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STEEL PIPELINE FLANGES

Standard Practice
Developed and Approved by the
Manufacturers Standardization Society of the
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MSS

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Substantive changes in this 1996 edition are "flagged" by parallel bars as shown on the margins of this paragraph. The specific detail of the change may be determined by comparing the material flagged with that in the previous edition.

Non-toleranced dimensions in this Standard Practice are nominal, and unless otherwise specified, shall be considered "for reference only".

Originally Approved July 1952

FOREWORD

The Manufacturers Standardization Society originally developed the Standard Practice in response to the continued requests for steel pipe flanges for pipeline use, particularly in sizes larger than those covered by ANSI Standard B16.5 on Steel Pipe Flanges and Flanged Fittings. The line pipe is uniquely characterized by high-strength, cold worked, thin-wall of the carbon steel grade, which necessitates special considerations for the welding end of the flanges.

The size and pressure class range was originally NPS 26 through NPS 36 in pressure classes customarily designated in ANSI Standard B16.5 as 300, 400, 600, and 900 lb. The 1970 edition deleted the slip-on flanges for lack of demand, and added a 150 lb. class and coverage for sizes NPS 12 through NPS 24. Additional coverage was also necessitated by the advent of the use of line pipe of grades having minimum specified yield strength higher than the 52,000 psi maximum contemplated at the time of initial development, and therefore still thinner walls.

In some instances, this advent widened the differential between the tensile properties of the flange steel versus that of the mating pipe steel. This, in turn necessitated greater flexibility in the selection of hub dimensions, so that various combinations of material-strength and flange-dimensions could be utilized to supply the flanges. Section 5 on Flange Design was introduced at this point, and is one of the key features of this standard. The 1972 edition included the coverage of blind flanges in all pressure classes and clarification of text requirements for better understanding and usage under the more diverse conditions.

The 1975 edition expanded the size range above size NPS 36. The drilling templates for the Class 150 flanges of the NPS 38 and larger sizes continued the previous philosophy of adopting the drilling template of the Class 125 of ANSI Standard B16.1. However, the drilling templates of the Class 300 flanges of the NPS 38 and larger sizes did not continue the adoption of the Class 250 of ANSI Standard B16.1 drilling templates, nor did the NPS 38 and larger sizes of Classes 400, 600, and 900 continue the extrapolation of ANSI B16.5 drilling templates; instead, these drilling templates were necessarily designed more compactly because of the increased loads. While these flanges are designated by the customary ANSI Standard Class 150, 300, 400, 600, and 900, their use is almost entirely confined to cross country transmission pipelines at atmospheric temperatures. The flanges have been designed primarily for use at their cold ratings which conform to the ANSI Standard B16.5 ratings of 100F, and are intended primarily for attachment to relatively thin-wall, high-strength cold worked pipe, and high-strength butt-welding fittings in pipeline service at temperatures of 450F and lower. However, flanges forged of other materials are capable of pressure temperature ratings as specified in Paragraph 2.2.

The 1980 edition was created to bring the document into closer editorial alignment with ANSI B16.5. However, out of recognition of the successful experience of the pipeline industry, room temperature ratings were extended to 250F. De-rating above 250F was accelerated such that the 450F ratings are the same as B16.5. Users are cautioned that when these flanges are bolted to valves and used at temperatures between 100F and 450F, the rating of the valve will not be as high as the flange.

The 1990 revision of this SP was required to update the reference standards list and delete the metric equivalents.

The 1991 revision of this SP was required to add blind flange machining guidance, flat face requirements and precautionary notes as well as update of referenced standards.

The 1996 revision adds a table with permissible imperfections in flange facing finish and clarifies annex A design criteria. There were several errata, or corrections made to references to other standards. Dimensional tolerances have been changed where necessary to conform with ASME B16.5 and B16.47.

CONTENTS

1. SCOPE

1.1 General — This standard covers pressure-temperature ratings, materials, dimensions, tolerances (by reference to ASME/ANSI B16.5), marking and testing. The welding neck type flanges shall be forged steel, and the blind flanges may be made of either forged steel or from steel plates.

1.1.1 Dimensional requirements for sizes NPS 10 and smaller are provided by reference to ASME/ANSI B16.5. When such flanges meet all other stipulations of this standard, they shall be considered as complying therewith.

1.2 References

1.2.1 Referenced Standards — Standards and specifications adopted by reference in this standard are shown in Annex C, for convenience of identifying edition number, date and source of supply.

A flange made in conformance with a prior edition of referenced standards and in all other respects conforming to this standard will be considered to be in conformance even though the edition reference may be changed in a subsequent revision of this Standard Practice.

1.2.2 Codes and Regulations — A flange used under the jurisdiction of the ASME Boiler and Pressure Vessel Code, the ANSI Code for Pressure Piping, or Governmental Regulations, is subject to any limitation of that code or regulation. This includes any maximum temperature limitation for a material, or rule governing the use of a material at a low temperature.

2. PRESSURE-TEMPERATURE RATINGS

2.1 General Flanges covered by this standard shall be designated as one of the following: Class 150, 300, 400, 600 and 900. Ratings in Table 3 are in U.S. customary units.

2.2 Rating for Other Materials and Temperatures above 450 F — NPS 26 and larger flanges forged of steels covered in ASME/ANSI B16.5 whose bores are no larger than those which may be calculated for pipe complying with parallel ASTM pipe specifications, and which comply with all requirements (except dimensions) of American National Standard B16.5 are capable of being utilized at the pressure-temperature ratings given in that standard.

3. MATERIALS

3.1 The steel used in the manufacture of these flanges shall be selected by the manufacturer to meet the following requirements.

3.1.1 All materials used for flanges shall be killed steel.

3.1.2 The steel used shall be suitable for field welding to other flanges, fittings, or pipe manufactured under ASTM specifications A 105, A 53, A 106, A 350, A 381, A 694, A 707, or API Standard 5L.

3.1.3 The steel used shall have a maximum carbon content of 0.35 and a carbon equivalent computed by the following equation:

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

that should not exceed 0.48%, based on ladle analysis. If the carbon equivalent factor exceeds 0.48%, the acceptance of the flanges shall be based on agreement between purchaser and manufacturer.

3.1.3.1 The choice and use of alloying elements, combined with the elements within the limits prescribed in paragraph 3.1.3 to give the required tensile properties prescribed in paragraphs 3.1.4 shall be made by the flange manufacturer and included and reported in the ladle analysis to identify the type of steel.

3.1.4 The steel used shall have tensile properties conforming to the requirements prescribed in Table 1 and capable of meeting the requirements of section 4 and the flange manufacturer's design conditions as given in Annex A.

3.1.4.1 The test specimens may be taken from the forgings or, at the manufacturers' option, from the billets or forging bar entering into the finished product, provided such test blank has undergone relatively the same forming and the equivalent heat treatment as the finished flange. The dimensions of the test blank must be such as to adequately reflect the heat treatment properties of the hub of the flange. Specimens shall be obtained from the midwall of the thinnest section of the hub of the flange or ¾ in. from the surface of the test blank. The orientation of specimens taken from a flange shall be longitudinal.

3.2 Bolting — Bolting listed in Table 2 shall be used in flanged joints covered by this standard. Bolting of other material may be used if permitted by the applicable code or governmental regulation. All bolting materials are subject to the following limitations.

3.2.1 High Strength Bolting — Bolting materials having allowable stresses not less than those for ASTM A193 Gr B7 are listed as high strength in Table 2. These and other materials of comparable strength may be used in any flanged joint.

3.2.2 Intermediate Strength Bolting — Bolting materials listed as intermediate strength in Table 2, and other bolting of comparable strength, may be used in any flanged joint, provided the user verifies their ability to seat the selected gasket and maintain a sealed joint under expected operating conditions.

3.2.3 Low Strength Bolting — Bolting materials having not more than 30 ksi specified minimum yield strength are listed as low strength in Table 2. These materials and others of comparable strength shall be used only in Class 150 and Class 300 joints, and only with gaskets described in 3.3.2.

TABLE 1. TENSILE REQUIREMENTS

GRADE	YIELD POINT MIN. ksi	TENSILE STRENGTH MIN. ksi	ELONGATION IN 2 IN. MIN. PERCENT
F36	36[a]	60	20
F42	42	60	20
F46	46	60	20
F48	48	62	20
F50	50	64	20
F52	52	66	20
F56	56	68	20
F60	60	75	20
F65	65	77	18
F70	70	80	18

[a] Note: except as required in para. 4.2.

TABLE 2. LIST OF BOLTING SPECIFICATIONS

ASTM BOLTING MATERIALS							
HIGH STRENGTH [a]		INTERMEDIATE STRENGTH [b]			LOW STRENGTH [c]		
SPEC-GR.	NOTES	SPEC-GR.		NOTES	SPEC-GR.		NOTES
A193-B7		A193-B5			A193-B8	CL1	(g)
A193-B16		A193-B6			A193-B8C	CL1	(g)
A320-L7	(d)	A193-B6X			A193-B8M	CL1	(g)
A320-L7A	(d)	A193-B7M			A193-B8T	CL1	(g)
A320-L7B	(d)	A193-B8	CL2	(f)	A193-B8A		(g)
A320-L7C	(d)	A193-B8C	CL2	(f)	A193-B8CA		(g)
A320-L43	(d)	A193-B8M	CL2	(f)	A193-B8MA		(g)
A354-BC		A193-B8T	CL2	(f)	A193-B8TA		(g)
A354-BD		A320-B8	CL2	(f)	A307-B		(h)
A540-B21		A320-B8C	CL2	(f)	A320-B8	CL1	(g)
A540-B22		A320-B8F	CL2	(f)	A320-B8C	CL1	(g)
A540-B23		A320-B8M	CL2	(f)	A320-B8M	CL1	(g)
A540-B24							
		A320-B8T	CL2	(f)	A320-B8T	CL1	(g)
		A449		(i)			
		A453-651		(e)			
		A453-660		(e)			

General Note:

Bolting materials shall not be used beyond temperature limits specified in the governing Code.

NOTES:

(a) These bolting materials may be used with all listed materials and gaskets.

(b) These bolting materials may be used with all listed materials and gaskets; provided it has been verified that a sealed joint can be maintained under rated pressure and temperature.

(c) These bolting materials may be used with all listed materials but are limited to Class 150 and Class 300 joints. See 3.3 for recommended gasket practices.

(d) This ferritic material is intended for low temperature service, use A194 Gr. 4 or Gr. 7 nuts.

(e) This special alloy is intended for high temperature service with austenitic stainless steel.

(f) This austenitic stainless steel has been carbide solution treated and strain hardened. Use A194 nuts of corresponding material.

(g) This austenitic stainless material has been carbide solution treated but not strain hardened. Use A194 nuts of corresponding material.

(h) This carbon steel fastener shall not be used above 400 F or below -20 F, see also Note (c). Bolts with drilled or undersized heads shall not be used.

(i) Acceptable nuts for use with quenched and tempered bolts are A194 Gr. 2 and Gr. 2H. Mechanical property requirements for studs shall be the same as those for bolts.

TABLE 3. PRESSURE-TEMPERATURE RATINGS
MAXIMUM ALLOWABLE NON-SHOCK WORKING PRESSURES
IN POUNDS PER SQUARE INCH (GAGE)

TEMP. F	CLASS 150	CLASS 300	CLASS 400	CLASS 600	CLASS 900
-20 to 250	285	740	990	1480	2220
300	275	715	955	1430	2145
350	265	690	925	1380	2070
400	255	665	890	1330	2000
450	245	640	860	1285	1925

3.3 Gasket Material

3.3.1 The user is responsible for selection of gasket materials which will withstand the expected bolt loading without injurious crushing, and which are suitable for the service conditions. Particular attention should be given to gasket selection if a system hydrostatic test will exceed the test pressure specified in 8.2. Such a test involves the risk of excessive flange distortion.

3.3.2 Gasket dimensions for 1/16 inch sheet asbestos in Table 4 are based on a contact area equal to approximately twice the bolt root area. Class 150 flanged joints should use these exclusively.

3.3.3 Ring joint gasket materials shall conform to ANSI B16.20 with dimensions as given in Table 5.

3.3.4 Sheet and ring joint gaskets for sizes NPS 10 and smaller shall conform to ASME/ANSI B16.5 dimensions and recommendations.

4. HEAT TREATMENT

4.1 The F42 and higher grades of flanges of all pressure classes and the class 400 and higher classes of Grade F36 flanges shall be normalized or quenched and tempered.

4.2 It is recognized that the cooling rate in a quenching operation may be slower in the thicker ring section of the flange than in the thinner hub section. Hence, the increase in yield strength due to the quenching operation may be less in the ring section than in the hub section. This factor is accounted for in the Section on Design in Paragraph 5.3. NPS 38 and larger sizes of the 300 and higher classes of welding neck flanges shall have 42 ksi minimum yield strength in the ring section.

5. FLANGE DESIGN

5.1 Drilling Templates — Drilling templates are derived as follows:

5.1.1 Class 150 flange drilling templates are the same as ASME/ANSI B16.5 and Class 125 of ANSI/ASME B16.1.

5.1.2 Sizes 24 and smaller class 300 flanges have drilling templates which are the same as ASME/ANSI B16.5 and Class 250 of ANSI/ASME B16.1. Sizes 24 through 36 inclusive have drilling templates which are interpolations of Class 250 of ANSI/ASME B16.1 except the diameter of the bolt holes are only one-eighth inch larger than bolt diameters. Larger sizes are designed in accordance with Appendix 2 of Division 1 of Section VIII of ASME Boiler and Pressure Vessel Code.

5.1.3 Size 36 and smaller of Classes 400, 600, and 900 flanges have drilling templates which are extrapolations from ASME/ANSI B16.5. Larger sizes are designed in accordance with Appendix 2 of Division I of Section VIII of ASME Boiler and Pressure Vessel Code.

5.2 Flange Ring Design — The outside diameter and flange thickness of sizes NPS 24 and smaller flanges are in accordance with ASME/ANSI B16.5. Larger sizes are designed in accordance with Appendix 2 of Division 1 of Section VIII of ASME Boiler and Pressure Vessel Code and the flange ring shall have sufficient pressure capacity for the service based on its strength in the normalized condition. This capacity shall be substantiated by the Rules for Bolted Flange Connections, Appendix 2 of Division 1 of the ASME Unfired Pressure Code Section VIII, with allowable design stresses as given in Annex A of this standard.

5.3 Hub Design

5.3.1 Sizes NPS 24 and smaller. When the mechanical (minimum yield strength) properties of all sections of the flanges are equal to or higher than those of the pipe to be matched, the hub dimensions may be the same as those of ASME/ANSI B16.5. Larger sizes are designed in accordance with Appendix 2 of Section VIII of ASME Boiler and Pressure Vessel Code.

5.3.2 In addition, when the minimum yield strength of the hub portion of any flange or its representative test specimen is less than that specified for the pipe to be matched, the minimum thickness of the hub at the welding end shall be such that the product of its thickness times its yield strength (at welding end) shall at least equal the product of the specified nominal wall thickness and minimum specified yield strength of the pipe to be matched. Under these conditions, Sizes NPS 24 and smaller flanges may also have a single taper hub and the outside diameter of the hub at the base may be modified in accordance with ASME Section VIII Division 1 Appendix 2 calculations.

5.3.3 When the manufacturer employs this option, the flange identification should be a combination of the class of material of the flange and of the pipe for which the flange has been designed. See 6.1.

5.3.4 When the hub thickness at the welding end must be greater than the adjoining pipe, the joint design shall be as shown in any of the three sketches in Figure 1.

5.4 Welding End — The welding end shall be in accordance with Figure 2 for wall thickness (of intended mating pipe) of 0.88 in. and less. For thicker walls, refer to Figure 3.

5.5 Blind Flange

5.5.1 a) The outside diameter and thickness of blind flanges shall be as listed in Tables 6, 7, 8, 9 and 10. Thicknesses listed are based on material having mechanical properties for Grade F36 of Table 1. Drilling templates are per Paragraph 5.1. Thinner flanges of higher strength material may be furnished in accordance with Annex B rules.

5.5.2 b) Blind flanges need not be faced in the center if, when this center is raised, its diameter is at least 5 in. smaller than the nominal pipe size. When the center part is depressed, its diameter shall not be greater than the gasket ID specified in Table 4 less 2 inches (I.D. - 2 = max. depression O.D.).

5.6 Dimensional requirements for NPS 10 and smaller shall be in accordance with ASME/ANSI B16.5.

5.7 Flat Face Flanges — This standard permits flat face flanges in all classes, by providing flanges having either the full thickness or the thickness with the raised face removed, without reduction of the pressure-temperature ratings subject to the following provisions.

5.7.1 The thickness of a Class 150 or 300 flange from which the raised face has been removed shall be no less than the applicable dimension C of Tables 6 & 7 minus 0.06 in.

5.7.2 The thickness of a flange of Class 400 or higher from which the raised face has been removed shall be no less than the applicable C dimension of Tables 8, 9 and 10.

5.7.3 The flange facing shall conform with section 7.2 for the full width of seating of the gasket.

5.8 Spot Facing — All flanges shall have bearing surfaces for bolting which shall be parallel to the flange face within 1 deg. Any back facing or spot

facing required to accomplish parallelism shall not reduce the flange thickness C below the dimensions given in Tables 6, 7, 8, 9 and 10. Any spot facing or back facing shall be in accordance with MSS SP-9.

6. MARKING

6.1 Flanges shall be marked in accordance with the rules established in MSS Standard Practice SP-25, Standard Marking System for Valves, Fittings, Flanges, and Unions. In addition, the letters, "PL" shall precede the grade symbol marking. The grade symbol marked on the Welding Neck Flange shall designate the grade of material in the welding end of the hub. When flanges are produced under the option of Paragraph 5.3.1, the marking will also include the grade of the material of the pipe which the flange will match. For example, a flange having a grade F42 hub designed to be used with grade X60 pipe would contain the marking PL F42/X60 in addition to the marking specified in MSS SP-25.

6.2 Flanges in sizes NPS 10 and smaller produced to B16.5 dimensions and complying with all other requirements of this Standard Practice shall be marked in accordance with 6.1.

7. FACINGS

7.1 Flange Facing Finish — The finish of contact faces of pipe flanges shall be judged by visual comparison with Ra Standards (see ANSI B46.1) and not by instruments having stylus tracers and electronic amplification. The finishes required are given below. Other finishes may be furnished by agreement between user and manufacturer.

7.2 Raised Face — Either a serrated-concentric or serrated-spiral finish having from 125 μ in. to 250 μ in. average shall be furnished. The cutting tool employed should have an approximate 0.06 in. or larger radius, and there should be from 44 to 55 grooves per in.

7.3 Ring Joint — The side wall surface of gasket groove shall not exceed 63 microinch roughness.

7.4 Flange Facing Finish Imperfections in the flange facing finish shall not exceed the dimensions shown in Table 11. Adjacent imperfections shall be separated by a distance of at least four times the permissable radial projection. Protrusions above the separations are not allowed.

8. CODE LIMITATIONS

8.1 A product used under the jurisdiction of the ASME Boiler and Pressure Vessel Code or of the ANSI Code for Pressure Piping, is subject to any limitation of that code. This includes any maximum temperature limitation for a material, or a code rule governing the use of a material at a low temperature.

8.2 Flange Testing — Flanges are not required to be hydrostatically tested. Flanged joints may be subjected to system hydrostatic tests at pressures not exceeding 1.5 times the 100 F rating.

9. FLANGE BOLTING DIMENSIONS

9.1 Alloy-steel stud-bolts threaded at both ends or full length, or bolts with hexagonal heads conforming to American National Standard heavy dimensions (ANSI B18.2.1) may be used and shall have nuts conforming to American National Standard heavy dimensions (ANSI B18.2.2).

9.2 Carbon Steel bolts smaller than ¾ in. shall have square heads or heavy hex heads (ANSI B18.2.1), and shall have heavy hex nuts (ANSI B18.2.2). Bolts ¾ in. and larger shall have square heads or hex heads (ANSI B18.2.1), and shall have hex nuts or heavy hex nuts (ANSI B18.2.2).

9.3 Threads of carbon steel bolts and stud bolts shall be coarse series, Class 2A (ANSI B1.1), and nuts shall be coarse series, Class 2B.

9.4 All alloy steel bolting shall be threaded in accordance with ANSI B1.1. Nominal diameters 1 in. and smaller shall be of the coarse thread series; nominal diameters 1⅛ in. and larger shall be of the 8 thread series. Bolts, studs and stud-bolts shall have a Class 2A thread, and nuts shall have a class 2B thread.

9.5 Bolting to Cast Iron Flanges — Where Class 150 steel flanges are bolted to Class 125 cast iron flanges or Class 300 steel flanges are bolted to Class 250 cast iron flanges, it is recommended that low strength bolting be used. If intermediate or high-strength bolting is used, it is recommended that the mating flanges be flat faced and that full faced gaskets extending to the O.D. of the flange be used.

10. TOLERANCES

10.1 Facings

Outside Diameter, 0.06 in. raised face:
Sizes NPS 12 to NPS 24 inclusive: ±0.03 in.
Sizes NPS 26 and Larger: ±0.08 in.

Outside Diameter, 0.25 in. raised face:
Sizes NPS 12 to NPS 24 inclusive: ±0.02 in.
Sizes NPS 26 and Larger: ±0.04 in.

10.2 Flange Thickness

Sizes NPS 18 and Smaller	+0.12 in. −zero
Sizes NPS 20 and larger	+0.19 in. −zero

10.3 Hub Dimensions (including welding ends)

10.3.1 Nominal Outside Diameter of Welding End of welding neck flanges (Dimension H, in Tables 6, 7, 8, 9 and 10.

Sizes NPS 12 to NPS 24 in.	+0.16 in. −0.03 in.
Sizes NPS 26 and larger	+0.21 in. −0.06 in.

10.3.2 Nominal Inside Diameter of Welding Ends of welding neck flanges (Dimension B in the referenced Figures).

Sizes NPS 12 to 18 inclusive	±0.06 in.
Sizes NPS 20 and larger	+0.12 in. −0.06 in.

10.3.3 Thickness of Hub — Regardless of tolerances specified for dimensions A and B, the thickness of hub at the welding end shall never be less than 87½ percent of the nominal thickness of the pipe to which the flange is to be attached.

10.4 Overall Length through Hub on Welding Neck Flanges

Sizes NPS 12 to NPS 24 incl.	+0.12 in. - 0.18 in.
Sizes NPS 26 and larger	±0.19 in.

10.5 Drilling and Facing

10.5.1 Bolt Circle Diameter, ±0.06 in.

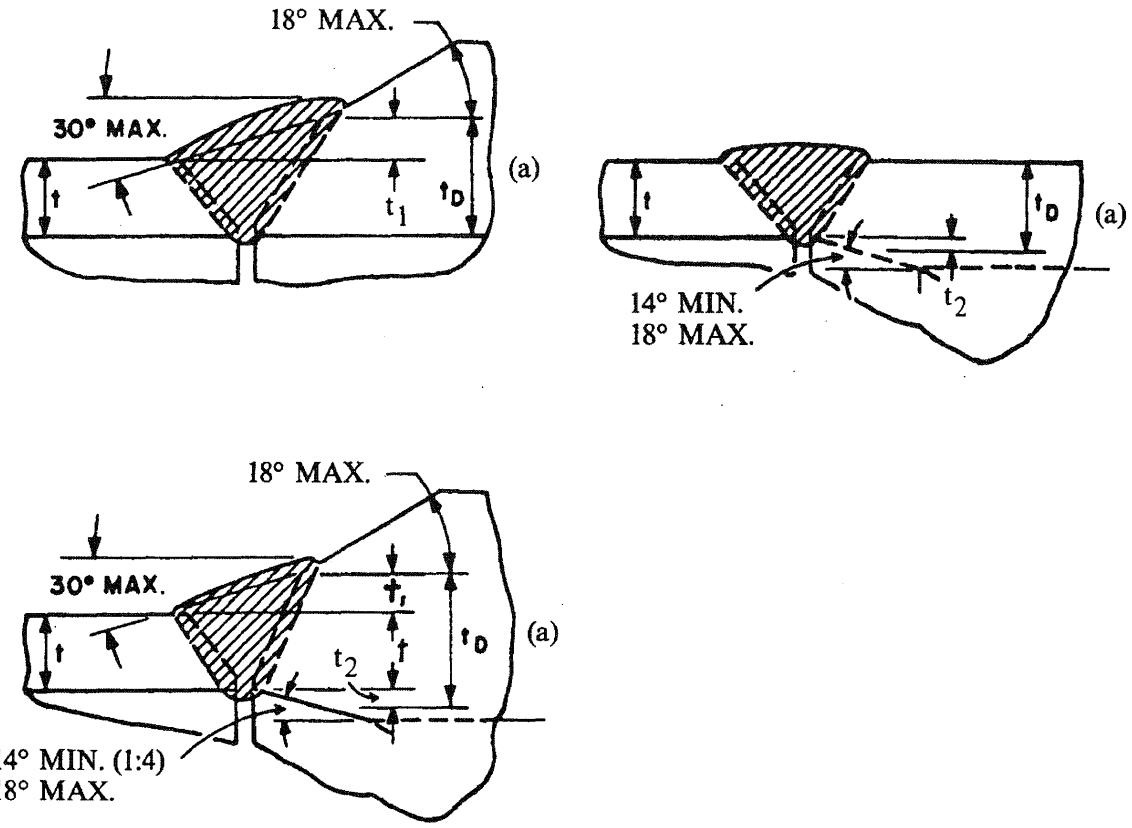
10.5.2 Center-to-Center of adjacent bolt holes, ±0.03 in.

10.5.3 Eccentricity between bolt circle diameter and machined facing diameters.

Sizes NPS 12 to NPS 24, incl.	0.06 in.
Sizes NPS 26 and larger	0.09 in.

10.6 Sizes NPS 10 and Smaller Tolerances for these sizes shall be as specified in ASME/ANSI B16.5.

The listing of decimal tolerances does not imply method of measurement.



NOTES:

GENERAL:

When the minimum specified yield strengths of the sections to be joined are unequal, the deposited weld metal shall have mechanical properties at least equal to those of the section having the higher strength, and the minimum thickness, t_D, shall at least equal t times the ratio of minimum specified yield strength of pipe and flange, but not to exceed 1.5t.

(a) Neither t_1, t_2, nor $t_1 + t_2$ shall exceed 0.5t.

FIGURE 1 — ACCEPTABLE DESIGNS FOR UNEQUAL WALL THICKNESS(1)
(See Paragraph 5.3)

(1) SUPPLEMENTARY FOOTNOTE: See ASME B31 Piping Codes for additional fabrication details.

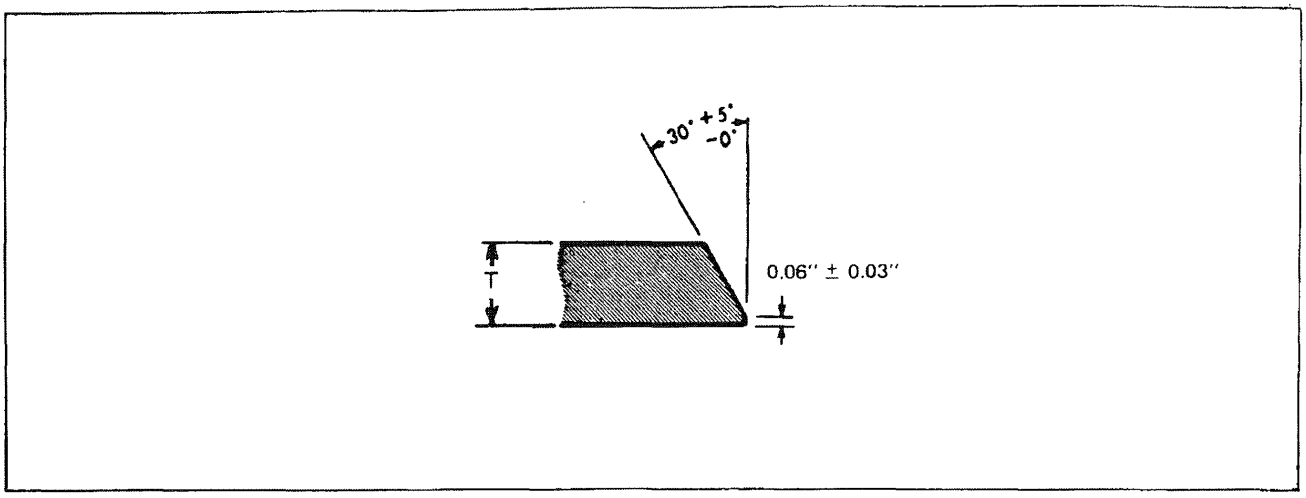


FIGURE 2 — BEVEL DETAIL FOR WALL THICKNESS (T) 0.88[a] OR LESS

NOTE: [a] Flange sizes 24 and smaller may be furnished with 37-½° bevel at option of manufacturer.

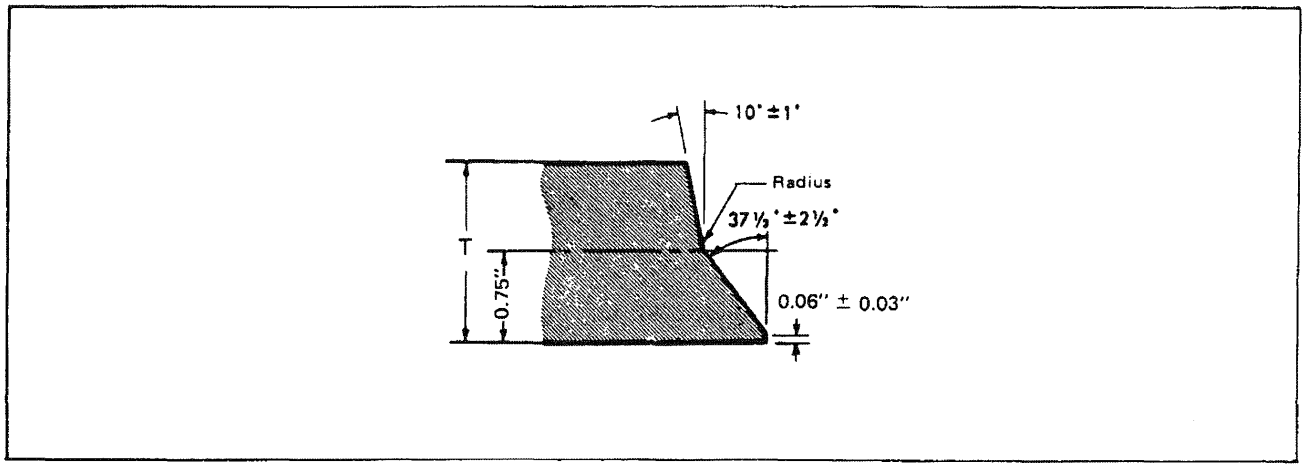


FIGURE 3 — BEVEL DETAIL FOR WALL THICKNESS (T) GREATER THAN 0.88

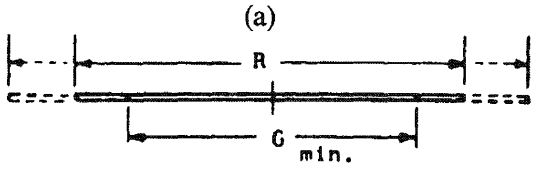
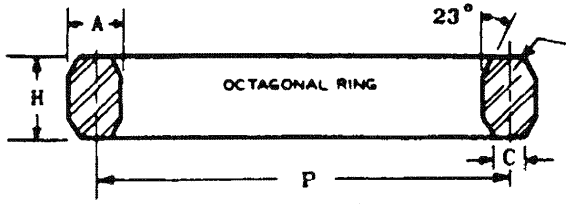


TABLE 4 — SHEET GASKET DIMENSIONS

Dimensions in inches

NOM. PIPE SIZE	O.D. GASKET R[(a)]	I. D. GASKET G MIN.				
		150	300	400	600	900
12	15.00	12.75	12.75	12.75	12.75	12.75
14	16.25	14.00	14.00	14.00	14.00	14.00
16	18.50	16.00	16.00	16.00	16.00	16.00
18	21.00	18.00	18.00	18.00	18.00	18.00
20	23.00	20.00	20.00	20.00	20.00	20.00
22	25.25	22.00	22.00	22.00	22.00	–
24	27.25	24.00	24.00	24.00	24.00	24.00
26	29.50	26.00	27.62	27.00	26.62	26.38
28	31.50	28.00	29.50	28.88	28.38	28.38
30	33.75	30.00	31.62	30.88	30.38	30.38
32	36.00	32.00	33.75	33.00	32.50	32.38
34	38.00	34.00	35.62	34.88	34.25	34.38
36	40.25	36.00	37.62	36.88	36.25	36.38
38	Same as O.D. of Raised Face, R, in Tables 6, 7, 8, 9 & 10	38.00	38.00	37.75	37.50	37.00
40		40.00	40.00	39.75	39.50	39.00
42		42.00	42.00	41.75	41.50	41.00
44		44.00	44.00	43.75	43.50	43.00
46		46.00	46.00	45.75	45.50	45.00
48		48.00	48.00	47.75	47.50	47.00
50		50.00	50.00	49.62	49.25	–
52		52.00	52.00	51.62	51.25	–
54		54.00	54.00	53.62	53.25	–
56		56.00	56.00	55.62	55.25	–
58		58.00	58.00	57.62	57.25	–
60		60.00	60.00	59.62	59.25	–

NOTE: [(a)] Outside Diameter R may be made to fit the inside diameter of the bolts to act as a locating device when making a joint in the field, however, in no case should the contact area of the gasket be increased by changing the diameter of the raised face on the flange.



Radius
0.06 in. for ring widths 0.88 in. and smaller;
0.09 in. for ring widths 1 in. and larger.

TABLE 5 — RING-JOINT GASKET DIMENSIONS [1]

Dimensions in inches

CLASS 300,400, AND 600						CLASS 900				
Nominal Pipe Size	Pitch Dia. of Ring P	Width of Ring A	Height of Octagonal Ring H	Oct. Ring Flat C	Ring No.	Pitch Dia. of Ring P	Width of Ring A	Height of Octagonal Ring H	Oct. Ring Flat C	Ring No.
12	15.000	0.438	0.625	0.305	R57	15.000	0.438	0.625	0.305	R57
14	16.500	0.438	0.625	0.305	R61	16.500	0.625	0.812	0.413	R62
16	18.500	0.438	0.625	0.305	R65	18.500	0.625	0.812	0.413	R66
18	21.000	0.438	0.625	0.305	R69	21.000	0.750	0.938	0.485	R70
20	23.000	0.500	0.688	0.341	R73	23.000	0.750	0.938	0.485	R74
22	25.000	0.562	0.750	0.377	R81	—	—	—	—	—
24	27.250	0.625	0.812	0.413	R77	27.250	1.000	1.250	0.681	R78
26	29.500	0.750	0.938	0.485	R93	29.500	1.125	1.375	0.780	R100
28	31.500	0.750	0.938	0.485	R94	31.500	1.250	1.500	0.879	R101
30	33.750	0.750	0.938	0.485	R95	33.750	1.250	1.500	0.879	R102
32	36.000	0.875	1.062	0.583	R96	36.000	1.250	1.500	0.879	R103
34	38.000	0.875	1.062	0.583	R97	38.000	1.375	1.625	0.977	R104
36	40.250	0.875	1.062	0.583	R98	40.250	1.375	1.625	0.977	R105

SUPPLEMENTAL INFORMATION

NOTE: [1] For matching tolerances of ring-joint gasket dimensions, see ASME B16.20. Ring-Joint Gaskets are not contemplated for size 38, and larger flanges.

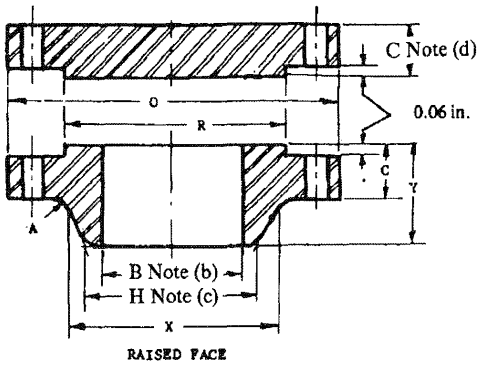


TABLE 6 — CLASS 150, 285 PSI AT ATMOSPHERIC TEMPERATURE RAISED FACE[a]

Dimensions in inches

PIPE SIZE	FLANGE DIMENSIONS			HUB DIMENSIONS	DRILLING			Raised Face Dia.	
	OD of Flange O	Thick. of Flange C (MIN)	Length Thru Hub Y	OD Large End Hub X	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	R	Fillet Radius (MIN) A
12	19.00	1.25	4.50	14.38	12	1.00	17.00	15.00	0.38
14	21.00	1.38	5.00	15.75	12	1.12	18.75	16.25	0.38
16	23.50	1.44	5.00	18.00	16	1.12	21.25	18.50	0.38
18	25.00	1.56	5.50	19.88	16	1.25	22.75	21.00	0.38
20	27.50	1.69	5.69	22.00	20	1.25	25.00	23.00	0.38
22	29.50	1.81	5.88	24.00	20	1.38	27.25	25.25	0.38
24	32.00	1.88	6.00	26.12	20	1.38	29.50	27.25	0.38
26	34.25	2.69	4.75	26.62	24	1.38	31.75	29.50	0.38
28	36.50	2.81	4.94	28.62	28	1.38	34.00	31.50	0.44
30	38.75	2.94	5.38	30.75	28	1.38	36.00	33.75	0.44
32	41.75	3.18	5.69	32.75	28	1.62	38.50	36.00	0.44
34	43.75	3.25	5.88	34.75	32	1.62	40.50	38.00	0.50
36	46.00	3.56	6.19	36.75	32	1.62	42.75	40.25	0.50
38	48.75	3.44	6.19	39.00	32	1.62	45.25	42.25	0.50
40	50.75	3.56	6.44	41.00	36	1.62	47.25	44.25	0.50
42	53.00	3.81	6.75	43.00	36	1.62	49.50	47.00	0.50
44	55.25	4.00	7.00	45.00	40	1.62	51.75	49.00	0.50
46	57.25	4.06	7.31	47.12	40	1.62	53.75	51.00	0.50
48	59.50	4.25	7.56	49.12	44	1.62	56.00	53.50	0.50
50	61.75	4.38	8.00	51.25	44	1.88	58.25	55.50	0.50
52	64.00	4.56	8.25	53.25	44	1.88	60.50	57.50	0.50
54	66.25	4.75	8.50	55.25	44	1.88	62.75	59.50	0.50
56	68.75	4.88	9.00	57.38	48	1.88	65.00	62.00	0.50
58	71.00	5.06	9.25	59.38	48	1.88	67.25	64.00	0.50
60	73.00	5.19	9.44	61.38	52	1.88	69.25	66.00	0.50

General Notes:

For matching tolerances see Section 10.

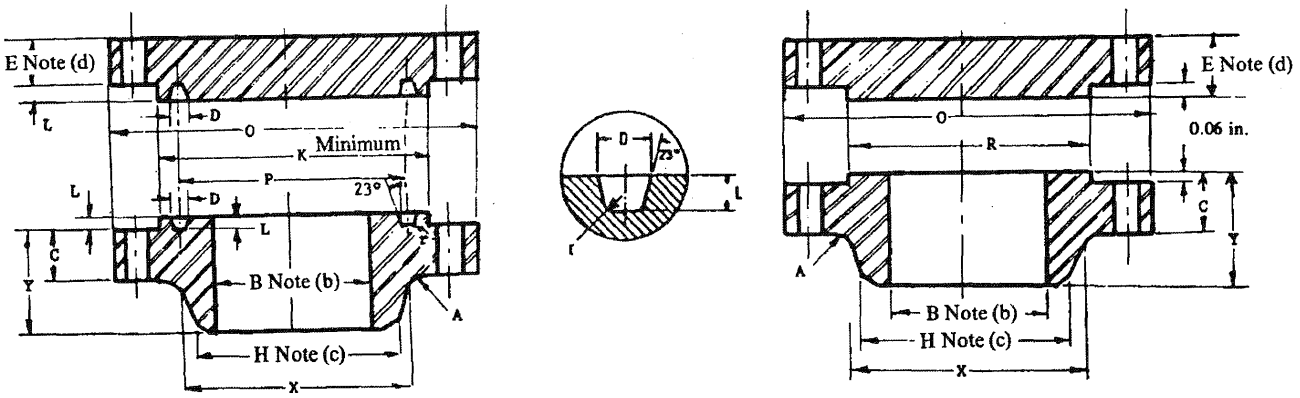
For matching end detail see Figures 1, 2 and 3.

(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 2.

(b) Dimensions to be specified by customer.

(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See paragraph 5.5 for material requirements.



RING-TYPE JOINT

RAISED FACE

TABLE 7 — CLASS 300, 740 PSI AT ATMOSPHERIC TEMPERATURE RAISED FACE[a] AND RING-TYPE JOINTS

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS						Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange: Weld-Neck	Thick of Flange: (d) Bld. Flg.	Length Thru Hub	OD[e] Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint: Facing Dia.	Ring-Type Joint: Depth of Groove	Ring-Type Joint: Ptich Dia.	Ring-Type Joint: Width of Groove	Ring-Type Joint: Ring No.		
	O	C	E	Y	X				R	K	L	P	D		A	r
12	20.50	2.00	2.00	5.12	14.75	16	1.25	17.75	15.00	16.25	0.312	15.000	0.469	R57	0.38	0.03
14	23.00	2.12	2.12	5.62	16.75	20	1.25	20.25	16.25	18.00	0.312	16.500	0.469	R61	0.38	0.03
16	25.50	2.25	2.25	5.75	19.00	20	1.38	22.50	18.50	20.00	0.312	18.500	0.469	R65	0.38	0.03
18	28.00	2.38	2.38	6.25	21.00	24	1.38	24.75	21.00	22.62	0.312	21.000	0.469	R69	0.38	0.03
20	30.50	2.50	2.50	6.38	23.12	24	1.38	27.00	23.00	25.00	0.375	23.000	0.531	R73	0.38	0.06
22	33.00	2.62	2.62	6.50	25.25	24	1.62	29.25	25.25	27.00	0.438	25.000	0.594	R81	0.38	0.06
24	36.00	2.75	2.75	6.62	27.62	24	1.62	32.00	27.25	29.50	0.438	27.250	0.656	R77	0.38	0.06
26	38.25	3.12	3.31	7.25	28.38	28	1.75	34.50	29.50	31.88	0.500	29.500	0.781	R93	0.38	0.06
28	40.75	3.38	3.56	7.75	30.50	28	1.75	37.00	31.50	33.88	0.500	31.500	0.781	R94	0.44	0.06
30	43.00	3.62	3.75	8.25	32.56	28	1.88	39.25	33.75	36.12	0.500	33.750	0.781	R95	0.44	0.06
32	45.25	3.88	3.94	8.75	34.69	28	2.00	41.50	36.00	38.75	0.562	36.000	0.906	R96	0.44	0.06
34	47.50	4.00	4.12	9.12	36.88	28	2.00	43.50	38.00	40.75	0.562	38.000	0.906	R97	0.50	0.06
36	50.00	4.12	4.38	9.50	39.00	32	2.12	46.00	40.25	43.00	0.562	40.250	0.906	R98	0.50	0.06
38	46.00	4.25	4.25	7.12	39.12	32	1.62	43.00	40.50	—	—	—	—	—	0.50	—
40	48.75	4.50	4.50	7.62	41.25	32	1.75	45.50	42.75	—	—	—	—	—	0.50	—
42	50.75	4.69	4.69	7.88	43.25	32	1.75	47.50	44.75	—	—	—	—	—	0.50	—
44	53.25	4.88	4.88	8.12	45.25	32	1.88	49.75	47.00	—	—	—	—	—	0.50	—
46	55.75	5.06	5.06	8.50	47.38	28	2.00	52.00	49.00	—	—	—	—	—	0.50	—
48	57.75	5.25	5.25	8.81	49.38	32	2.00	54.00	51.25	—	—	—	—	—	0.50	—
50	60.25	5.50	5.50	9.12	51.38	32	2.12	56.25	53.50	—	—	—	—	—	0.50	—
52	62.25	5.69	5.69	9.38	53.38	32	2.12	58.25	55.50	—	—	—	—	—	0.50	—
54	65.25	6.00	6.00	9.94	55.50	28	2.38	61.00	57.75	—	—	—	—	—	0.50	—
56	67.25	6.06	6.06	10.25	57.62	28	2.38	63.00	59.75	—	—	—	—	—	0.50	—
58	69.25	6.25	6.25	10.50	59.62	32	2.38	65.00	62.00	—	—	—	—	—	0.50	—
60	71.25	6.44	6.44	10.75	61.62	32	2.38	67.00	64.00	—	—	—	—	—	0.50	—

General Notes:

For matching tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

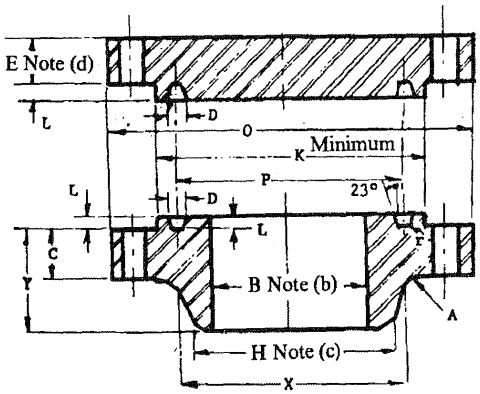
Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 2.

(b) Dimensions to be specified by customer.

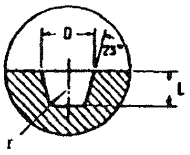
(c) See Section 5.

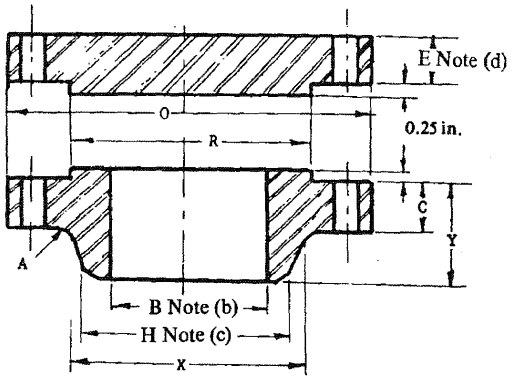
(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See paragraph 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in paragraph 5.3.2.



RING-TYPE JOINT





RAISED FACE

TABLE 8 — CLASS 400, 990 PSI AT ATMOSPHERIC TEMPERATURE RAISED FACE[a] AND RING-TYPE JOINTS

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM.	DRILLING			FACING DIMENSIONS								
	OD of Flange	THICK OF FLANGE		Length Thru Hub	OD Large End Hub[e]	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	RING-TYPE JOINT					Fillet Radius (min.)	Groove Fillet Radius
		Weld-Neck	Bld. Flg.[d]							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.		
	O	C	E	Y	X				R	K	L	P	D		A	r
12	20.50	2.25	2.25	5.38	14.75	16	1.38	17.75	15.00	16.25	0.312	15.000	0.469	R57	0.44	0.03
14	23.00	2.38	2.38	5.88	16.75	20	1.38	20.25	16.25	18.00	0.312	16.500	0.469	R61	0.44	0.03
16	25.50	2.50	2.50	6.00	19.00	20	1.50	22.50	18.50	20.00	0.312	18.500	0.469	R65	0.44	0.03
18	28.00	2.62	2.62	6.50	21.00	24	1.50	24.75	21.00	22.62	0.312	21.000	0.469	R69	0.44	0.03
20	30.50	2.75	2.75	6.62	23.12	24	1.62	27.00	23.00	25.00	0.375	23.000	0.531	R73	0.44	0.06
22	33.00	2.88	2.88	6.75	25.25	24	1.75	29.25	25.25	27.00	0.438	25.000	0.594	R81	0.44	0.06
24	36.00	3.00	3.00	6.88	27.62	24	1.88	32.00	27.25	29.50	0.438	27.250	0.656	R77	0.44	0.06
26	38.25	3.50	3.88	7.62	28.62	28	1.88	34.50	29.50	31.88	0.500	29.500	0.781	R93	0.44	0.06
28	40.75	3.75	4.12	8.12	30.81	28	2.00	37.00	31.50	33.88	0.500	31.500	0.781	R94	0.50	0.06
30	43.00	4.00	4.38	8.62	32.94	28	2.12	39.25	33.75	36.12	0.500	33.750	0.781	R95	0.50	0.06
32	45.25	4.25	4.56	9.12	35.00	28	2.12	41.50	36.00	38.75	0.562	36.000	0.906	R96	0.50	0.06
34	47.50	4.38	4.81	9.50	37.19	28	2.12	43.50	38.00	40.75	0.562	38.000	0.906	R97	0.56	0.06
36	50.00	4.50	5.06	9.88	39.38	32	2.12	46.00	40.25	43.00	0.562	40.250	0.906	R98	0.56	0.06
38	47.50	4.88	4.88	8.12	39.50	32	1.88	44.00	40.75	———	———	———	———	———	0.56	———
40	50.00	5.12	5.12	8.50	41.50	32	2.00	46.25	43.00	———	———	———	———	———	0.56	———
42	52.00	5.25	5.25	8.81	43.62	32	2.00	48.25	45.00	———	———	———	———	———	0.56	———
44	54.50	5.50	5.50	9.19	45.62	32	2.12	50.50	47.25	———	———	———	———	———	0.56	———
46	56.75	5.75	5.75	9.62	47.75	36	2.12	52.75	49.50	———	———	———	———	———	0.56	———
48	59.50	6.00	6.00	10.12	49.88	28	2.38	55.25	51.50	———	———	———	———	———	0.56	———
50	61.75	6.19	6.25	10.56	52.00	32	2.38	57.50	53.62	———	———	———	———	———	0.56	———
52	63.75	6.38	6.44	10.88	54.00	32	2.38	59.50	55.62	———	———	———	———	———	0.56	———
54	67.00	6.69	6.75	11.38	56.12	28	2.62	62.25	57.88	———	———	———	———	———	0.56	———
56	69.00	6.88	6.94	11.75	58.25	32	2.62	64.25	60.12	———	———	———	———	———	0.56	———
58	71.00	7.00	7.12	12.06	60.25	32	2.62	66.25	62.12	———	———	———	———	———	0.56	———
60	74.25	7.31	7.44	12.56	62.38	32	2.88	69.00	64.38	———	———	———	———	———	0.56	———

General Notes:

For matching tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

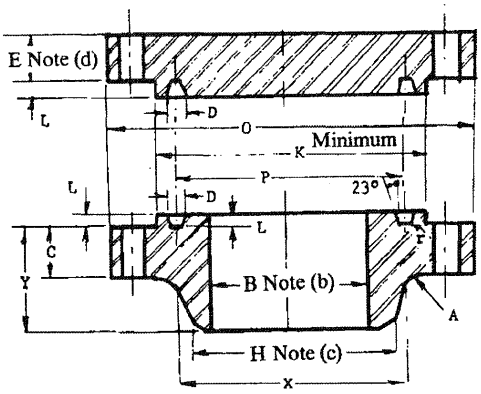
Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 2.

(b) Dimensions to be specified by customer.

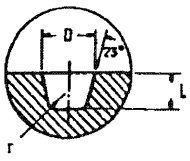
(c) See Section 5.

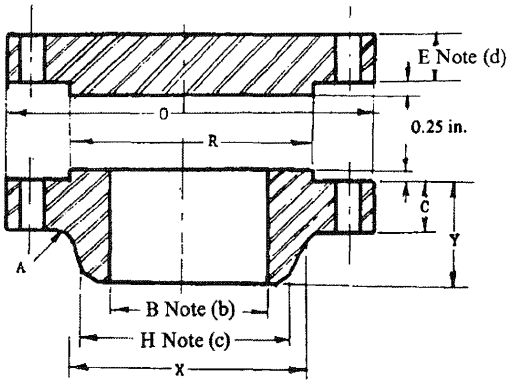
(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See paragraph 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in paragraph 5.3.2.



RING-TYPE JOINT





RAISED FACE

TABLE 9 — CLASS 600, 1480 PSI AT ATMOSPHERIC TEMPERATURE RAISED FACE[a] AND RING-TYPE JOINTS

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM.	DRILLING			FACING DIMENSIONS						Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	THICK. OF FLAN. Weld-Neck	THICK. OF FLAN. Bld. Flg.(d)	Length Thru Hub	(e) OD Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	RING-TYPE JOINT Facing Dia.	RING-TYPE JOINT Depth of Groove	RING-TYPE JOINT Pitch Dia.	RING-TYPE JOINT Width of Groove	RING-TYPE JOINT Ring No.		
	O	C	E	Y	X				R	K	L	P	D		A	r
12	22.00	2.62	2.62	6.12	15.75	20	1.38	19.25	15.00	16.25	0.312	15.000	0.469	R57	0.44	0.03
14	23.75	2.75	2.75	6.50	17.00	20	1.50	20.75	16.25	18.00	0.312	16.500	0.469	R61	0.44	0.03
16	27.00	3.00	3.00	7.00	19.50	20	1.62	23.75	18.50	20.00	0.312	18.500	0.469	R65	0.44	0.03
18	29.25	3.25	3.25	7.25	21.50	20	1.75	25.75	21.00	22.62	0.312	21.000	0.469	R69	0.44	0.03
20	32.00	3.50	3.50	7.50	24.00	24	1.75	28.50	23.00	25.00	0.375	23.000	0.531	R73	0.44	0.06
22	34.25	3.75	3.75	7.75	26.25	24	1.88	30.62	25.25	27.00	0.438	25.000	0.594	R81	0.44	0.06
24	37.00	4.00	4.00	8.00	28.25	24	2.00	33.00	27.25	29.50	0.438	27.250	0.656	R77	0.44	0.06
26	40.00	4.25	4.94	8.75	29.44	28	2.00	36.00	29.50	31.88	0.500	29.500	0.781	R93	0.50	0.06
28	42.25	4.38	5.19	9.25	31.62	28	2.12	38.00	31.50	33.88	0.500	31.500	0.781	R94	0.50	0.06
30	44.50	4.50	5.50	9.75	33.94	28	2.12	40.25	33.75	36.12	0.500	33.750	0.781	R95	0.50	0.06
32	47.00	4.62	5.81	10.25	36.12	28	2.38	42.50	36.00	38.75	0.562	36.000	0.906	R96	0.50	0.06
34	49.00	4.75	6.06	10.62	38.31	28	2.38	44.50	38.00	40.75	0.562	38.000	0.906	R97	0.56	0.06
36	51.75	4.88	6.38	11.12	40.62	28	2.62	47.00	40.25	43.00	0.562	40.250	0.906	R98	0.56	0.06
38	50.00	6.00	6.12	10.00	40.25	28	2.38	45.75	41.50	—	—	—	—	—	0.56	—
40	52.00	6.25	6.38	10.38	42.25	32	2.38	47.75	43.75	—	—	—	—	—	0.56	—
42	55.25	6.62	6.75	11.00	44.38	28	2.62	50.50	46.00	—	—	—	—	—	0.56	—
44	57.25	6.81	7.00	11.38	46.50	32	2.62	52.50	48.25	—	—	—	—	—	0.56	—
46	59.50	7.06	7.31	11.81	48.62	32	2.62	54.75	50.25	—	—	—	—	—	0.56	—
48	62.75	7.44	7.69	12.44	50.75	32	2.88	57.50	52.50	—	—	—	—	—	0.56	—
50	65.75	7.75	8.00	12.94	52.88	28	3.12	60.00	54.50	—	—	—	—	—	0.56	—
52	67.75	8.00	8.25	13.25	54.88	32	3.12	62.00	56.50	—	—	—	—	—	0.56	—
54	70.00	8.25	8.56	13.75	57.00	32	3.12	64.25	58.75	—	—	—	—	—	0.56	—
56	73.00	8.56	8.88	14.25	59.12	32	3.38	66.75	60.75	—	—	—	—	—	0.62	—
58	75.00	8.75	9.12	14.56	61.12	32	3.38	68.75	63.00	—	—	—	—	—	0.62	—
60	78.50	9.19	9.56	15.31	63.38	28	3.62	71.75	65.25	—	—	—	—	—	0.69	—

General Notes:

For matching tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 2.

(b) Dimensions to be specified by customer.

(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See paragraph 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in paragraph 5.3.2.

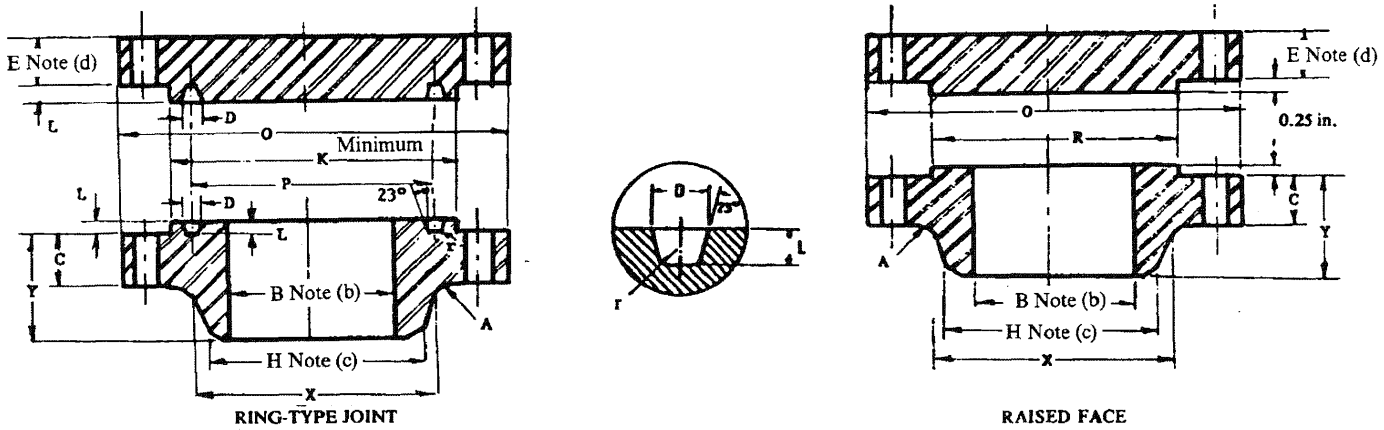


TABLE 10 — CLASS 900, 2220 PSI AT ATMOSPHERIC TEMPERATURE RAISED FACE[a] AND RING-TYPE JOINTS Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM.	DRILLING			FACING DIMENSIONS							
	OD of Flange	THICK OF FLANGE		Length Thru Hub	OD Large [e] End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	RING-TYPE JOINT					Fillet Radius (min)	Groove Fillet Radius
		Weld-Neck	Bld. Flg. [d]							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.		
	O	C	E	Y	X				R	K	L	P	D		A	r
12	24.00	3.12	3.12	7.88	16.50	20	1.50	21.00	15.00	16.50	0.312	15.000	0.469	R57	0.44	0.03
14	25.25	3.38	3.38	8.38	17.75	20	1.62	22.00	16.25	18.38	0.438	16.500	0.656	R62	0.44	0.06
16	27.75	3.50	3.50	8.50	20.00	20	1.75	24.25	18.50	20.62	0.438	18.500	0.656	R66	0.44	0.06
18	31.00	4.00	4.00	9.00	22.25	20	2.00	27.00	21.00	23.38	0.500	21.000	0.781	R70	0.44	0.06
20	33.75	4.25	4.25	9.75	24.50	20	2.12	29.50	23.00	25.50	0.500	23.000	0.781	R74	0.44	0.06
24	41.00	5.50	5.50	11.50	29.50	20	2.62	35.50	27.25	30.38	0.625	27.250	1.062	R78	0.44	0.09
26	42.75	5.50	6.31	11.25	30.50	20	2.88	37.50	29.50	32.75	0.688	29.500	1.188	R100	0.44	0.09
28	46.00	5.62	6.75	11.75	32.75	20	3.12	40.25	31.50	35.00	0.688	31.500	1.312	R101	0.50	0.09
30	48.50	5.88	7.18	12.25	35.00	20	3.12	42.75	33.75	37.25	0.688	33.750	1.312	R102	0.50	0.09
32	51.75	6.25	7.62	13.00	37.25	20	3.38	45.50	36.00	39.50	0.688	36.000	1.312	R103	0.50	0.09
34	55.00	6.50	8.06	13.75	39.62	20	3.62	48.25	38.00	42.00	0.812	38.000	1.438	R104	0.56	0.09
36	57.50	6.75	8.44	14.25	41.88	20	3.62	50.75	40.25	44.25	0.812	40.250	1.438	R105	0 56	0.09
38	57.50	7.50	8.50	13.88	42.25	20	3.62	50.75	43.25	—	—	—	—	—	0.75	—
40	59.50	7.75	8.81	14.31	44.38	24	3.62	52.75	45.75	—	—	—	—	—	0.81	—
42	61.50	8.12	9.12	14.62	46.31	24	3.62	54.75	47.75	—	—	—	—	—	0.81	—
44	64.88	8.44	9.56	15.38	48.62	24	3.88	57.62	50.00	—	—	—	—	—	0.88	—
46	68.25	8.88	10.06	16.18	50.88	24	4.12	60.50	52.50	—	—	—	—	—	0.88	—
48	70.25	9.19	10.38	16.50	52.88	24	4.12	62.50	54.50	—	—	—	—	—	0.94	—

General Notes:

For matching tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 2.

(b) Dimensions to be specified by customer.

(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See paragraph 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in paragraph 5.3.2.

TABLE 11 — PERMISSABLE IMPERFECTIONS IN FLANGE FACING FINISH[a]

NPS	MAXIMUM RADIAL[b] PROJECTION OF IMPERFECTIONS WHICH ARE NO DEEPER THAN THE BOTTOM OF THE SERRATIONS, IN.	MAXIMUM DEPTH AND RADIAL PROJECTION OF IMPERFECTIONS WHICH ARE DEEPER THAN THE BOTTOM OF THE SERRATIONS, IN.
12 - 14	0.31	0.18
16	0.38	0.18
18 - 24	0.50	0.25
26 - 36	0.50	0.25
38 - 48	0.56	0.28
50 - 60	0.62	0.31

NOTES: [a] Imperfections less than half the depth of the serrations shall not be cause for rejection. See paragraph 7.4.

[b] A radial projection shall be measured by the difference between an inner radius and an outer radius encompassing the imperfection where the radius is struck from the center line of the bore.

ANNEX A
DESIGN CRITERIA

This Annex is an integral part of this Standard Practice which is placed after the main text for convenience.

These flanges were designed in accordance with the formula of paragraphs UA 45 - UA 59 (inclusive) of Section VIII Unfired Pressure Vessel, Division 1. (1950ed.) Currently, the equivalent paragraphs are found in Appendix 2 of ASME Section VIII Division 1. This Annex is presented as a description of the basis for this Standard. Any deviations from the dimensions, material, or provisions of this standard are the responsibility of the User/ Designer. The maximum allowable stresses were established as follows.

	SIZES 12-36 incl. ksi	SIZES 38-60 incl. ksi
Longitudinal Hub Stress	30	30
Radial Flange Stress	20	25
Tangential Flange Stress	20	25
Average Stress	20	25
Bolt Stress (2½" and Smaller)	20	25
Bolt Stress (Larger than 2½")		23

1. The suggested ASME Section VIII, Division 1 values of 3700 and 2.75 for Y and M factors of 0.06 in. thick, flat, asbestos ring gaskets were assumed.

2. The widths of the gaskets were established as those whose surface areas would be at least twice the new bolt area.

3. For the Class 300, 400, 600 and 900 flanges, the slope and the O.D. of the hub at the base are designed for welding ends having equivalent yield strength and thickness as those of the mating pipe. The wall thickness of the intended mating pipe was based upon API 5LX-52 with a 0.68 design factor for the NPS 26-36 sizes, and API 5LX-65 with 0.72 design factor for the NPS 38 and larger sizes. When the manufacturer of the NPS 26-36 sizes elects to utilize the alternative permitted in paragraph 5.3.1, or when the mating pipe has a minimum specified yield strength exceeding 65,000 psi, it will be necessary for him to recalculate the design in accordance with the requirements of paragraph 5.3.1.

4. The design of the 38 NPS and larger sizes of the 300 and higher classes of welding neck flanges is predicated upon the flange material having a minimum specified yield strength of at least 42,000 psi in the ring section of the flange and a minimum yield at the welding end at least equal to that specified for the mating pipe. When the yield strength of the welding end of the flange is less than specified, compensation in accordance with paragraph 5.3.1.b may be made, but the hub slope and diameter at larger end must be preserved.

5. The design of all sizes is predicated on the use of heat treated carbon steel bolt studs for Class 150 flanges and alloy steel bolt studs for Class 300, 400, 600, and 900 flanges. Bolt diameters shall be ⅛ in. less than the bolt hole sizes shown in the tables.

ANNEX B
BLIND FLANGE DESIGN CRITERIA

This Annex is an integral part of this Standard Practice which is placed after the main text for convenience.

Blind flanges were designed in accordance with the formula of Paragraph UG34 of Section VIII (Pressure Vessels, Division 1) of the ASME Boiler and Pressure Vessel Code. The thicknesses listed in Tables 6, 7, 8, 9 and 10 were based on material having mechanical properties for Grade F36 of Table 1 with allowable stresses as listed below:

	SIZES 26-60
	KSI
Blind Flange Stress	26
	(1.5x17.5)

Where the calculated blind flange thickness is less than the mating welding neck, the thicknesses were made equal to the welding neck thicknesses.

Blind flanges may be produced using any of the higher strength grades of materials listed in Table 1. The thicknesses may then be reduced in accordance with the following formula, but in no case shall they be thinner than the corresponding welding neck flange:

$$E' = E \sqrt{\frac{60000}{UTS_F}}$$

where E' = Reduced blind flange thicknesses based on higher grade material.

$E^{(a)}$ = Present blind thickness based on F36 grade material (See Tables 6-10).

UTS_F = Tensile strength of higher grade material from Table 1.

Blinds produced to a thinner thickness from higher strength material should be identified in the marking with the higher grade material designation. All other marking required by Section 6 shall be included.

NOTE: [a] E' shall not be less than the corresponding welding neck flange thickness "C".

ANNEX C
Referenced Standards and Applicable Dates

This Annex is an integral part of this Standard Practice which is placed after the main text for convenience.

ANSI, ANSI/ASME, ASME/ANSI, ASME

B1.1-1989	Unified Inch Screw Threads
B16.1-1989	Cast Iron Pipe Flanges and Flanged Fittings
B16.5-1988-92 add	Pipe Flanges and Flanged Fittings
B16.20-1993	Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
B16.47-1990-92 add	Large Diameter Steel Flanges
B18.2.1-1981 (R 1992)	Square and Hex Bolts and Screws (Inch Series)
B18.2.2-1987 (R 1993)	Square and Hex Nuts (Inch Series)
B31.1-B31.8-1994	Code for Pressure Piping
B46.1-1985	Surface Texture, Surface Roughness, Waviness, and Lay

Boiler and Pressure Vessel Code 1992 Edition (including addendum)

ASTM

A 53-93a	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
A 105-92	Forgings, Carbon Steel, for Piping Components
A 106-93	Seamless Carbon Steel Pipe for High-Temperature Service
A 193-93a	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
A 194-94a	Carbon and Alloy Steel Nuts for Bolts for High-Pressure
A 307-92a	Carbon Steel Bolts and Studs, 60,000 PSI Tensile
A 320-94a	Alloy Steel Bolting Materials for Low Temperature Service
A 350-93	Forgings, Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components
A 354-92a	Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
A 381-93	Metal-Arc-Welded Steel Pipe for Use with High-Pressure Transmission Systems
A 449-92	Quenched and Tempered Steel Bolts and Studs
A 453-92	Bolting Materials, High-Temperature, 50 to 120 ksi Yield Strength, With Expansion Coefficients. Comparable to Austenetic Steels.
A 540-92	Alloy-Steel Bolting Materials for Special Applications
A 694-93	Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
A 707-92	Flanges, Forged, Carbon and Alloy Steel for Low-Temperature Service

API

5L	Line Pipe, Thirty-Ninth Edition, May 1991

MSS

SP-9-1992	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1993	Standard Marking System for Valves, Fittings, Flanges and Unions

ANNEX C
Referenced Standards (con't.)

Publications of the following organizations appear on the previous page:

ANSI	American National Standards Institute, Inc. 11 West 42nd Street, 13th floor, New York, NY 10036
API	American Petroleum Institute 1220 L Street, N.W., Washington, D.C. 20005-8029
ASME	The American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017-2392
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E., Vienna, VA 22180-4602