

MIL-F-20042D
30 March 1984
SUPERSEDING
MIL-F-20042C
24 July 1961
(See 6.3)

MILITARY SPECIFICATION
FLANGES, PIPE AND BULKHEAD,
BRONZE (SILVER BRAZING)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers 50, 100, 150, 250 and 400 pound silver brazing bronze pipe and bulkhead flanges for use with water, oil, gas or steam service not to exceed 425 degrees Fahrenheit (°F).

1.2 Classification. The flanges shall be of the following types, classes, sizes and ratings as specified (see 6.2):

1.2.1 Types. Flanges shall be of the following types:

- Type PR - With preinserted rings of silver brazing alloy.
- Type EF - Without preinserted rings (end or face feed type).

1.2.2 Classes, sizes and ratings. Flanges shall be of the classes, sizes and ratings specified in table I.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

TABLE I. Classes, sizes and ratings.

Classes	NPS (inches)	Ratings	Applicable tables
Plain:			
50 pounds	14 to 40, inclusive	50 lb/in ² at 150°F	VI, XVII, XXI
150 pounds	1/4 to 12, inclusive	150 lb/in ² at 150°F	VII, VIII, XVIII, XIX, XXII, XXIII
		100 lb/in ² at 425°F	XXII, XXIII
250 pounds	1/4 to 12, inclusive	250 lb/in ² at 150°F	XI, XII, XVIII, XX
		150 lb/in ² at 425°F	XXIV, XXV
400 pounds	1/4 to 10, inclusive	400 lb/in ² at 150°F	XIII, XIV, XVIII, XIX
		200 lb/in ² at 425°F	XXVI, XXVII
Bulkhead:			
100 pounds	1/4 to 12, inclusive	100 lb/in ² at 425°F	IX, X, XVIII, XIX
400 pounds	1/4 to 10, inclusive	400 lb/in ² at 150°F	XV, XVI, XXVI, XXVII
		200 lb/in ² at 425°F	
Brazing rings:			
50 pounds	14 to 40, inclusive	- - -	XXVIII
100, 150, 250 and 400 pounds	1/4 to 12, inclusive	- - -	XXIX

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

- QQ-B-654 - Brazing Alloys, Silver.
- QQ-C-390 - Copper Alloy Castings (Including Cast Bar).

MILITARY

- MIL-V-3 - Valves, Fittings, and Flanges (except for Systems Indicated herein), Packaging of.
- MIL-B-16541 - Bronze, Valve: Castings.

STANDARDS

FEDERAL

- FED-STU-151 - Metals, Test Methods.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by
Attributes.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the document which is indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI).

ANSI B46.1 - Surface Texture Surface Roughness Waviness and Lay.
(DoD adopted)

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

ASTM

B 61 - Standard Specification for Steam or Valve Bronze Castings.
(DoD adopted)

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Chemical composition. Unless otherwise specified in the contract or order (see 6.2), the chemical composition of flanges shall be as specified in table II, or as specified in QQ-C-390 Alloy No. 922, MIL-B-16541, or ASTM B 61.

TABLE II. Chemical composition.

Copper	Tin	Zinc	Lead	Iron (max)	Nickel (max)	Phosphorus (max)
Percent	Percent	Percent	Percent	Percent	Percent	Percent
86.0 - 89.0	5.5 - 6.5	3.0 - 5.0	1.0 - 2.0	0.25	1.00	0.05

3.2 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3 Type PR, with preinserted rings of silver brazing alloy.

3.3.1 Type PR flanges are grooved for preinsert rings of silver brazing alloy. The insert rings shall not be installed in the flange groove by the contractor. These flanges may be supplied without the silver brazing rings, in which case they shall be ordered separately, or with the rings separately packaged and furnished with the parent component for installation in the groove prior to brazing (see 6.2). The preinserted silver brazing rings shall be of a design to fill the groove shown on figure 1, the minimum internal diameter of which shall be not less than the bore of the hub as shown on diameter "S" of figures 2 and 3. Unless otherwise specified in the contract or order (see 6.2), the silver brazing alloy used shall conform to BCuP-5 of QQ-B-654. Machining details shall be in accordance with tables XXVIII and XXIX. Dimensions noted on figures 1 through 3 shall be as specified in tables VI through XXVII.

3.3.2 The thinnest wall caused by machining the groove shall be not less than one-fourth the difference between dimensions "E" and "S" as shown on figures 2 and 3.

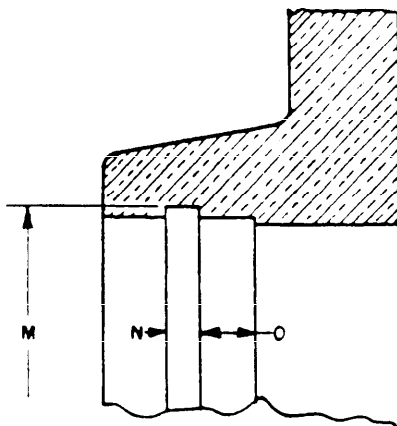
3.4 Type EF, without preinserted rings (end or face feed type). Type EF flanges shall be chamfered at the outer end of socket a distance of 1/32 inch and at an angle of about 45 degrees with the axis at the socket.

3.5 Machining.

3.5.1 Flange finish. The machined surface finish of gasket mating surfaces on the flanges shall be in accordance with ANSI B46.1 and as follows:

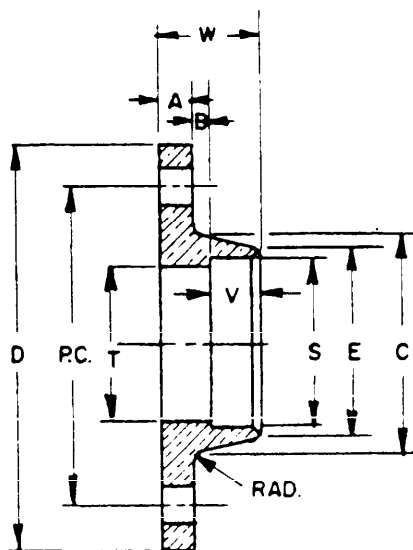
- (a) For flanges of a nominal size of 12 inches or less, a finish with a circular lay (concentric) of 500 to 1000 roughness or (spiral) 125 to 500 produced by machining 30 to 80 serrations of uniform depth per inch of face width.
- (b) For flanges over a nominal size of 12 inches, the requirements shall be the same except that 21 to 80 serrations per inch of face width may be used.

Unless otherwise specified (see 6.2), flanges shall have the bore of the hub and the waterway (diameters "S" and "T" as shown on figures 2 and 3) machined with a finish of 125 or better. Flanges need not be finished on the rim, provided that they are cast smooth and true. The remaining external surfaces shall not be finished except for bolt hole spot facing.



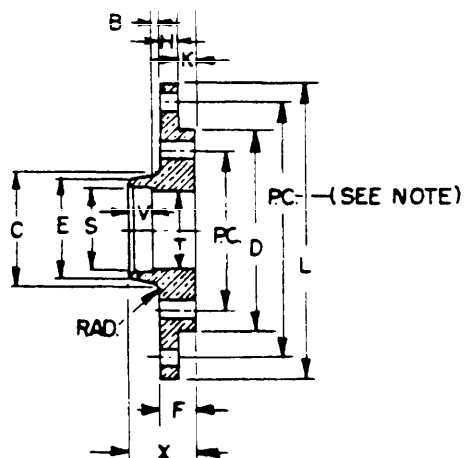
SH 4356

FIGURE 1. Detail dimensions of groove for preinserted ring of silver brazing alloy.



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FIGURE 2. Detail dimensions of plain flanges.



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NOTE: To be used only when bulkhead joint is required to be furnished.

FIGURE 3. Detail dimensions of bulkhead flanges.

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3.5.2 Flange drilling. Unless otherwise specified (see 6.2), flanges shall be drilled. Only the flange joint drilling shall be furnished unless bulkhead joint drilling (for bulkhead flanges) is specified and located in relation to the flange joint drilling in the contract or order (see 6.2). Flanges shall be spot faced on the back parallel to the face of the flange for the bolt-heads and nuts. The spot face shall not cut more than 1/32 inch below the minimum flange thickness. Eccentricity of the spot face diameter with the bolt hole shall be limited to provide sufficient facing for the bolt head and nut used in the joint assembly. Cutting into the hub of the flanges by spot facing shall be avoided. Diameters for spot facing shall be in accordance with table III. The number and size of holes shall conform to the applicable tables specified herein according to the classification of the flanges furnished.

TABLE III. Spot facing.

Bolt size	Spot facing
	minimum inches
1/2	1.12
5/8	1.37
3/4	1.56
7/8	1.78
1	2.03
1-1/8	2.21
1-1/4	2.43

3.6 Dimensions.

3.6.1 In measuring the depth of the socket in all the applicable tables specified herein, the chamfer shall be included.

3.6.2 Flange dimensions shall be in accordance with the applicable figures and tables specified herein.

3.6.3 Tolerances. Unless otherwise specified herein, the tolerances for the flanges shall be as shown in table IV.

TABLE IV. Tolerances.

NPS	W	X	T	S	O
Inches	Inch	Inch	Inch	Inch	Inch
1-1/4 and under	$\pm 1/16$	$\pm 1/16$	± 0.010	+ 0.003 - .000	+ 0.000 - .031
1-1/2 to 2	$\pm 1/16$	$\pm 1/16$	± 0.010	+ .005 - .000	+ .000 - .031
2-1/2 to 12	$\pm 1/16$	$\pm 1/16$	± 0.010	+ .007 - .000	+ .000 - .047

3.7 Marking. The size, pressure ("50", "100", "150", "250", or "400") and "WOG" shall be cast in raised figures and letters or stamped or engraved on the rim of all flanges for identification. The figures and letters shall be approximately 3/16 to 1/2 inch high, depending on the size of the flange.

3.8 Workmanship. Flanges shall be sound, smoothly cored, true to form, uniform in texture and free from cold shuts, porosity, or any other defects which may affect their serviceability. They shall be thoroughly cleaned, both inside and outside, and all fins and roughness that are not well rounded shall be blended.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The contractor shall provide and maintain an inspection system as specified in the contract or order (see 6.2).

4.2 Quality conformance inspection. Quality conformance inspection shall consist of the examination of 4.3 and tests 4.4.1 through 4.4.3.

4.2.1 Lot. Flanges of the same type, class, size and rating presented at one time shall be considered a lot for purposes of sampling and inspection.

4.2.2 Sampling for visual and dimensional examination. Sample flanges shall be selected at random from each lot of completely finished flanges in accordance with MIL-STD-105 at inspection level II for the examination specified in 4.3. The acceptable quality level (AQL) shall be 1.5 percent defective for major defects and 4.0 percent defective for minor defects.

4.2.3 Sampling for hydrostatic pressure leakage test. Sample flanges shall be selected from each lot of completely finished flanges in accordance with MIL-STD-105 at inspection level II for the hydrostatic pressure leakage test specified in 4.4.1. The AQL shall be 1.0 percent defective.

4.2.4 Sampling for chemical analysis. Samples for chemical analysis shall be taken from one or more flanges selected from each melt from which the lot offered was cast, for the analysis specified in 4.4.3.

4.3 Examination. Each of the sample flanges selected in accordance with 4.2.2 shall be examined to verify compliance with all the requirements of this specification not involving tests. Examination shall be conducted as specified in table V. Any flange in the sample containing one or more defects shall be rejected, and if the number of defective flanges in any sample exceeds the acceptable number for that sample, the lot represented by the sample shall be rejected.

TABLE V. Classification of defects.

Categories	Defects
Critical:	None defined.
Major:	
101	Type, class, size and rating not as specified.
102	Material not as specified.
103	Flanges not sound, smoothly corded, true to form, uniform in texture, not free from cold shuts and porosity.
104	Flanges surface (internal and external) not thoroughly cleaned, fins and roughness not removed.
105	Brazing ring (if specified) missing or not as specified.
106	Socket not smooth.
107	Socket dimensions not as specified.
108	Flange dimensions not within tolerances specified.
Minor:	
201	Ends (other than preinserted ring type) not chamfered as specified.
202	Marking not cast, or stamped incorrect, or illegible.

4.4 Tests.

4.4.1 Hydrostatic pressure leakage test. Each sample flange in accordance with 4.2.3 shall be subjected to a hydrostatic pressure 1-1/2 times the working pressure for 1 minute. Under the hydrostatic pressure, the fitting shall not leak water, or sweat at any part of the surface.

4.4.2 Air pressure leakage test. Each flange shall be tested under water or with soapsuds at 100 pounds per square inch (lb/in²) (nominal) air pressure (85 lb/in² minimum) for 5 to 10 seconds. No leakage is allowed.

4.4.3 Chemical analysis. Samples selected for chemical analysis as specified in 4.2.4 shall be tested in accordance with methods 111 or 112 of FED-STD-151 to determine conformance with the requirements specified in 3.1.

4.5 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisition.)

5.1 Preservation-packaging and packing. Flanges shall be preserved-packaged level A or C and packed level A, B or C as specified (see 6.2) in accordance with MIL-V-3.

5.1.1 Talc and talcum and soapstone. Talc and talcum and soapstone used in the packaging process of flanges shall be free of asbestos.

5.1.2 Cushioning, filler, dunnage and wrapping materials.

5.1.2.1 Level A preservation-packaging and levels A and B packing. Use of all types of loose-fill materials for packaging and packing applications such as cushioning, filler or dunnage is prohibited for flanges destined for shipboard installation and stowage.

5.1.2.2 Level C preservation-packaging and packing. When loose-fill type materials are used for packaging and packing applications such as cushioning, filler and dunnage, all containers (unit, intermediate and shipping) shall be marked or labelled with the following information:

"CAUTION

Contents cushioned etc. with loose-fill material.
Not to be taken aboard ship.
Remove and discard loose-fill material.
If required, recushion with cellulosic material, bound fiber,
fiberboard or transparent flexible cellular material."

5.1.2.3 Cushioning. Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

5.2 Marking. In addition to any special marking required (see 6.2), interior packages and exterior shipping containers shall be marked in accordance with MIL-V-3.

6. NOTES

6.1 Intended use. The installation of these flanges is intended to be accomplished by silver brazing without exceeding a temperature of 1500°F. The fittings are intended for use with the following or their equivalent commercial pipe standards:

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<u>Material</u>	<u>Specification</u>
Copper tube	MIL-T-24107
Copper nickel tube	MIL-T-16420
Brass tube	MIL-T-20168
Nickel copper alloy tube	MIL-T-1368

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Type, class, size and ratings required (see 1.2).
- (c) If chemical composition is other than specified (see 3.1).
- (d) When brazing rings are to be furnished with the flanges (see 3.3.1).
- (e) If silver brazing rings are other than specified (see 3.3.1).
- (f) If flange finish is other than specified (see 3.5.1).
- (g) When flanges are to be undrilled (see 3.5.2).
- (h) When bulkhead joint drilling is required and the location (see 3.5.2).
- (i) Inspection system in accordance with MIL-I-45208 (see 4.1.1).
- (j) Levels of preservation-packaging and packing required (see 5.1).
- (k) Special marking (see 5.2).
- (l) Bore diameters when 400 lb/in² flanges are ordered (see tables XIII through XVI).

6.3 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army - ME

Navy - SH

Review activity:

DLA - CS

User activity:

Navy - OS

Preparing activity:

Navy - SH

(Project 4730-0575)

TABLE VI. Plain flanges, 50-pound.
(See figure 2)

NPS	A (min)	D	E (min)	S (min)	T	V (min)	w_1 / ₁	Radius
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inch
14	3/4	19-1/8	14-13/16	14.188	14	1-3/16	1-15/16	1/2
16	3/4	21-3/16	16-15/16	16.212	16	1-3/16	1-15/16	1/2
18	7/8	23-1/4	19	18.238	18	1-3/16	2-1/16	1/2
20	7/8	25-13/16	21-1/16	20.262	20	1-3/16	2-1/6	1/2
22	7/8	27-7/8	23-1/4	22.292	22	1-5/16	2-3/16	9/16
24	1	30	25-5/16	24.316	24	1-5/16	2-5/16	9/16
26	1	32-9/16	27-3/8	26.342	26	1-5/16	2-5/16	9/16
28	1	34-11/16	29-1/2	28.366	28	1-3/8	2-3/8	5/8
30	1-1/8	36-13/16	31-5/8	30.392	30	1-7/16	2-9/16	5/8
32	1-1/8	39	33-3/4	32.420	32	1-1/2	2-5/8	5/8
34	1-1/8	41	35-3/4	34.446	34	1-5/8	2-3/4	11/16
36	1-1/4	43-7/8	37-7/8	36.470	36	1-11/16	2-7/8	11/16
38	1-1/4	46-1/8	40	38.496	38	1-3/4	3	11/16
40	1-1/4	48-1/8	42	40.520	40	1-13/16	3	3/4

1/ For tolerance see 3.6.3.

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TABLE VII. Plain flanges, 150-pound, standard sizes.
(See figure 2)

NPS	O.D.	A (min)	B	C	D	E (min)	$\frac{S^2/3}{\text{Inches}}$	$\frac{T^2/3}{\text{Inches}}$	V (min)	$\frac{W^2}{\text{Inches}}$	Radius	P
Inches	Inches	Inch	Inch		Inches	Inches	Inches	Inches	Inches	Inches	Inch	Inch
1-1/4	0.540	3/8	15/64	---	3-1/4	13/16	0.540	0.41	17/64	7/8	1/4	0.008
3/8	.675	3/8	1/4	---	3-3/8	1	.675	.54	5/16	15/16	1/4	.008
1/2	.840	3/8	1/4	---	3-9/16	1-5/32	.840	.71	3/8	1	1/4	.008
3/4	1.050	7/16	7/32	---	3-13/16	1-11/32	1.050	.92	13/32	1-1/16	1/4	.008
1	1.315	7/16	1/4	---	4-1/4	1-5/8	1.315	1.18	7/16	1-1/8	1/4	.016
1-1/4	1.660	7/16	5/16	---	4-1/2	2	1.660	1.53	1/2	1-1/4	5/16	.016
1-1/2	1.900	7/16	5/16	---	5-1/16	2-1/4	1.900	1.77	5/8	1-3/8	5/16	.016
2	2.375	7/16	9/32	---	5-9/16	2-3/4	2.375	2.24	21/32	1-3/8	5/16	.016
2-1/2	2.875	1/2	1/4	---	6-1/8	3-1/4	2.875	2.71	5/8	1-3/8	5/16	.031
3	3.500	1/2	1/4	---	6-5/8	3-7/8	3.500	3.31	5/8	1-3/8	5/16	.031
3-1/2	4.000	1/2	1/4	---	7-3/16	4-3/8	4.000	3.81	11/16	1-7/16	3/8	.031
4	4.500	1/2	1/4	---	7-11/16	4-15/16	4.500	4.28	11/16	1-7/16	3/8	.031
4-1/2	5.000	1/2	5/16	---	8-3/16	5-7/16	5.000	4.76	11/16	1-1/2	3/8	.031
5	5.563	9/16	5/16	4/	9-1/16	6	5.563	5.32	11/16	1-9/16	3/8	.047
5-1/2	6.125	9/16	3/8	4/	9-9/16	6-1/2	6.125	5.88	3/4	1-11/16	7/16	.047
6	6.625	9/16	3/8	4/	10-1/8	7-1/16	6.625	6.36	3/4	1-11/16	7/16	.047
7	7.625	9/16	7/16	4/	11-5/16	8-1/16	7.625	7.36	13/16	1-13/16	7/16	.047
8	8.625	5/8	7/16	4/	12-3/8	9-1/8	8.625	8.33	15/16	2	7/16	.063
9	9.625	11/16	1/2	4/	13-15/16	10-3/16	9.625	9.25	1	2-3/16	1/2	.063
10	10.750	11/16	1/2	4/	15	11-5/16	10.750	10.38	1-1/16	2-1/4	1/2	.063
11	11.750	11/16	1/2	4/	16-9/16	12-7/16	11.750	11.35	1-1/8	2-5/16	1/2	.063
12	12.750	3/4	1/2	4/	17-5/8	13-7/16	12.750	12.25	1-1/4	2-1/2	1/2	.063

1/ For flanged gage connections with 0.250 inch o.d. or 0.500 inch o.d. tube, "S" becomes 0.250 +0.003 or 0.500 +0.003 respectively "T" becomes 0.12 or 0.38 respectively.
- .000

2/ For tolerance see 3.6.3.

3/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

4/ Two degree minimum taper for size 5 inches and above.

TABLE VIII. Plain flanges, 150-pound, special sizes.
(Not to be used for new construction.)
(See figure 2)

NPS	O.D.	A (min)	B	C	D	F (min)	S ₁ /2/ Inches	T ₁ /2/ Inches	V (min)	W ₁ / Inches	Radius	P
Inches	Inches	Inch	Inch	Inches		Inches	Inches	Inches	Inches	Inches	Inch	Inch
6-1/2	7.125	9/16	3/8	7-7/8	3/	7-9/16	7.125	6.86	13/16	1-3/4	7/16	0.047
7-1/2	8.125	5/8	7/16	8-15/16	3/	8-5/8	8.125	7.83	7/8	1-15/16	7/16	.047
8-1/2	9.125	5/8	1/2	10	3/	9-11/16	9.125	8.80	1	2-1/8	1/2	.063
9-1/2	10.250	11/16	1/2	11-1/16	3/	10-3/4	10.250	9.88	1-1/16	2-1/4	1/2	.063

1/ For tolerance see 3.6.3.

2/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

3/ Two degree minimum taper for size 5 inches and above.

TABLE IX. Bulkhead flanges, 100-pound, standard sizes.
(See figure 3)

NPS	O.D.	B	C	D	E (min)	F (min)	H (min)	K	L	S $\frac{1}{2}$ / $\frac{2}{}$	T $\frac{1}{2}$ / $\frac{2}{}$	V (min)	X $\frac{1}{2}$ / $\frac{2}{}$	Radius	P
Inches	Inches	Inch		Inches	Inches	Inches	Inch	Inch	Inches	Inches	Inches	Inches	Inches	Inch	Inch
1/4	0.540	15/64	---	3-1/4	13/16	7/8	3/8	1/2	6-1/16	0.540	0.41	17/64	1-3/8	1/4	0.008
3/8	.675	1/4	---	3-3/8	1	7/8	3/8	1/2	6-1/8	.675	.54	5/16	1-7/16	1/4	.008
1/2	.840	1/4	---	3-9/16	1-5/32	7/8	3/8	1/2	6-3/16	.840	.71	3/8	1-1/2	1/4	.008
3/4	1.050	7/32	---	3-13/16	1-11/32	7/8	3/8	1/2	6-7/16	1.050	.92	13/32	1-1/2	1/4	.008
1	1.315	1/4	---	4-1/4	1-5/8	7/8	3/8	1/2	6-7/8	1.315	1.18	7/16	1-9/16	1/4	.016
1-1/4	1.660	5/16	---	4-1/2	2	7/8	3/8	1/2	7-1/8	1.660	1.53	1/2	1-11/16	5/16	.016
1-1/2	1.900	5/16	---	5-1/16	2-1/4	1	1/2	1/2	7-11/16	1.900	1.77	5/8	1-15/16	5/16	.016
2	2.375	9/32	---	5-9/16	2-3/4	1	1/2	1/2	8-3/16	2.375	2.24	21/32	1-15/16	5/16	.016
2-1/2	2.875	1/4	---	6-1/8	3-1/4	1	1/2	1/2	8-3/4	2.875	2.71	5/8	1-7/8	5/16	.031
3	3.500	1/4	---	6-5/8	3-7/8	1	1/2	1/2	9-1/4	3.500	3.31	5/8	1-7/8	5/16	.031
3-1/2	4.000	1/4	---	7-3/16	4-3/8	1-1/16	9/16	1/2	9-13/16	4.000	3.81	11/16	2	3/8	.031
4	4.500	1/4	---	7-11/16	4-15/16	1-1/16	9/16	1/2	10-5/16	4.500	4.28	11/16	2	3/8	.031
4-1/2	5.000	5/16	---	8-3/16	5-7/16	1-1/16	9/16	1/2	10-13/16	5.000	4.76	11/16	2-1/16	3/8	.031
5	5.563	5/16	3/	9-1/16	6	1-1/16	9/16	1/2	12-3/8	5.563	5.32	11/16	2-1/16	3/8	.047
5-1/2	6.125	3/8	3/	9-9/16	6-1/2	1-1/16	9/16	1/2	12-7/8	6.125	5.88	3/4	2-3/16	7/16	.047
6	6.625	3/8	3/	10-1/8	7-1/16	1-1/8	5/8	1/2	13-7/16	6.625	6.36	3/4	2-1/4	7/16	.047
7	7.625	7/16	3/	11-5/16	8-1/16	1-1/8	5/8	1/2	14-5/8	7.625	7.36	13/16	2-3/8	7/16	.047
8	8.625	7/16	3/	12-3/8	9-1/8	1-1/8	5/8	1/2	15-11/16	8.625	8.33	15/16	2-1/2	7/16	.063
9	9.625	1/2	3/	13-15/16	10-3/16	1-1/8	5/8	1/2	18-5/16	9.625	9.25	1	2-5/8	1/2	.063
10	10.750	1/2	3/	15	11-5/16	1-1/8	5/8	1/2	19-3/8	10.750	10.38	1-1/16	2-11/16	1/2	.063
11	11.750	1/2	3/	16-9/16	12-7/16	1-1/8	5/8	1/2	21	11.750	11.35	1-1/8	2-3/4	1/2	.063
12	12.750	1/2	3/	17-5/8	13-7/16	1-3/16	11/16	1/2	22	12.750	12.25	1-1/4	2-15/16	1/2	.063

1/ For tolerance see 3.6.3.

2/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

3/ Two degree minimum taper for size 5 inches and above.

TABLE X. Bulkhead flanges, 100-pound, special sizes.
(Not to be used for new construction.)
(See figure 3)

NPS	O.D.	B	C	D	E (min)	F (min)	H (min)	K	L	S _{1/2/} ^{1/2/}	T _{1/2/} ^{1/2/}	V (min)	X _{2/} ^{2/}	Radius	P
Inches	Inches	Inch		Inches	Inches	Inches	Inch	Inch	Inches	Inches	Inches	Inches	Inches	Inch	Inch
6-1/2	7.125	3/8	3/	10-5/8	7-9/16	1-1/8	5/8	1/2	13-15/16	7.125	6.86	13/16	2-5/16	7/16	0.047
7-1/2	8.125	7/16	3/	11-7/8	8-5/8	1-1/8	5/8	1/2	15-3/16	8.125	7.83	7/8	2-7/16	7/16	.047
8-1/2	9.125	1/2	3/	12-15/16	9-11/16	1-1/8	5/8	1/2	16-1/4	9.125	8.80	1	2-5/8	1/2	.063
9-1/2	10.250	1/2	3/	14-1/2	10-3/4	1-1/8	5/8	1/2	18-7/8	10.250	9.88	1-1/16	2-11/16	1/2	.063

1/ For tolerance see 3.6.3.
2/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.
3/ Two degree minimum taper for size 5 inches and above.

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TABLE XI. Plain flanges, 250-pound, standard sizes.
(See figure 2)

NPS	O. D.	A (min)	B	C	D	E (min)	S _{2/3/} Inches	T _{2/3/} Inches	V (min)	W _{3/} Inches	Radius	P
1/4	0.540	11/16	15/64	---	3-1/4	13/16	0.540	0.398	17/64	1-3/16	1/4	0.008
3/8	.675	11/16	1/4	---	3-3/8	1	.675	.532	5/16	1-1/4	1/4	.008
1/2	.840	11/16	1/4	---	3-9/16	1-5/32	.840	.697	3/8	1-5/16	1/4	.008
3/4	1.050	11/16	7/32	---	3-13/16	1-11/32	1.050	.907	13/32	1-5/16	1/4	.008
1	1.315	3/4	1/4	---	4-1/4	1-5/8	1.315	1.171	7/16	1-7/16	1/4	.016
1-1/4	1.660	13/16	5/16	---	4-1/2	2	1.660	1.502	1/2	1-5/8	5/16	.016
1-1/2	1.900	13/16	5/16	---	5-1/16	2-1/4	1.900	1.742	5/8	1-3/4	5/16	.016
2	2.375	13/16	9/32	---	5-9/16	2-3/4	2.375	2.186	21/32	1-3/4	5/16	.016
2-1/2	2.875	15/16	1/4	---	6-1/8	3-1/4	2.875	2.686	5/8	1-13/16	5/16	.031
3	3.500	15/16	1/4	---	6-5/8	3-7/8	3.500	3.286	5/8	1-13/16	5/16	.031
3-1/2	4.000	1	1/4	---	7-3/16	4-3/8	4.000	3.786	11/16	1-15/16	3/8	.031
4	4.500	1	1/4	---	7-11/16	4-15/16	4.500	4.252	11/16	1-15/16	3/8	.031
5	5.563	1-1/16	5/16	1/	9-1/16	6	5.563	5.278	11/16	2-1/16	3/8	.047
6	6.625	1-3/16	3/8	1/	10-1/8	7-1/16	6.625	6.321	3/4	2-5/16	7/16	.047
8	8.625	1-5/16	7/16	1/	12-3/8	9-1/8	8.625	8.286	15/16	2-11/16	7/16	.063
10	10.750	1-7/16	1/2	1/	15	11-5/16	10.750	10.325	1-1/16	3	1/2	.063
12	12.750	1-1/2	1/2	1/	17-5/8	13-7/16	12.750	12.322	1-1/4	3-1/4	1/2	.063

1/ Two degree taper for size 5 inches and above.

2/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

3/ For tolerance see 3.6.3.

TABLE XII. Plain flanges, 250-pound, special size.
 (Not to be used on new construction.)
 (See figure 2)

NPS	O.D.	A (min)	B	C	D	E (min)	S ^{2/3/}	T ^{2/3/}	V (min)	W ^{3/}	Radius	P
Inches	Inches	Inches	Inch		Inches	Inches	Inches	Inches	Inch	Inches	Inch	Inch
4-1/2	5.00	15/16	5/16	1/16	8-3/16	5-7/16	5.000	4.726	11/16	2	3/8	0.031
7	7.625	1-1/4	1/2	1/16	11-5/16	8-1/16	7.625	7.315	3/4	2-1/2	7/16	.047
9	9.625	1-3/8	1/2	1/16	13-15/16	10-3/16	9.625	9.202	1	2-7/8	1/2	.063

1/ Two degree taper for size 5 inches and above.

2/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

3/ For tolerance see 3.6.3.

TABLE XIII. Plain flanges, 400-pound, standard sizes.
(See figure 2)

NPS	O.D.	A (min)	B	C	D	E (min)	S $\frac{3}{4}$ / $\frac{4}$	T $\frac{3}{4}$ / $\frac{4}$	V (min)	W $\frac{3}{4}$ / $\frac{4}$	Radius	P
Inches	Inches	Inches	Inch		Inches	Inches	Inches	Inches	Inches	Inches	Inch	Inch
<u>1</u> / <u>1</u> / <u>4</u>	0.540	11/16	15/64	---	3-3/4	7/8	0.540	0.41	17/64	1-3/16	1/4	0.008
<u>3</u> / <u>8</u>	.675	11/16	1/4	---	3-7/8	1-1/16	.675	.54	5/16	1-1/4	1/4	.008
<u>1</u> / <u>2</u>	.840	11/16	1/4	---	4	1-1/4	.840	.71	3/8	1-5/16	1/4	.008
<u>3</u> / <u>4</u>	1.050	11/16	7/32	---	4-5/16	1-7/16	1.050	.92	13/32	1-5/16	1/4	.008
<u>1</u>	1.315	3/4	1/4	---	5-1/16	1-3/4	1.315	1.18	7/16	1-7/16	1/4	.016
<u>1</u> - <u>1</u> / <u>4</u>	1.660	13/16	5/16	---	5-3/8	2-1/8	1.660	1.53	1/2	1-5/8	5/16	.016
<u>1</u> - <u>1</u> / <u>2</u>	1.900	13/16	5/16	---	5-15/16	2-3/8	1.900	1.77	5/8	1-3/4	5/16	.016
<u>2</u>	2.375	13/16	9/32	---	6-1/2	2-7/8	2.375	2.24	21/32	1-3/4	5/16	.016
<u>2</u> - <u>1</u> / <u>2</u>	2.875	15/16	3/8	---	7-9/16	3-3/8	2.875	2/	1	2-5/16	1/2	.031
<u>3</u>	3.500	15/16	7/16	---	8-1/8	4	3.500	2/	1	2-3/8	1/2	.031
<u>3</u> - <u>1</u> / <u>2</u>	4.000	1	7/16	---	8-11/16	4-1/2	4.000	2/	1	2-7/16	1/2	.031
<u>4</u>	4.500	1	1/2	---	9-1/4	5	4.500	2/	1	2-5/8	9/16	.031
<u>4</u> - <u>1</u> / <u>2</u>	5.000	1	1/2	---	9-13/16	5-5/8	5.000	2/	1-1/8	2-5/8	9/16	.031
<u>5</u>	5.563	1-1/16	1/2	---	10-3/8	6-3/16	5.563	2/	1-1/8	2-5/8	9/16	.047
<u>5</u> - <u>1</u> / <u>2</u>	6.125	1-1/8	9/16	<u>5</u> / <u>5</u>	11-3/8	6-3/4	6.125	2/	1-1/4	2-13/16	9/16	.047
<u>6</u>	6.625	1-3/16	9/16	<u>5</u> / <u>5</u>	11-15/16	7-5/16	6.625	2/	1-1/4	2-15/16	5/8	.047
<u>7</u>	7.625	1-1/4	5/8	<u>5</u> / <u>5</u>	13-1/8	8-3/8	7.625	2/	1-3/8	3-1/8	5/8	.047
<u>8</u>	8.625	1-5/16	11/16	<u>5</u> / <u>5</u>	14-3/4	9-3/8	8.625	2/	1-3/8	3-1/4	11/16	.047
<u>9</u>	9.625	1-3/8	3/4	<u>5</u> / <u>5</u>	15-7/8	10-1/2	9.625	2/	1-1/2	3-1/2	11/16	.063
<u>10</u>	10.750	1-7/16	13/16	<u>5</u> / <u>5</u>	17	11-5/8	10.750	2/	1-5/8	3-3/4	3/4	.063

1/ For flanged gage connections with 0.250 inch o.d. or 0.500 inch o.d. tube, "S" becomes 0.250 +0.003 or 0.500 +0.003 respectively and "T" becomes 0.12 and 0.38 respectively.
- .000

2/ Bore to suit inside diameter of tube (see 6.2).

3/ For tolerance see 3.6.3.

4/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

5/ Two degree minimum taper for size 5 inches and above.

TABLE XIV. Plain flanges, 400-pound, special sizes.
(Not to be used for new construction.)
(See figure 2)

NPS	O. D.	A (min)	B	C	D	E (min)	S _{2/3/} Inches	T _{2/3/} Inches	V (min)	W _{2/} Inches	Radius Inch	P Inch
6-1/2	7.125	1-1/4	5/8	4/4	12-9/16	7-7/8	7.125	1/4	1-3/8	3-1/4	5/8	0.047
7-1/2	8.125	1-1/4	11/16	4/4	14-3/16	8-7/8	8.125	1/4	1-1/2	3-7/16	11/16	.047
8-1/2	9.125	1-5/16	3/4	4/4	15-5/16	10	9.125	1/4	1-5/8	3-11/16	3/4	.063
9-1/2	10.250	1-7/16	13/16	4/4	16-7/16	11-1/8	10.250	1/4	1-3/4	4	3/4	.063

1/ Bore to suit inside diameter of tube (see 6.2).

2/ For tolerance see 3.6.3.

3/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

4/ Two degree minimum taper for size 5 inches and above.

TABLE XV. Bulkhead flanges, 400-pound, standard sizes.
(See figure 3)

NPS Inches	O.D. Inches	B Inch	C	D Inches	E (min) Inches	F (min) Inches	H (min) Inch	K Inch	L Inches	S _{2/3/} Inches	T _{2/3/} Inches	V (min) Inches	X _{2/} Inches	Radius Inch	P Inch
1/4	0.540	15/64	---	3-3/4	7/8	7/8	3/8	1/2	6-3/4	0.540	0.41	17/64	1-3/8	1/4	0.008
3/8	.675	1/4	---	3-7/8	1-1/16	7/8	3/8	1/2	6-7/8	.675	0.54	5/16	1-7/16	1/4	.008
1/2	.840	1/4	---	4	1-1/4	7/8	3/8	1/2	7	.840	0.71	3/8	1-1/2	1/4	.008
3/4	1.050	7/32	---	4-5/16	1-7/16	7/8	3/8	1/2	7-3/8	1.050	0.92	13/32	1-1/2	1/4	.008
1	1.315	1/4	---	5-1/16	1-3/4	1	1/2	1/2	8-1/8	1.315	1.18	7/16	1-11/16	1/4	.016
1-1/4	1.660	5/16	---	5-3/8	2-1/8	1	1/2	1/2	8-3/8	1.660	1.53	1/2	1-13/16	5/16	.016
1-1/2	1.900	5/16	---	5-15/16	2-3/8	1	1/2	1/2	9	1.900	1.77	5/8	1-15/16	5/16	.016
2	2.375	9/32	---	6-1/2	2-7/8	1-1/16	9/16	1/2	10-1/4	2.375	2.24	21/32	2	5/16	.016
2-1/2	2.875	3/8	---	7-9/16	3-3/8	1-1/16	9/16	1/2	11-3/8	2.875	1/	1	2-7/16	1/2	.031
3	3.500	7/16	---	8-1/8	4	1-1/16	9/16	1/2	11-7/8	3.500	1/	1	2-1/2	1/2	.031
3-1/2	4.000	7/16	---	8-11/16	4-1/2	1-1/8	5/8	1/2	12-1/2	4.000	1/	1	2-9/16	1/2	.031
4	4.500	1/2	---	9-1/4	5	1-1/8	5/8	1/2	13	4.500	1/	1-1/8	2-3/4	9/16	.031
4-1/2	5.000	1/2	---	9-13/16	5-5/8	1-1/8	5/8	1/2	13-5/8	5.000	1/	1-1/8	2-3/4	9/16	.031
5	5.563	1/2	4/	10-3/8	6-3/16	1-1/8	5/8	1/2	14-1/8	5.563	1/	1-1/8	2-7/8	9/16	.047
5-1/2	6.125	9/16	4/	11-3/8	6-3/4	1-1/8	5/8	1/2	15-3/4	6.125	1/	1-1/4	2-15/16	5/8	.047
6	6.625	9/16	4/	11-15/16	7-5/16	1-3/16	11/16	1/2	16-3/8	6.625	1/	1-3/8	3-1/8	5/8	.047
7	7.625	5/8	4/	13-1/8	8-3/8	1-1/4	3/4	1/2	17-1/2	7.625	1/	1-3/8	3-1/4	11/16	.047
8	8.625	11/16	4/	14-3/4	9-3/8	1-5/16	13/16	1/2	19-1/8	8.625	1/	1-1/2	3-1/2	11/16	.063
9	9.625	3/4	4/	15-7/8	10-1/2	1-3/8	7/8	1/2	20-1/4	9.625	1/	1-5/8	3-3/4	3/4	.063
10	10.750	13/16	4/	17	11-5/8	1-7/16	7/8	9/16	21-3/8	10.750	1/	1-3/4	4	3/4	.063

1/ Bore to suit inside diameter of tube (see 6.2).

2/ For tolerance see 3.6.3.

3/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

4/ Two degree minimum taper for size 5 inches and above.

TABLE XVI. Bulkhead flanges, 400-pound, special sizes.
(Not to be used for new construction.)
(See figure 3)

NPS	O.D.	B	C	D	E (min)	F (min)	H (min)	K (min)	L	S $\frac{2}{3}$ / $\frac{3}{}$	T $\frac{2}{3}$ / $\frac{3}{}$	V (min)	X $\frac{2}{}$ / $\frac{2}{}$	Radius	P
Inches	Inches	Inch		Inches	Inches	Inches	Inch	Inch	Inches	Inches		Inches	Inches	Inch	Inch
6-1/2	7.125	5/8	4/	12-9/16	7-7/8	1-1/4	3/4	1/2	17	7.125	1/	1-3/8	3-1/4	5/8	0.047
7-1/2	8.125	11/16	4/	14-3/16	8-7/8	1-1/4	3/4	1/2	18-5/8	8.125	1/	1-1/2	3-7/16	11/16	.047
8-1/2	9.125	3/4	4/	15-5/16	10	1-5/16	13/16	1/2	19-3/4	9.125	1/	1-5/8	3-11/16	3/4	.063
9-1/2	10.250	13/16	4/	16-7/16	11-1/8	1-7/16	7/8	9/16	20-7/8	10.250	1/	1-3/4	4	3/4	.063

1/ Bore to suit inside diameter of tube (see 6.2).

2/ For tolerance see 3.6.3.

3/ The eccentricity of bores "S" and "T" shall not exceed that shown in column P where measured.

4/ Two degree minimum taper for size 5 inches and above.

TABLE XVII. Machining details for type PR, 50-pound flanges, standard sizes. (See figure 1)

NPS	0 ^{1/}	N		M	
		Minimum	Maximum	Minimum	Maximum
Inches	Inch	Inch	Inch	Inches	Inches
14	0.395	0.398	0.408	14.366	14.386
16	.395	.398	.408	16.390	16.410
18	.395	.398	.408	18.416	18.436
20	.395	.398	.408	20.440	20.460
22	.457	.398	.408	22.506	22.526
24	.457	.398	.408	24.530	24.550
26	.457	.398	.408	26.556	26.576
28	.488	.398	.408	28.580	28.600
30	.520	.398	.408	30.606	30.626
32	.551	.398	.408	32.634	32.654
34	.613	.398	.408	34.660	34.680
36	.645	.398	.408	36.684	36.704
38	.676	.398	.408	38.710	38.730
40	.707	.398	.408	40.734	40.754

^{1/} For tolerance see 3.6.3.

TABLE XVIII. Machining details for type PR, 100, 150, 250 and 400 pound flanges, standard sizes. (See figure 1)

NPS	O.D.	o ₁ /	N		M	
			Minimum	Maximum	Minimum	Maximum
Inches	Inches	Inch	Inch	Inch	Inches	Inches
1/4	0.540	0.100	0.068	0.078	0.614	0.639
3/8	.675	.117	.083	.093	.764	.784
1/2	.840	.149	.083	.093	.929	.949
3/4	1.050	.154	.099	.109	1.159	1.179
1	1.315	.154	.130	.140	1.424	1.444
1-1/4	1.660	.185	.130	.140	1.769	1.789
1-1/2	1.900	.217	.192	.202	2.011	2.031
2	2.375	.232	.192	.202	2.486	2.506
2-1/2	2.875	.217	.192	.202	2.988	3.008
3	3.500	.185	.255	.265	3.613	3.633
3-1/2	4.000	.217	.255	.265	4.113	4.133
4	4.500	.217	.255	.265	4.673	4.693
<u>2/</u> 4-1/2	5.000	.217	.255	.265	5.173	5.193
5	5.563	.217	.255	.265	5.736	5.756
<u>2/</u> 5-1/2	6.125	.248	.255	.265	6.298	6.318
6	6.625	.248	.255	.265	6.798	6.818
<u>2/</u> 7	7.625	.247	.320	.330	7.798	7.818
8	8.625	.270	.398	.408	8.798	8.818
<u>2/</u> 9	9.625	.301	.398	.408	9.798	9.818
10	10.750	.333	.398	.408	10.923	10.943
<u>2/3/</u> 11	11.750	.364	.398	.408	11.963	11.983
<u>3/</u> 12	12.750	.426	.398	.408	12.963	12.983

1/ For tolerance see 3.6.3.

2/ Not for 250# flange.

3/ Not for 400# flange.

TABLE XIX. Machining details for type PR, 100, 150 and 400 pound flanges, special sizes.

(Not to be used for new construction.)

(See figure 1)

NPS	O.D.	$\alpha_1^1/$	N		M	
			Minimum	Maximum	Minimum	Maximum
Inches	Inches	Inch	Inch	Inch	Inches	Inches
6-1/2	7.125	0.247	0.320	0.330	7.298	7.318
7-1/2	8.125	.278	.320	.330	8.298	8.318
8-1/2	9.125	.301	.398	.408	9.298	9.318
9-1/2	10.250	.333	.398	.408	10.423	10.443

 $\frac{1}{1}$ For tolerance see 3.6.3.TABLE XX. Machining details for type PR, 250-pound flanges, special sizes.

(Not to be used for new construction.)

(See figure 1)

NPS	O.D.	$\alpha_1^1/$	N		M	
			Minimum	Maximum	Minimum	Maximum
Inches	Inches	Inch	Inch	Inch	Inches	Inches
4-1/2	5.000	0.217	0.255	0.265	5.173	5.193
7	7.625	.247	.320	.330	7.798	7.818
9	9.625	.301	.398	.408	9.798	9.818

 $\frac{1}{1}$ For tolerance see 3.6.3.

TABLE XXI. Drilling dimensions, 50-pound flanges.
(See figure 2)

NPS	Flange joint			
	Number of holes	Diameter of holes	Pitch circle P.C.	Pitch cord
Inches		Inches	Inches	Inches
14	19	15/16	17-3/8	2.86
16	20	15/16	19-7/16	3.04
18	22	15/16	21-1/2	3.06
20	24	1-1/16	23-13/16	3.11
22	26	1-1/16	25-7/8	3.12
24	28	1-1/16	28	3.13
26	30	1-3/16	30-5/16	3.17
28	32	1-3/16	32-7/16	3.18
30	35	1-3/16	34-9/16	3.10
32	36	1-3/16	36-3/4	3.20
34	36	1-3/16	38-3/4	3.38
36	36	1-5/16	41-3/8	3.61
38	36	1-5/16	43-5/8	3.80
40	36	1-5/16	45-5/8	3.98

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TABLE XXII. Drilling dimensions, 150-pound flanges, standard sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint				Bulkhead joint			
		Number of holes	Diameter of holes	Pitch circle P.C.	Pitch cord	Number of holes	Diameter of holes	Pitch circle P.C.	Pitch cord
Inches	Inches		Inch	Inches	Inches		Inch	Inches	Inches
1/4	0.540	3	9/16	2-1/8	1.84	6	9/16	4-7/8	2.44
3/8	.675	3	9/16	2-1/4	1.95	6	9/16	4-15/16	2.47
1/2	.840	3	9/16	2-7/16	2.11	6	9/16	5-1/16	2.53
3/4	1.050	4	9/16	2-11/16	1.90	8	9/16	5-5/16	2.03
1	1.315	4	9/16	3-1/8	2.21	8	9/16	5-3/4	2.20
1-1/4	1.660	4	9/16	3-3/8	2.39	8	9/16	6	2.30
1-1/2	1.900	6	9/16	3-15/16	1.97	8	9/16	6-9/16	2.51
2	2.375	6	9/16	4-7/16	2.22	10	9/16	7-1/16	2.18
2-1/2	2.875	6	9/16	5	2.50	10	9/16	7-5/8	2.36
3	3.500	8	9/16	5-1/2	2.10	10	9/16	8-1/8	2.51
3-1/2	4.000	8	9/16	6-1/16	2.32	10	9/16	8-11/16	2.68
4	4.500	8	9/16	6-9/16	2.51	12	9/16	9-3/16	2.38
4-1/2	5.000	10	9/16	7-1/16	2.18	12	9/16	9-11/16	2.51
5	5.563	10	11/16	7-13/16	2.41	12	11/16	10-15/16	2.83
5-1/2	6.125	10	11/16	8-5/16	2.57	12	11/16	11-7/16	2.96
6	6.625	12	11/16	8-7/8	2.30	12	11/16	12	3.11
7	7.625	12	11/16	10	2.59	14	11/16	13-3/16	2.93
8	8.625	14	11/16	11-1/16	2.46	14	11/16	14-1/4	3.17
9	9.625	14	13/16	12-3/8	2.75	14	13/16	16-9/16	3.69
10	10.750	15	13/16	13-7/16	2.79	16	13/16	17-5/8	3.44
11	11.750	16	13/16	15	2.93	16	13/16	19-1/4	3.75
12	12.750	18	13/16	16-1/16	2.79	18	13/16	20-1/4	3.51

TABLE XXIII. Drilling dimensions, 150-pound flanges, special sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint				Bulkhead joint			
		Number of holes	Diameter of holes	Pitch circle P.C.	Pitch cord	Number of holes	Diameter of holes	Pitch circle P.C.	Pitch cord
Inches	Inches		Inch	Inches	Inches		Inch	Inches	Inches
6-1/2	7.125	12	11/16	9-3/8	2.43	14	11/16	12-1/2	2.78
7-1/2	8.125	12	11/16	10-9/16	2.73	14	11/16	13-3/4	3.06
8-1/2	9.125	14	11/16	11-5/8	2.59	14	11/16	14-13/16	3.29
9-1/2	10.250	14	13/16	12-15/16	2.88	14	13/16	17-1/8	3.81

TABLE XXIV. Drilling dimensions, 250-pound flanges, standard sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint		
		Number of holes	Diameter of holes	Pitch circle P.C.
Inches	Inches		Inch	Inches
1/4	0.540	3	9/16	2-1/8
3/8	.675	3	9/16	2-1/4
1/2	.840	3	9/16	2-7/16
3/4	1.050	4	9/16	2-11/16
1	1.315	4	9/16	3-1/8
1-1/4	1.660	4	9/16	3-3/8
1-1/2	1.900	6	9/16	3-15/16
2	2.375	6	11/16	4-7/16
2-1/2	2.875	6	11/16	5
3	3.500	8	11/16	5-1/2
3-1/2	4.000	8	11/16	6-1/16
4	4.500	8	11/16	6-9/16
5	5.563	10	11/16	7-13/16
6	6.625	12	11/16	8-7/8
8	8.625	14	11/16	11-1/16
10	10.750	15	13/16	13-7/16
12	12.750	18	13/16	16-1/16

TABLE XXV. Drilling dimensions, 250-pound flanges, special sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint		
		Number of holes	Diameter of holes	Pitch circle P.C.
Inches	Inches		Inch	Inches
4-1/2	5.000	10	11/16	7-1/16
7	7.625	12	11/16	10
9	9.625	14	13/16	12-3/8

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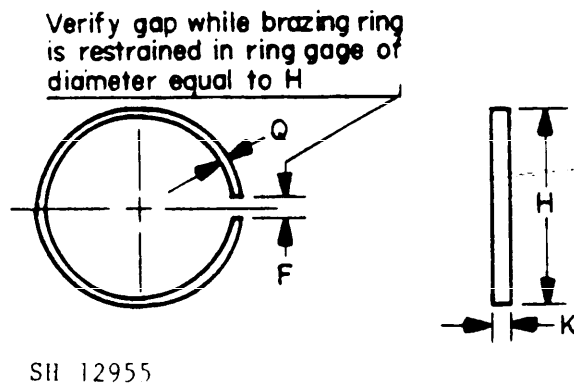
TABLE XXVI. Drilling dimensions, 400-pound flanges, standard sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint				Bulkhead joint			
		Num-ber of holes	Dia-meter of holes	Pitch circle P.C.	Pitch cord	Num-ber of holes	Dia-meter of holes	Pitch circle P.C.	Pitch cord
Inches	Inches		Inches	Inches	Inches		Inch	Inches	Inches
1/4	0.540	3	9/16	2-5/8	2.27	8	9/16	5-1/2	2.10
3/8	.675	4	9/16	2-3/4	1.94	8	9/16	5-5/8	2.15
1/2	.840	4	9/16	2-7/8	2.03	8	9/16	5-3/4	2.20
3/4	1.050	4	9/16	3-3/16	2.25	8	9/16	6-1/8	2.34
1	1.315	5	11/16	3-3/4	2.20	8	9/16	6-7/8	2.63
1-1/4	1.660	5	11/16	4-1/16	2.39	10	9/16	7-1/8	2.20
1-1/2	1.900	6	11/16	4-5/8	2.31	10	9/16	7-3/4	2.39
2	2.375	7	11/16	5-3/16	2.25	10	11/16	8-3/4	2.70
2-1/2	2.875	8	13/16	6	2.30	10	11/16	9-7/8	3.05
3	3.500	8	13/16	6-9/16	2.51	10	11/16	10-3/8	3.21
3-1/2	4.000	9	13/16	7-1/8	2.44	12	11/16	11	2.85
4	4.500	9	13/16	7-11/16	2.63	12	11/16	11-1/2	2.98
4-1/2	5.000	10	13/16	8-1/4	2.55	12	11/16	12-1/8	3.14
5	5.563	11	13/16	8-13/16	2.48	12	11/16	12-5/8	3.27
5-1/2	6.125	11	15/16	9-5/8	2.71	12	13/16	14	3.62
6	6.625	12	15/16	10-3/16	2.64	12	13/16	14-5/8	3.79
7	7.625	12	15/16	11-3/8	2.94	14	13/16	15-3/4	3.50
8	8.625	13	1-1/16	12-3/4	3.05	16	13/16	17-3/8	3.39
9	9.625	14	1-1/16	13-7/8	3.09	16	13/16	18-1/2	3.61
10	10.750	15	1-1/16	15	3.12	18	13/16	19-5/8	3.41

TABLE XXVII. Drilling dimensions, 400-pound flanges, special sizes.
(See figures 2 and 3)

NPS	O.D.	Flange joint				Bulkhead joint			
		Num-ber of holes	Dia-meter of holes	Pitch circle P.C.	Pitch cord	Num-ber of holes	Dia-meter of holes	Pitch circle P.C.	Pitch cord
Inches	Inches		Inches	Inches	Inches		Inch	Inches	Inches
6-1/2	7.125	12	15/16	10-13/16	2.80	14	13/16	15-1/4	3.39
7-1/2	8.125	12	1-1/16	12-3/16	3.15	14	13/16	16-7/8	3.76
8-1/2	9.125	13	1-1/16	13-5/16	3.19	16	13/16	18	3.51
9-1/2	10.250	15	1-1/16	14-7/16	3.00	16	13/16	19-1/8	3.73

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TABLE XXVIII. Dimensions of silver brazing ring for 50 pound flanges.

Nominal pipe size	Q +0.003	K +0.003	H	F	
				Minimum	Maximum
Inches	Inch	Inch	Inches	Inch	Inch
14	0.096	0.391	14.386	0.073	0.266
16	0.096	0.391	16.410	0.073	0.266
18	0.096	0.391	18.436	0.073	0.266
20	0.096	0.391	20.460	0.073	0.266
22	0.115	0.391	22.526	0.073	0.302
24	0.115	0.391	24.550	0.073	0.302
26	0.115	0.391	26.578	0.073	0.302
28	0.115	0.391	28.600	0.073	0.302
30	0.115	0.391	30.626	0.073	0.302
32	0.115	0.391	32.654	0.073	0.302
34	0.115	0.391	34.680	0.073	0.302
36	0.115	0.391	36.704	0.073	0.302
38	0.115	0.391	38.730	0.073	0.302
40	0.115	0.391	40.754	0.073	0.302

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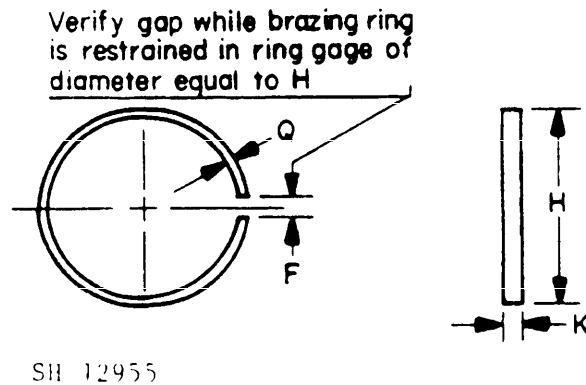


TABLE XXIX. Dimensions of silver-brazing ring for 100, 150, 250, and 400-pound flanges.

Nominal pipe size (Inches)	Q ± 0.003 Inch	K ± 0.003 Inch	H Inches	F	
				Minimum Inch	Maximum Inch
1/4	0.035	0.063	0.639	0.073	0.130
3/8	.040	.078	.784	.073	.130
1/2	.040	.078	.949	.073	.130
3/4	.050	.094	1.179	.073	.130
1	.050	.125	1.444	.073	.135
1-1/4	.050	.125	1.789	.073	.135
1-1/2	.050	.188	2.031	.073	.135
2	.050	.188	2.506	.073	.135
2-1/2	.050	.188	3.008	.073	.135
3	.050	.250	3.633	.073	.167
3-1/2	.050	.250	4.133	.073	.167
4	.080	.250	4.693	.073	.229
5	.080	.250	5.756	.073	.229
6	.080	.250	6.818	.073	.261
7	.080	.391	7.818	.073	.261
8	.080	.391	8.818	.073	.261
9	.080	.391	9.818	.073	.261
10	.080	.391	10.943	.073	.261
11	.080	.391	11.983	.073	.261
12	.096	.391	12.983	.073	.261

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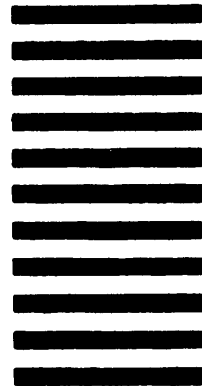
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