ladle analysis does not exceed 0.45% and 0.43% for non-sour and sour services accordingly where:

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

5.3.5 Bolting to gray cast iron flanges

This clause shall be deleted. **(Del.)**

5.4 Gaskets **(Sub.)**

Different material used for supply of gaskets and joint rings for use with bolted flanged joints, primarily in piping systems and for connections of piping to equipment is covered in this section.

All gasket materials shall be asbestos free.

5.4.1 Health, safety and environmental requirements

The supplier shall provide details of any necessary protective equipment to be used when handling jointing materials.

5.4.2 Non-metallic flat gaskets

Non-metallic flat gaskets for flanges covered in this Standard shall be in accordance with ASME B.16.21.

5.4.2.1 Non-metallic flat gaskets for raised face flanges shall be either self-centering within the flange bolts or full face type as follows:

a) Gaskets with outside diameter matching the raised face of flanges should not be used.

b) Full face gaskets are recommended for raised face flanges smaller than DN 50 (2 inch nominal Bore) to avoid potential problems of incorrect size gaskets being fitted. For DN 50 (2 inch NB) and above self-centering gaskets shall be used for raised face flanges.

c) Non-metallic flat gaskets for use with flat face flanges should be full face.

5.4.3 Metallic and semi metallic gasket and joint rings

5.4.3.1 Metallic gaskets double jacketed Corrugated, Ring joint and Spiral wound gaskets shall be in accordance with ASME 16.26.

5.4.3.2 Gaskets not standardized by ASME or API or API shall be in accordance with manufacturer standard however company/engineer prior approval is required case by case.

5.4.3.3 Material test certificate shall be provided in accordance with EN 10204-3.1, B.

5.4.3.4 Solid metal joint rings for wellhead equipment to API 6A shall comply with the requirements of API 6A.

7. SECTION B: LARGE DIAMETER STEEL FLANGES SIZED DN 650 (NPS 26) Through DN 1500 (NPS 60)

Steel flanges in sizes DN 650 (NPS 26) and larger shall be in accordance with ASME B 16.47. Sizes smaller than DN 650 (NPS 26) shall be excluded from this section.

5. MATERIAL

5.1.4 Requirements of 5.1.7 of Section A shall be applied. **(Add.)**

ANNEX A

The title of second column of table in this Annex shall be changed to cover sizes 26-36 inch inclusive. **(Mod.)**

8. SECTION C: ORIFICE FLANGES

Orifice flanges shall be in accordance with ASME B 16.36.

PART III

STEEL PIPE FITTINGS

CONTENTS: PAGE No.

1. SCOPE

This Part of the Standard covers minimum requirements for the procurement of steel pipe fittings in sizes DN 15 (NPS ½) through DN 1200 (NPS 48). Fittings shall be manufactured according to the following standards except for supplements mentioned in the relevant paragraphs:

1.1 Wrought steel butt welding fittings as per ASME B 16.9 (2007) and MSS-SP-75 (2008).

1.2 Wrought and cast stainless steel butt welding fittings as per MSS-SP-43.

1.3 Carbon steel and alloy steel threaded and socket-welding fittings, Swage (d) Nipples and Bull Plugs as per ASME B 16.11, MSS SP- 83 and MSS SP-95.

1.4 Integrally……...as per MSS SP-97.

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

This Section is supplement to reference standard ASME B 16.9.

5.1 Any particular requirements for materials used in low temperature services shall be specified by Engineer. **(Add.)**

5.2 Materials shall conform to SR-10 of Appendix X1 in this standard. **(Add.)**

7. SECTION B: SPECIFICATION FOR HIGH TEST WROUGHT BUTT WELDING FITTINGS (FOR OFF-PLOT PIPING SYSTEMS)

This section is supplement to reference standard MSS-SP-75.

1. SCOPE

1.5 Additional requirements may be specified by Purchaser for sour services. **(Add.)**

1.6 This section shall not be applied to general refinery and petrochemical plant duties. **(Add.)**

6. MATERIAL

6.5 The fittings should be designed in material with a strength equal to line pipe for which they are intended. **(Add.)**

6.6 For grades wphy 42 and higher the measured yield strength shall be in accordance with IPS-M-PI-190. **(Add.)**

7. CHEMICAL COMPOSITION

7.1 The chemical composition of the steel shall meet the requirements of relevant tables of IPS-M-PI-190. **(Sub.)**

7.3 This clause shall be deleted. **(Del.)**

7.4 The analysis shall be determined both on each heat of steel used, and on a broken mechanical test piece from each heat. **(Add.)**

7.5 If any part of the product analysis fails to meet the requirements of 7.1, the whole heat shall be rejected or each individual item shall be fully analyzed and all items failing to meet the requirements shall be rejected. **(Add.)**

8. TENSILE PROPERTIES

8.9 The transverse tensile properties (yield strength, tensile strength, elongation and reduction of area) shall be determined in the parent metal and any weld using the round bar transverse specimen of API Specification 5L. The tensile and yield properties shall meet the requirements for the equivalent line pipe in accordance with IPS-M-PI-190. **(Add.)**

10. TRANSVERSE GUIDED WELD BEND TEST

10.5 The Inspector will only permit a retest if there is reason to believe that failure was due to some fault in preparation or testing, and that the result was not representative of the test sample. Otherwise the failed test shall be carried out on every fitting in the heat or lot, or alternatively the entire heat or lot shall be re-heat-treated and the full set of tests carried out on one item. **(Sub.)**

11. NOTCH TOUGHNESS PROPERTIES

For fracture toughness sampling, testing and acceptance criteria refer to relevant sections of IPS-M-PI-190. **(Sub.)**

14. MANUFACTURE

14.4.9 For hardness sampling, testing and acceptance criteria refer to relevant sections of IPS-M-PI-190. **(Add.)**

14.6 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 heat treatment. **(Add.)**

14.7 Body repairs by welding shall not be permitted. **(Add.)**

14.8 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. **(Add.)**

15. NON-DESTRUCTIVE EXAMINATION (NDE)

15.1 Substitute to the last sentence:

If applicable, girth welds shall meet the acceptability standards in IPS-C-PI-270.

15.4 All NDT shall be carried out after the final heat treatment using procedures approved by the Inspector. **(Add.)**

15.5 Each fitting shall first be cleaned and examined internally and externally for surface faults which shall conform to the limitations of section 9 of IPS-M-PI-190. Adequate illumination shall be provided to facilitate proper examination. **(Add.)**

15.6 Defects on the surface of the fitting may be removed by grinding, provided that a smooth curved surface is maintained, and that the remaining thickness as verified by ultrasonic testing is not less than the specified minimum wall thickness. **(Add.)**

15.7 Any welds shall be of uniform width and profile, and shall blend smoothly into the body of the fitting. The height of any internal or external weld beads shall not exceed 3 mm (1/8 in). The Inspector may specify tighter tolerances for the height of internal weld beads. **(Add.)**

15.8 The image quality indicator shall be of agreed type and the thinnest wire clearly visible across the weld shall be not more than 1.25% of the wall thickness. **(Add.)**

15.9 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 (2 in) length of weld.

c) Any slag inclusion exceeding 3 mm (1/8 in) long or 1.5 mm (1/16 in) wide.

d) Slag inclusions exceeding 6 mm (¼ in) total length in 100 mm (4 in) of weld. **(Add.)**

15.10 Each fitting shall be examined for laminations, using an ultrasonic method approved by the Inspector covering a band at least 25 mm (1 in) wide at each end of the fitting. **(Add.)**

15.11 After beveling, the whole surface of the bevel and 100 mm (4 in) at each end of any longitudinal weld shall be examined by wet magnetic particle inspection, to BS 6072. Defects such as laps, cracks or laminations shall not be permitted. **(Add.)**

15.12 The welding ends of each fitting shall be 100% ultrasonically tested over a distance of 25 mm from each end from both the internal and external surfaces.

The acceptance criteria for ultrasonic inspection shall be in accordance with ASME VIII Division 1, Appendix 12. **(Add.)**

16. INSPECTION

16.2 Add to This Clause:

An inspection certificate shall be provided by the manufacturer in accordance with the following:

- ISO 10474 Type 5.1 B for chemical analysis, mechanical properties, notch toughness properties, hardness properties, heat treatment, non-destructive examination.
- ISO 10474 Type 5.1 C for other tests, e.g. dimensional checks, pressure test (when specified), functional checks. **(Mod.)**

16.4 Each fitting shall be dimensionally checked for the tolerance on diameter and out of roundness. The tolerance on wall thickness shall be checked at a minimum of 10 points equidistant around the circumference of the fitting. **(Add.)**

APPENDIX X1

1.0 SUPPLEMENTARY REQUIREMENTS

d) SR-4 This SR shall be deleted. **(Del.)**

e) SR-5 This SR shall be deleted. **(Del.)**

f) SR-6 This SR shall be deleted. **(Del.)**

h) SR-8 This SR shall be deleted. **(Del.)**

k) SR-10 This SR shall be deleted. **(Del.)**

8. SECTION C: WROUGHT AND FABRICATED BUTT-WELDING FITTINGS FOR LOW PRESSURE CORROSION RESISTANT APPLICATIONS

This section is supplement to reference standard MSS-SP-43 (2008).

7. METAL THICKNESS

7.1 The dimensions of the welding ends shall match those of the equivalent straight pipe dimensions, subject to the tolerances in clause 10. In order to obtain the proper dimensions at the welding ends, it is permissible to machine the inside of the fittings to a taper of not less than 1 in 4. **(Sub.)**

7.2 Body Thickness of Fittings

The body thickness of fittings shall be such that their actual bursting pressure is not less than the computed bursting pressure of straight seamless pipe having the same size and the same nominal wall thickness.

The computed bursting pressure of straight pipe shall be determined by the following formula:

$$P = \frac{2St}{D}$$

Where:

P = Bursting pressure of the pipe,

S = minimum specified tensile strength of the pipe material,

t = nominal pipe wall thickness,

D = outside diameter of the pipe.

Note: Coherent units should be used.

To ensure adequacy of design the manufacturer shall carry out bursting tests on prototype fittings. These bursting tests shall be made as specified in Clause 9.2. **(Add.)**

9. TESTS

9.2 Prototype Bursting Tests

The fitting shall be satisfactory if the pressure attained on bursting is equal to or greater than the computed bursting pressure of the straight pipe as ascertained by the formula in clause 7.2. if so specified by the purchaser, the manufacture shall supply certificates stating that satisfactory bursting tests have been carried out on prototype fittings of the types and size covered by the purchaser's order. **(Add.)**

9.3 Intergranular Corrosion Test **(Add.)**

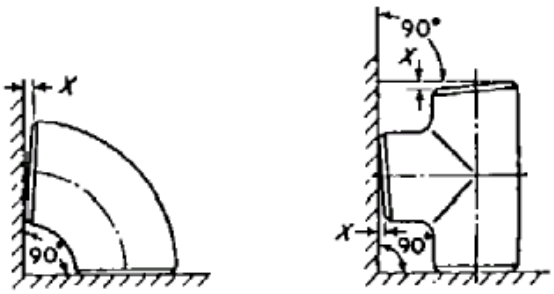
9.3.1 Wrought fittings

All materials shall be subjected to the intergranular corrosion test specified in BS EN 3651-2 if so required by the purchaser. **(Add.)**

10. TOLERANCES

10.2 Off-Square Tolerances

Following are the tolerances permitted for off-square X as shown in following figure.



TYPICAL EXAMPLES OF OFF-SQUARE TOLERANCE X
CHECKED AGAINST REFERENCE PLANES

DN 50 (NPS 2) up to and including DN 100 (NPS 4)	X = 0.8 mm
DN 150 (NPS 6)	X = 1.2 mm
DN 200 (NPS 8) to DN 600 (NPS 24)	X = 1.6 mm

(Add.)

BS 3799-1974 Amd 2 Steel Pipe Fittings, Screwed and Socket-welding for the Petroleum Industry

9. SECTION D: CARBON STEEL AND ALLOY STEEL THREADED AND SOCKET WELDING FITTINGS

This Section is supplement to reference standard ASME B 16.11 and MSS SP-95 and MSS SP-83 accordingly.