

(17)

**Table 1C Flange Bolting Dimensional Recommendations**

Product	Carbon Steel	Alloy Steel
Stud bolts	ASME B18.31.2	ASME B18.31.2
Bolts smaller than $\frac{3}{4}$ in.	ASME B18.2.1, square or heavy hex head	ASME B18.2.1, heavy hex head
Bolts equal to or larger than $\frac{3}{4}$ in.	ASME B18.2.1, square or heavy hex head	ASME B18.2.1, heavy hex head
Nuts smaller than $\frac{3}{4}$ in.	ASME B18.2.2, heavy hex	ASME B18.2.2, heavy hex
Nuts equal to or larger than $\frac{3}{4}$ in.	ASME B18.2.2, hex or heavy hex	ASME B18.2.2, heavy hex
External threads	ASME B1.1, Cl. 2A coarse series	ASME B1.1, Cl. 2A coarse series up through 1 in.; eight thread series for larger bolts
Internal threads	ASME B1.1, Cl. 2B coarse series	ASME B1.1, Cl. 2B coarse series up through 1 in.; eight thread series for larger bolts

on the end of the pipe as shown in Figure 6 (Figure II-6 of Mandatory Appendix II).

## 6.12 Auxiliary Connections

**6.12.1 General.** Auxiliary connections or openings for flanged fittings are not required unless specified by the purchaser. Welding to attach auxiliary connections to flanged fittings shall be made by a qualified welder using a qualified weld procedure in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

**6.12.2 Pipe Thread Tapping.** Holes may be tapped in the wall of a fitting if the metal is thick enough to allow the effective thread length specified in Figure 11 (Figure II-11 of Mandatory Appendix II). Where thread length is insufficient or the tapped hole needs reinforcement, a boss shall be added.

**6.12.3 Sockets.** Sockets for socket welding connections may be provided in the wall of a fitting if the metal is thick enough to afford the depth of socket and retaining wall specified in Figure 12 (Figure II-12 of Mandatory Appendix II). Where the wall thickness is insufficient, or the size of the connection requires opening reinforcement, a boss shall be added [see Figure 13 (Figure II-13 of Mandatory Appendix II)].

**6.12.4 Butt Welding.** Connections may be attached by butt welding directly to the wall of the fitting [see Figure 14 (Figure II-14 of Mandatory Appendix II)]. Where the size of an opening requires reinforcement, a boss shall be added.

**6.12.5 Bosses.** Where bosses are required, the diameters shall be no less than those shown in Figure 13 (Figure II-13 of Mandatory Appendix II), and the height shall provide lengths as specified in Figure 11 or 12 (Figure II-11 or II-12 of Mandatory Appendix II).

**6.12.6 Size.** Unless otherwise specified, auxiliary connections shall be of the pipe sizes given below.

Fitting Size	Connection Size (NPS)
$2 \leq \text{NPS} \leq 4$	$\frac{1}{2}$
$5 \leq \text{NPS} \leq 8$	$\frac{3}{4}$
$\text{NPS} \geq 10$	1

**6.12.7 Designating Locations.** The designation of locations for auxiliary connections for flanged fittings is shown in Figure 15. A letter is used to designate each location.

## 7 TOLERANCES

### 7.1 General

For the purpose of determining conformance with this Standard, the convention for fixing significant digits where limits, maximum or minimum values, are specified shall be rounded as defined in ASTM Practice E29. This requires that an observed or calculated value shall be rounded to the nearest unit in the last right-hand digit used for expressing the limit. The listing of decimal tolerances does not imply a particular method of measurement.

### 7.2 Center-to-Contact Surfaces and Center-to-End Tolerances

Required tolerances for various flanges and flanged fitting elements are as follows:

(a) *Center-to-Contact Surfaces Other Than Ring Joint*

Size	Tolerance
$\text{NPS} \leq 10$	$\pm 1.0 \text{ mm } (\pm 0.03 \text{ in.})$
$\text{NPS} \geq 12$	$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$

(b) *Center-to-End (Ring Joint)*

Size	Tolerance
$\text{NPS} \leq 10$	$\pm 1.0 \text{ mm } (\pm 0.03 \text{ in.})$
$\text{NPS} \geq 12$	$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$

(c) Contact Surface-to-Contact Surface Other Than Ring Joint

Size	Tolerance
NPS ≤ 10	±2.0 mm (±0.06 in.)
NPS ≥ 12	±3.0 mm (±0.12 in.)

(d) End-to-End (Ring Joint)

Size	Tolerance
NPS ≤ 10	±2.0 mm (±0.06 in.)
NPS ≥ 12	±3.0 mm (±0.12 in.)

### 7.3 Facings

Tolerances that apply to both flange and flanged fitting facings are as follows:

(a) Inside and outside diameter of large and small tongue and groove and female, ±0.5 mm (±0.02 in.).

(b) Outside diameter, 2.0 mm (0.06 in.) raised face, ±1.0 mm (±0.03 in.).

(c) Outside diameter, 7.0 mm (0.25 in.) raised face, ±0.5 mm (±0.02 in.).

(d) Ring joint groove tolerances are shown in Table 5 (Table II-5 of Mandatory Appendix II).

Tolerances that apply to flanges are as follows:

(e) Perpendicularity of the face with the bore

Size	Tolerance
NPS ≤ 5	1 deg
NPS ≥ 6	0.5 deg

### 7.4 Flange Thickness

Required tolerances for flange thickness are as follows:

Size	Tolerance
NPS ≤ 18	+3.0, -0.0 mm (+0.12, -0.00 in.)
NPS ≥ 20	+5.0, -0.0 mm (+0.19, -0.00 in.)

The plus tolerance is applicable to bolting bearing surfaces whether as-forged, as-cast, spot-faced, or back-faced (see para. 6.6).

### 7.5 Welding End Flange Ends and Hubs

**7.5.1 Outside Diameter.** Required tolerances for the nominal outside diameter dimension *A* of Figures 7 and 8 (Figures II-7 and II-8 of Mandatory Appendix II) of welding ends of welding neck flanges are as follows:

Size	Tolerance
NPS ≤ 5	+2.0, -1.0 mm (+0.09, -0.03 in.)
NPS ≥ 6	+4.0, -1.0 mm (+0.16, -0.03 in.)

**7.5.2 Inside Diameter.** Required tolerances for the nominal inside diameter of welding ends of welding neck flanges and smaller bore of socket welding flanges (dimension *B* in the referenced figures) are as follows:

(a) For Figures 7 and 8 (Figures II-7 and II-8 of Mandatory Appendix II) and Figure 4, the tolerances are

Size	Tolerance
NPS ≤ 10	±1.0 mm (±0.03 in.)
12 ≤ NPS ≤ 18	±1.5 mm (±0.06 in.)
NPS ≥ 20	+3.0, -1.5 mm (+0.12, -0.06 in.)

(b) For Figure 9 (Figure II-9 of Mandatory Appendix II), the tolerances are

Size	Tolerance
NPS ≤ 10	+0.0, -1.0 mm (+0.0, -0.03 in.)
NPS ≥ 12	+0.0, -1.5 mm (+0.0, -0.06 in.)

**7.5.3 Backing Ring Contact Surface.** Required tolerances for the bore of the backing ring contact surface of welding neck flanges, dimension *C* of Figures 9 and 10 (Figures II-9 and II-10 of Mandatory Appendix II) are as follows:

Size	Tolerance
2 ≤ NPS ≤ 24	+0.25, -0.0 mm (+0.01, -0.0 in.)

**7.5.4 Hub Thickness.** Despite the tolerances specified for dimensions *A* and *B*, the thickness of the hub at the welding end shall not be less than 87½% of the nominal thickness of the pipe, having an under-tolerance of 12.5% for the pipe wall thickness to which the flange is to be attached or the minimum wall thickness as specified by the purchaser.

### 7.6 Length Through Hub on Welding Neck Flanges

The required tolerances for the length through hubs on welding neck flanges are as follows:

Size	Tolerance
NPS ≤ 4	±1.5 mm (±0.06 in.)
5 ≤ NPS ≤ 10	+1.5, -3.0 mm (+0.06, -0.12 in.)
NPS ≥ 12	+3.0, -5.0 mm (+0.12, -0.18 in.)

### 7.7 Flange Bore Diameter

**7.7.1 Lapped and Slip-On Flange Bores.** The required tolerances for lapped and slip-on flange bore diameters are as follows:

Size	Tolerance
NPS ≤ 10	+1.0, -0.0 mm (+0.03, -0.0 in.)
NPS ≥ 12	+1.5, -0.0 mm (+0.06, -0.0 in.)

**7.7.2 Counterbores, Threaded Flanges.** The required tolerances for threaded flange counterbores are as follows:

Size	Tolerance
NPS ≤ 10	+1.0, -0.0 mm (+0.03, -0.0 in.)
NPS ≥ 12	+1.5, -0.0 mm (+0.06, -0.0 in.)

**7.7.3 Counterbores, Socket Welding Flanges.** The required tolerance for socket end counterbores is as follows:

Size	Tolerance
$\frac{1}{2} \leq \text{NPS} \leq 3$	$\pm 0.25 \text{ mm } (\pm 0.010 \text{ in.})$

**7.8 Drilling and Facing**

**7.8.1 Bolt Circle Diameter.** The required tolerance for all bolt circle diameters is as follows:

$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$

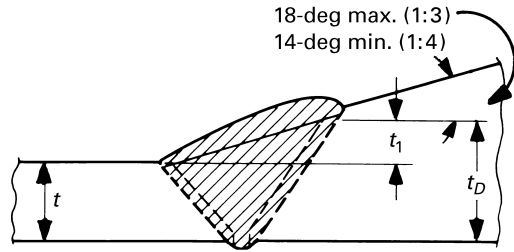
**7.8.2 Bolt Hole to Bolt Hole.** The required tolerance for the center-to-center of adjacent bolt holes is as follows:

$\pm 0.8 \text{ mm } (\pm 0.03 \text{ in.})$

**7.8.3 Bolt Circle Concentricity.** The required tolerances for concentricity between the flange bolt circle diameter and machine facing diameters are as follows:

Size	Tolerance
$\text{NPS} \leq 2\frac{1}{2}$	0.8 mm (0.03 in.)
$\text{NPS} \geq 3$	1.5 mm (0.06 in.)

**Figure 1 Bevel for Outside Thickness**



**Welding Ends  
(Welding Neck Flanges)  
Additional Thickness for  
Welding to Higher Strength Pipe**

**GENERAL NOTES:**

- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b) Neither  $t_1$ ,  $t_2$ , nor their sum  $t_1 + t_2$  shall exceed  $0.5t$ .
- (c) When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal the mating wall thickness times the ratio of minimum specified yield strength of the pipe to minimum specified yield strength of the flange.
- (d) Welding shall be in accordance with the applicable code.

**8 PRESSURE TESTING**

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Flanges are not required to be pressure tested.

**8.2 Flanged Fitting Test**

**8.2.1 Shell Pressure Test.** Each flanged fitting shall be given a shell pressure test.

**8.2.2 Test Conditions.** The shell pressure test for flanged fittings shall be at a pressure no less than 1.5 times the 38°C (100°F) pressure rating rounded off to the next higher 1 bar (25 psi) increment.

**8.2.3 Test Fluid.** The pressure test shall be made using water, which may contain a corrosion inhibitor or kerosene as the test fluid. Other suitable test fluids may be used provided their viscosity is no greater than that of water. The test fluid temperature shall not exceed 50°C (125°F).

**8.2.4 Test Duration.** The test duration shall be as follows:

Fitting Size	Duration, sec
$\text{NPS} \leq 2$	60
$2\frac{1}{2} \leq \text{NPS} \leq 8$	120
$\text{NPS} \geq 10$	180

**8.2.5 Acceptance.** No visible leakage is permitted through the pressure boundary wall.