

GUIDE TO MATERIAL LAYOUT & SPECIFICATIONS

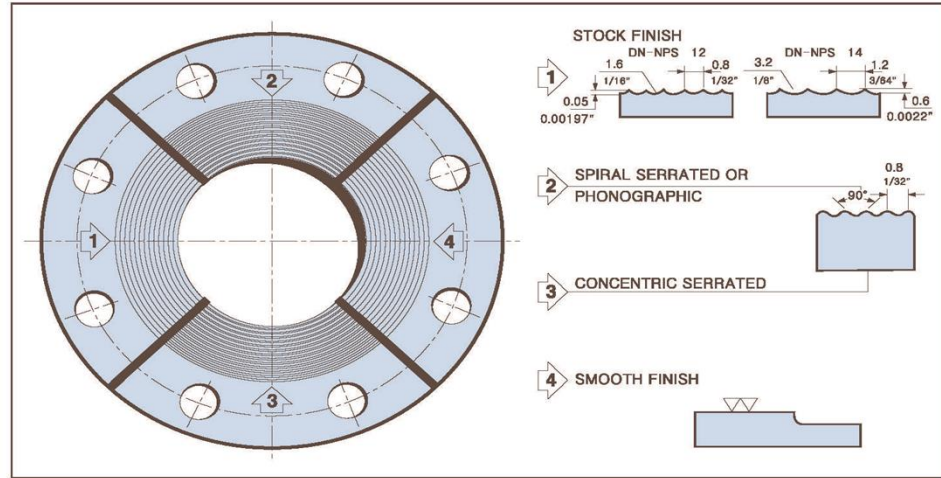
Pipe	Weld Fittings	Screwed & Socket Fittings	Flanges	Valves
A 53	A 234 WPB	A 105, A 181 Gr. 60 or 70	A 105, A 181 Gr. 60 or 70	A 105, A 216 WCB
A 106B	A 234 WPB	A 105, A 181 Gr. 60 or 70	A 105, A 181 Gr. 60 or 70	A 105, A 216 WCB
A 312 T304	A 403 WP-304	A 182 F 304	A 182 F 304	A 182 F 304 CMO
A 312 T316	A 403 WP-316	A 182 F 316	A 182 F 316	A 182 F 316 CM 8MO
A 333 Gr.1or6	A 420 WPL1&6	A 350 LF 1	A 350 LF 1	A 350 LF 1, A 352 LCB
A 333 Gr.3	A 420 WPL-3	A 350 LF 3	A 350 LF 3	A 350 LF 3, A 352 LC3
A 335 P-1	A 234 WP-1	A 182 F 1	A 182 F 1	A 217 WC 6
A 335 P-11	A 234 WP-11	A 182 F 11	A 182 F 11	A 182 F 11, A 217 WC 6
A 335 P-12	A 234 WP-12	A 182 F 12	A 182 F 12	A 217 WC 6
A 335 P-22	A 234 WP-22	A 182 F 22	A 182 F 22	A 182 F 22, A 217 WC 9
A 335 P-5	A 234 WP-5	A 182 F 5	A 182 F 5	A 182 F 5, A 216 WC 5
A 335 P-7	A 234 WP-7	A 182 F 7	A 182 F 7	A 182 F 7, A 217 WC 12
A 335 P-9	A 234 WP-9	A 182 F 9	A 182 F 9	A 182 F 9, A 217 WC 12

Notes:

- (1) Bore (B) is the same as nominal pipe size.
 (2) Welding necks longer than listed are available in all sizes on special order.

STANDARD FINISH

STANDARD FINISHES for Face of Flange (ANSI B16.5)



STOCK FINISH : The most widely used of any gasket finish, because practically, is suitable for all ordinary service conditions. This is a continuous spiral groove. Flanges sizes 12" (304.8mm) and smaller are produced with a 1/16" round-nosed tool at a feed of 1/32" per revolution. For sizes 14" (355.6mm) and larger, the finish is made with 1/8" round-nosed tool at a feed of 3/64" per revolution.

SPIRAL SERRATED OR PHONOGRAPHIC : This finish is produced by using a 90° round-nosed tool.

CONCENTRIC SERRATED : This finish is produced by using a 90° round-nosed tool.

SMOOTH FINISH : The cutting tool employed shall have an approximate 0.06" radius. The resultant surface finish shall have a 125μ inch to 250μ inch (ANSI B16.5 para 6.4, 4.1)

1. RAISED FACE, AND LARGE MALE AND FEMALE

Either a serrated-concentric or serrated-spiral finish having from 45 to 55 grooves per inch is used. The cutting tool employed has an approximate 0.06 in radius. The resultant surface finish shall have a 125μ inch (3.2μ) to 250μ inch (6.4μm) approximate roughness.

2. TONGUE AND GROOVE, AND SMALL MALE AND FEMALE

The gasket contact surface does not exceed 125μ in (3.2μm) roughness.

3. RING JOINT

The inside wall surface of gasket groove does not exceed 63μ in (1.6μm) roughness.

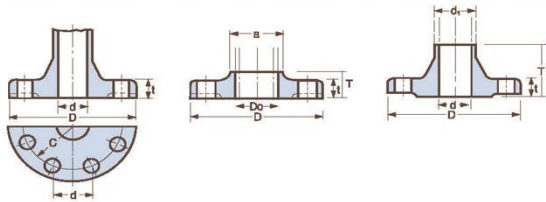
4. BLIND

Blind flanges need not be faced in the center if when this center part is raised its diameter is at least 1 in. smaller than the inside diameter of fittings of the corresponding pressure class. When the center part is depressed, its diameter is not greater than the inside diameter of the corresponding pressure class fittings. Machining of the depressed center is not required.

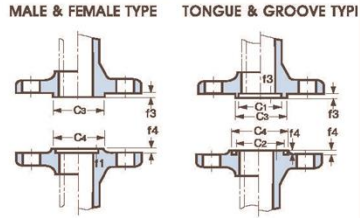
TOLERANCE

ANSI B16.5 FORGED FLANGES

SOLID FLANGE SLIP-ON FLANGE WELDING NECK FLANGE



TYPE OF GASKET SURFACE



THREAD, SOCKET-WELDING, SLIP-ON, LAP JOINT AND BLIND.

Outside Diameter	When O.D. is 24" or less	$\pm 1/16"$ (1.6mm)*
	When O.D. is Over 24"	$\pm 1/8"$ (3.2mm)*
Inside Diameter	Threaded	Within limits on boring gauge
	Socket-Welding, Slip-on and Lap joint	10" & Smaller $+1/32"$ (0.8mm), 0" 12" & Larger $+1/16"$ (1.6mm), 0"
Outside Diameter of Hub	5" and Smaller	$+3/32"$ (2.4mm)* $-1/32"$ (0.8mm)
	6" and Larger	$+5/32"$ (4.0mm) $-1/32"$ (0.8mm)
Diameter of Contact Face	1/16" Raised Face	$\pm 1/32"$ (0.8mm)
	1/4" Raised Face Tongue & Groove Male, Female	$\pm 1/64"$ (0.4mm)
Diameter of Counterbore	Same as for Inside Diameter	
Drilling	Bolt Circle	$\pm 1/16"$ (1.6mm)
	Bolt Hole Spacing	$\pm 1/32"$ (0.8mm)
	Eccentricity of Bolt Circle with Respect to Facing	2 1/2" Smaller $1/32"$ (0.8mm) Max. 3" & Larger $1/16"$ (1.6mm) Max.
	Eccentricity of Bolt Circle with Respect to bore	$1/32"$ (0.8mm) Max.*
Eccentricity of Facing with Respect to Bore		$1/32"$ (0.8mm) Max.*
		$1/32"$ (0.8mm) Max.*
Thickness	18" and Smaller	$+1/8"$ (3.2mm), -0"
	20" and Larger	$+3/16"$ (4.8mm), -0"
Length Thru Hub	10" and Smaller	$\pm 1/16"$ (1.6mm)
	12" and Larger	$\pm 1/8"$ (3.2mm)

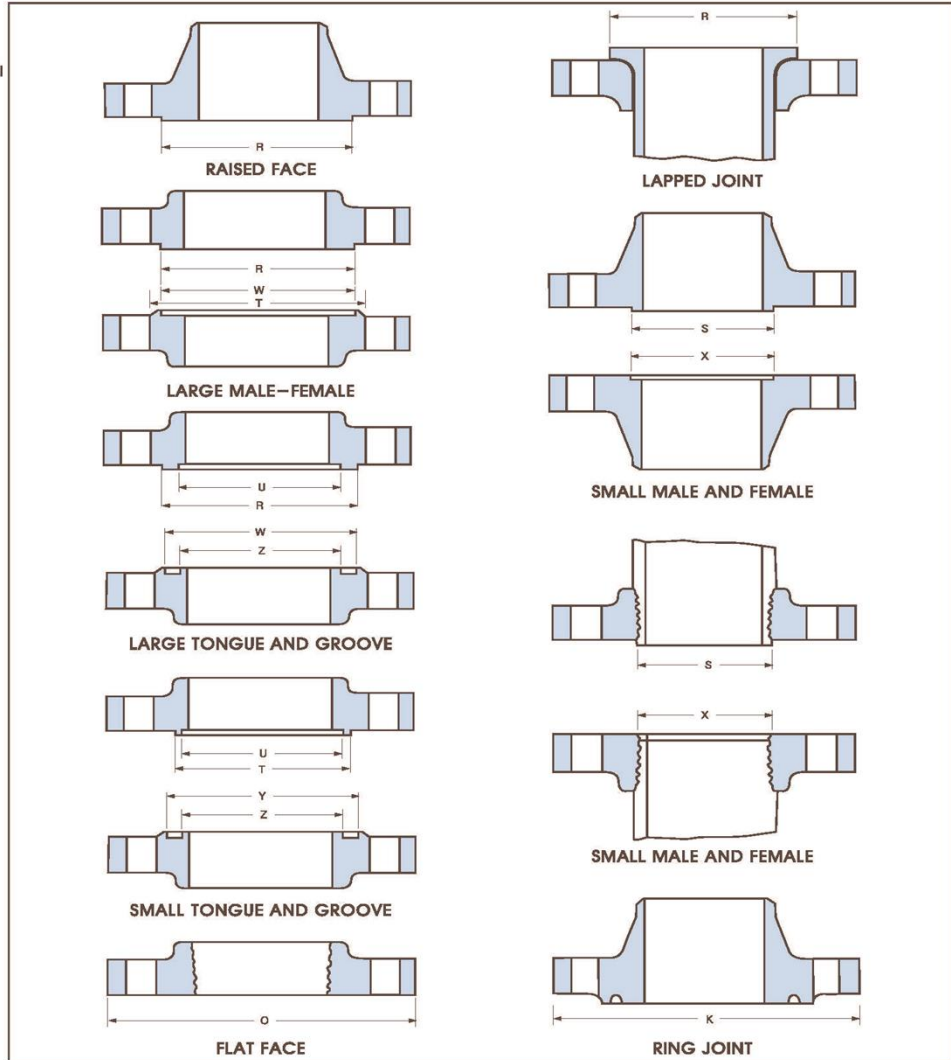
Note: *This tolerance is not covered in ANSI B16.5, but maker's option.

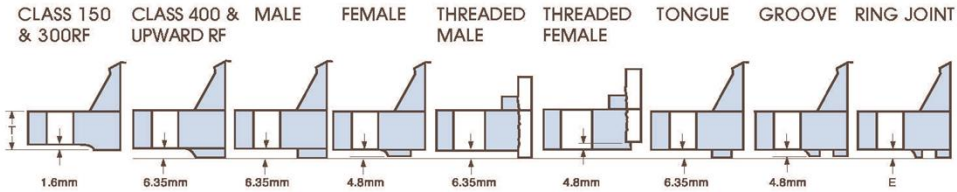
WELDING NECK

Outside Diameter	When O.D. is 24" or Less	$\pm 1/16"$ (1.6mm)*
	When O.D. is Over 24"	$\pm 1/8"$ (3.2mm)*
Inside Diameter	10" and Smaller	$\pm 1/32"$ (0.8mm)
	12" thru 18"	$\pm 1/16"$ (1.6mm)
	20" and Larger	$+1/8"$ (3.2mm) $-1/16"$ (1.6mm)
Diameter of Contact Face	1/16" Raised Face	$\pm 1/32"$ (0.8mm)
	1/4" Raised Face Tongue & Groove Male, Female	$\pm 1/64"$ (0.4mm)
Diameter of Hub at Base	When Hub Base is 24" or Smaller	$\pm 1/16"$ (1.6mm)*
	When Hub Base is Over 24"	$\pm 1/8"$ (3.2mm)*
Diameter of Hub at Point of Welding	5" and Smaller	$+3/32"$ (2.4mm) $-1/32"$ (0.8mm)
	6" and Larger	$+5/32"$ (4.0mm) $1/32"$ (0.8mm)
Drilling	Bolt Circle	$\pm 1/16"$ (1.6mm)
	Bolt Hole Spacing	$\pm 1/32"$ (0.8mm)
	Eccentricity of Bolt Circle with Respect to Facing	2 1/2" & Smaller $1/32"$ (0.8mm) Max. 3" & Larger $1/16"$ (1.6mm) Max.
	Eccentricity of Bolt Circle with Respect to Bore	$1/32"$ (0.8mm) Max.*
Eccentricity of Facing with Respect to Bore		$1/32"$ (0.8mm) Max.*
		$1/32"$ (0.8mm) Max.*
Thickness	18" and Smaller	$+1/8"$ (3.2mm), -0"
	20" and Larger	$+3/16"$ (4.8mm), -0"
Length Thru Hub	10" and Smaller	$\pm 1/16"$ (1.6mm)
	12" and Larger	$\pm 1/8"$ (3.2mm)

FLANGES FACINGS

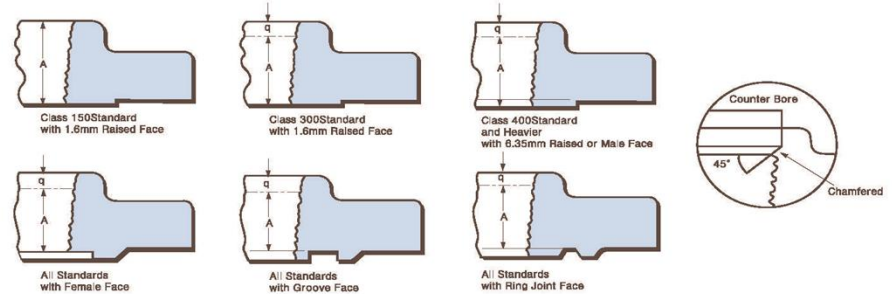
DIMENSIONS OF FLANGE FACINGS





THREAD

THREAD AND STANDARDS FOR ANSI FLANGES (ANSI B2.1)



ANSI B16.5 FORGED FLANGES

Unit: mm

Nominal Pipe Size	OUTSIDE DIAMETER				OUTSIDE DIAMETER					HEIGHT		Depth of Groove or Female
	Rated Face, Lapped Large Male and Large Tongue	Small Male	Small Tongue	I.D. of Large and Small Tongue	Large Female and Large Groove		Small Female	Small Groove	I.D. of Large and Groove	Raised Face, and 300 ST DS	Raised Face, Large and Small Male and Tongue Classes 400 2500 ST DS	
					W	L							X	Y	Z
1/2	35.1	18.3	35.1	25.4	36.6	46.0	19.8	36.6	23.9	1.5	6.4	4.8
3/4	42.9	23.9	42.9	33.3	44.5	53.8	26.4	44.5	31.8	1.5	6.4	4.8
1	50.8	30.2	47.8	38.1	52.3	62.0	31.8	49.3	36.6	1.5	6.4	4.8
1 1/4	63.5	38.1	57.2	47.8	65.0	74.7	39.6	58.7	46.0	1.5	6.4	4.8
1 1/2	73.2	44.5	63.5	53.8	74.7	84.1	46.0	65.0	52.3	1.5	6.4	4.8
2	91.9	57.2	82.6	73.2	93.7	103.1	58.7	84.1	71.4	1.5	6.4	4.8
2 1/2	104.6	68.3	95.3	85.9	106.4	115.8	69.9	96.8	84.1	1.5	6.4	4.8
3	127.0	84.1	117.3	108.0	128.5	138.2	85.9	119.1	106.4	1.5	6.4	4.8
3 1/2	139.7	96.8	130.0	120.7	141.2	150.9	98.6	131.8	119.1	1.5	6.4	4.8
4	157.2	109.5	144.5	131.8	158.8	168.1	111.3	146.1	130.0	1.5	6.4	4.8
5	185.7	136.7	173.0	160.3	187.5	196.9	138.2	174.8	158.8	1.5	6.4	4.8
6	215.9	162.1	203.2	190.5	217.4	227.1	163.6	204.7	189.0	1.5	6.4	4.8
8	269.7	212.9	254.0	238.3	271.5	280.9	214.4	255.5	236.5	1.5	6.4	4.8
10	323.9	266.7	304.8	285.8	325.4	335.0	268.2	306.3	284.2	1.5	6.4	4.8
12	381.0	317.5	352.0	342.9	382.5	392.2	319.0	363.5	341.4	1.5	6.4	4.8
14	412.8	349.3	393.7	374.7	414.3	423.9	350.8	395.2	373.1	1.5	6.4	4.8
16	469.9	400.1	447.5	425.5	471.4	481.1	401.6	449.3	423.9	1.5	6.4	4.8
18	533.4	450.9	511.0	489.0	534.9	544.6	452.4	512.8	487.4	1.5	6.4	4.8
20	584.2	501.7	558.8	533.4	585.7	595.4	503.2	560.3	531.9	1.5	6.4	4.8
24	692.2	603.3	666.8	641.4	693.7	703.3	604.8	668.3	639.8	1.5	6.4	4.8

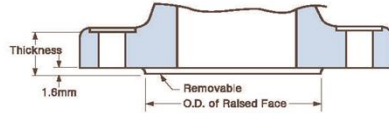
ANSI B16.5 FORGED FLANGES

Unit: mm

Nominal Pipe Size	A - THREAD LENGTHS							
	Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500	
1/2	15.9	15.9	15.9	15.9	22.2	22.2	28.6	
3/4	15.9	15.9	15.9	15.9	25.4	25.4	31.8	
1	17.5	17.5	17.5	17.5	28.6	28.6	34.9	
1 1/4	20.7	20.7	20.7	20.7	30.2	30.2	38.1	
1 1/2	22.2	22.2	22.2	22.2	31.8	31.8	44.5	
2	25.4	28.6	28.6	28.6	38.1	38.1	50.8	
2 1/2	28.6	31.8	31.8	31.8	47.6	47.6	57.2	
3	30.1	31.8	34.9	34.9	41.3	50.8	63.5	
3 1/2	31.8	36.5	39.7	39.7				
4	33.4	36.5	36.5	41.3	47.6	57.2	69.9	
5	36.5	42.9	42.9	47.6	54.0	63.5	76.2	
6	39.7	46.1	46.1	50.8	57.2	69.9	82.6	
8	44.5	50.8	50.8	60.3	63.5	76.2	95.3	
10	49.2	55.6	55.6	65.1	71.5	84.2	108.0	
12	55.6	60.3	60.3	69.9	76.2	92.1	120.7	
14	57.2	63.5	63.5	73.0	82.6			
16	63.5	68.3	68.3	77.8	85.7			
18	68.3	69.9	69.9	78.4	88.9			
20	69.9	73.0	73.0	82.6	92.1			
24	82.6	82.6	82.6	92.1	101.6			

Notes:

- Small male and female faces are not applicable to Slip-on Flange.
- Large male and female faces are not applicable to Class 150 Flanges.
- For flanges of Class 150 and 300 where they are to be bolted to ANSI Class 125 and 250 Cast-Iron Flanges or required with flat face, flat face can be made by removing raised face.



- Tolerances are $\pm 0.03^+$ ($+0.8\text{mm}$) for 0.06^+ (1.6mm) RF and $\pm 0.02^+$ ($+0.5\text{mm}$) for 0.25^+ (6.35mm) RF Large Male and Large Tongue.

Notes:

- Except flanges with Small Male/Female Face (on pipe end), threaded flanges, have an American National Standard taper pi thread conforming to ANSI B2.1.
- The thread is concentric with the axis of the flange and variations in alignment do not exceed 0.06 (1.6mm) in. per foot (0.5 percent)
- Class 150 flanges are made without counterbore. The threads are chamfered approximately to the major diameter of the thread at the back of the flange at an angle of approximately 45 degrees with the axis of thread. The chamfer is concentric with the thread and included in the measurement of the thread length.
- Class 300 and higher pressure flanges are made with a counterbore at the back of the flange. The threads are chamfered to the diameter of the counterbore at an angle of approximately 45 degrees with the axis of the thread. The counterbore and chamfer are concentric with the thread.
- The minimum length of effective thread in reducing flanges is at least equal to dimension Q of the corresponding class threaded flange as shown in the above tables. Threads do not necessarily extend to the face to the flange.

MATERIAL SPECIFICATIONS

APPLICABLE ASTM SPECIFICATIONS

Material Group No.	GROUP 1 MATERIALS				PRODUCT FORMS			
	Normal Designation (Steel)	Spec. -Gr.	Forgings	Notes	Spec. -Gr.	Notes	Spec. -Gr.	Notes
1.1	Carbon	A105 A350-LF2		(1)(3)	A216-WC8	(1)	A516-70 A516-70 A537-C1.1	(1)
1.2	C-Mn-Si				A216-WCC	(1)		
	Carbon				A352-LCC A352-LC2 A352-LC3		A203-B A302-E	
1.3	2-1/2 Ni	A350-LF3			A203-A A203-D A515-65 A516-65	(1)		
	3-1/2 Ni				A515-60 A516-60			
1.4	Carbon	A350-LF1			A204-A A204-B A204-C	(2)		
1.5	C-1/2 Mo	A182-F1		(2)	A217-WC1 A352-LC1	(2)(4)		
1.7	C-1/2 Mo	A182-F2			A217-WC4 A217-WC5	(4)	A387-11 C1.2 A387-22 C1.2	(2)
	1/2 Cr-1/2 Mo							
1.9	Ni-Cr-1/2 Mo	A182-F12		(4)				
	1 Cr-1/2 Mo	A182-F11		(4)				
1.10	2-1/4 Cr-1 Mo	A182-F22						
1.13	5 Cr-1/2 Mo	A181-F5 A182-F5a			A217-C5	(4)		
1.14	9 Cr-1 Mo	A182-F9		(4)	A217-C12	(4)		

Material Group No.	GROUP 2 MATERIALS			PRODUCT FORMS		
	Normal Designation (Steel)	Spec. -Gr.	Notes	Spec. -Gr.	Notes	Notes
2.1	18 Cr-8 Ni	A182-F304	(5)	A351-CF3	(5)	A240-304
	18 Cr-8 Ni	A182-F304H	(5)	A351-CF8	(5)	A240-304H
2.2	16 Cr-12 Ni-2 Mo	A182-F316	(5)			A240-316
	18 Cr-13 Ni-3 Mo	A182-F316H				A240-316H
2.3	18 Cr-9 Ni-2 Mo			A351-CF3M A351-CF8M	(5)	A240-317
	18 Cr-8 Ni	A182-F304L				A240-304L
2.4	16 Cr-12 Ni-2 Mo	A182-F316L				A240-316L
	18 Cr-10 Ni-Ti	A182-F321	(5)			A240-321
2.5	18 Cr-10 Ni-Cb	A182-F321H	(5)	A351-CF8C	(5)	A240-321H
		A182-F347 A182-F347H A182-F348 A182-F348H				A240-347 A240-347H A240-348 A240-348H
2.6	25 Cr-12 Ni			A351-CH8 A351-CH20	(5)	A240-347
						A240-347H
2.7	23 Cr-12 Ni			A240-309S	(5)(6)	
	25 Cr-20 Ni	A182-F310	(5)(7)	A351-CK20	(5)	A240-310S

General Notes:

- For temperature limitations see footnotes in ANSI B16.5 TABLES. (PRESSURE-TEMPERATURE RATINGS)
- Plate materials are listed only for use as blind flanges (see 5.1). Additional plate materials listed in ANSI B16.34 may also be used, with corresponding B16.34 Standard Class ratings.
- Material Groups not listed in Table 1A are intended for use in valves. See ANSI B16.34.

Notes:

- Upon prolonged exposure to temperatures above about 800°F (425°C), the carbide phase of carbon steel may be converted to graphite.
- Upon prolonged exposure to temperatures above about 875°F (470°C), the carbide phase of carbon-molybdenum steel may be converted to graphite.
- Only killed steel shall be used above 850°F (455°C).
- Use normalized and tempered material only.
- At temperatures over 1000°F (540°C), use only when the carbon content is 0.04 percent or higher.
- For temperatures above 1000°F (540°C), use only if the material is heat treated by heating it to a temperature of at least 1900°F (1040°C) and quenching in water or rapidly cooling by other means.
- Service temperatures of 1050°F (565°C) and above should be used only when assurance is provided that grain size is not finer than ASTM No.6.

PRESSURE-TEMPERATURE RATINGS

ANSI B16.5/B16.47 FORGED FLANGES

TABLES 2
PRESSURE-TEMPERATURE RATINGS

TABLE 2-75 CLASS 75 PRESSURE-TEMPERATURE RATINGS
Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C-1/2Mo	1/2Cr-1/2Mo, Ni-Cr-Mo	1Cr-1/2Mo, 1/2Cr-Mo	2 1/2Cr-1Mo	5Cr-1/2Mo	9Cr-1Mo	Type 304	Type 316	Types 304L, 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	140	145	130	115	130	145	145	145	145	145	135	135	115	135	135	130	130
200	130	130	125	105	130	130	130	130	130	130	115	120	95	115	120	115	115
300	115	115	115	105	115	115	115	115	115	115	100	105	85	105	110	110	110
400	100	100	100	100	100	100	100	100	100	100	90	95	80	95	100	100	100
500	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
600	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
650	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
700	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
750	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
800	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
850	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
900	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
950	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE 2-150 CLASS 150 PRESSURE-TEMPERATURE RATINGS
Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C-1/2Mo	1/2Cr-1/2Mo, Ni-Cr-Mo	1Cr-1/2Mo, 1/2Cr-Mo	2 1/2Cr-1Mo	5Cr-1/2Mo	9Cr-1Mo	Type 304	Type 316	Types 304L, 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	285	290	265	235	265	290	290	280	280	280	275	275	230	275	275	260	260
200	260	260	250	215	260	260	260	260	260	260	235	240	195	235	245	230	230
300	230	230	230	210	230	230	230	260	260	260	205	215	175	210	225	220	220
400	200	200	200	200	200	200	200	200	200	200	180	195	160	190	200	200	200
500	170	170	170	170	170	170	170	170	170	170	170	170	145	170	170	170	170
600	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
650	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
700	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
750	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
800	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
850	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
900	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
950	35	35	35	35	35	35	35	35	35	35	35	35	...	35	35	35	35
1000	20	20	20	20	20	20	20	20	20	20	20	20	...	20	20	20	20

(Table 2 continues on next page : Notes follow at end of Table)

TABLE 2-300 CLASS 300 PRESSURE-TEMPERATURE RATINGS

Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C- ½Mo	½Cr- ½Mo, Ni-Cr- Mo	1Cr- ½Mo, 1½Cr- ½Mo	2¼Cr- 1Mo	5Cr- ½Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	740	750	695	620	695	750	750	750	750	750	720	720	600	720	720	670	670
200	675	750	655	560	680	750	710	715	750	750	600	620	505	610	635	605	605
300	655	730	640	550	655	730	675	675	730	730	530	560	455	545	590	570	570
400	635	705	620	530	640	705	660	650	705	705	470	515	415	495	555	535	535
500	600	665	585	500	620	665	640	640	665	665	435	480	380	460	520	505	505
600	550	605	535	455	605	605	605	605	605	605	415	450	360	435	490	480	480
650	535	590	525	450	590	590	590	590	590	590	410	445	350	430	480	465	465
700	535	570	520	450	570	570	570	570	570	570	405	430	345	420	470	455	455
750	505	505	475	445	530	530	530	530	530	530	400	425	335	415	460	445	445
800	410	410	390	370	510	510	510	510	500	510	395	415	330	415	455	435	435
850	270	270	270	270	485	485	485	485	440	485	390	405	320	410	445	425	425
900	170	170	170	170	450	450	450	450	355	450	385	395	...	405	430	415	415
950	105	105	105	105	280	345	380	380	260	370	375	385	...	385	385	385	385
1000	50	50	50	50	165	215	225	270	190	290	325	365	...	355	365	335	350
1050	...	...	...	...	...	190	140	200	140	190	310	360	...	345	360	290	335
1100	...	...	...	...	...	...	95	115	105	115	260	325	...	300	325	225	290
1150	...	...	...	...	...	...	50	105	70	75	195	275	...	235	275	170	245
1200	...	...	...	...	...	...	35	55	45	50	155	205	...	180	170	130	205
1250	...	...	...	...	...	...	...	...	...	...	110	180	...	140	125	100	160
1300	...	...	...	...	...	...	...	...	...	...	85	140	...	105	95	80	120
1350	...	...	...	...	...	...	...	...	...	...	60	105	...	80	70	60	80
1400	...	...	...	...	...	...	...	...	...	...	50	75	...	60	50	45	55
1450	...	...	...	...	...	...	...	...	...	...	35	60	...	50	40	30	40
1500	...	...	...	...	...	...	...	...	...	...	25	40	...	40	35	25	25

TABLE 2-400 CLASS 400 PRESSURE-TEMPERATURE RATINGS

Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C- ½Mo	½Cr- ½Mo, Ni-Cr- Mo	1Cr- ½Mo, 1½Cr- ½Mo	2¼Cr- 1Mo	5Cr- ½Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	990	1000	925	825	925	1000	1000	1000	1000	1000	960	960	800	960	960	895	895
200	900	1000	875	750	905	1000	950	955	1000	1000	800	825	675	815	850	805	805
300	875	970	850	730	870	970	895	905	970	970	705	745	605	725	785	760	760
400	845	940	825	705	855	940	880	865	940	940	630	685	550	660	740	710	710
500	800	885	775	665	830	885	885	855	885	885	585	635	510	610	690	670	670
600	730	805	710	610	805	805	805	805	805	805	555	600	480	585	655	635	635
650	715	785	695	600	785	785	785	785	785	785	545	590	470	570	640	620	620
700	710	755	690	600	755	755	755	755	755	755	540	575	460	560	625	610	610
750	670	670	630	590	710	710	710	710	710	710	530	565	450	555	615	595	595
800	550	550	520	495	675	675	675	675	665	675	525	555	440	550	610	580	580
850	355	355	335	335	650	650	650	650	585	650	520	540	430	545	590	565	565
900	230	230	230	230	600	600	600	600	470	600	510	525	...	540	575	555	555
950	140	140	140	140	375	460	505	505	350	495	500	515	...	515	515	515	515
1000	70	70	70	70	220	285	300	355	255	390	430	485	...	475	485	450	465
1050	...	...	...	...	...	250	185	265	190	250	410	480	...	460	480	390	445
1100	...	...	...	...	...	...	130	150	140	150	345	430	...	400	430	300	390
1150	...	...	...	...	...	...	70	140	90	100	260	365	...	315	365	230	330
1200	...	...	...	...	...	...	45	75	60	70	205	275	...	240	230	175	275
1250	...	...	...	...	...	...	...	...	...	...	145	245	...	185	165	135	215
1300	...	...	...	...	...	...	...	...	...	...	110	185	...	140	125	105	160
1350	...	...	...	...	...	...	...	...	...	...	85	140	...	110	90	80	105
1400	...	...	...	...	...	...	...	...	...	...	65	100	...	80	70	60	75
1450	...	...	...	...	...	...	...	...	...	...	45	80	...	65	55	40	50
1500	...	...	...	...	...	...	...	...	...	...	30	55	...	50	45	30	30

(Table 2 continues on next page : Notes follow at end of Table)

PRESSURE–TEMPERATURE RATINGS

ANSI B16.5/B16.47 FORGED FLANGES

TABLE 2-600 CLASS 600 PRESSURE-TEMPERATURE RATINGS

Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C- 1/2Mo	1/2Cr- 1/2Mo, Ni-Cr- Mo	1Cr- 1/2Mo, 1 1/2Cr- 1/2Mo	2 1/4Cr- 1Mo	5Cr- 1/2Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	1480	1500	1390	1235	1390	1500	1500	1500	1500	1500	1440	1440	1200	1440	1440	1345	1345
200	1350	1500	1315	1125	1360	1500	1425	1430	1500	1500	1200	1240	1015	1220	1270	1210	1210
300	1315	1455	1275	1095	1305	1455	1345	1355	1455	1455	1055	1120	910	1090	1175	1140	1140
400	1270	1410	1235	1060	1280	1410	1315	1295	1410	1410	940	1030	825	990	1110	1065	1065
500	1200	1330	1165	995	1245	1330	1285	1280	1330	1330	875	955	765	915	1035	1010	1010
600	1095	1210	1065	915	1210	1210	1210	1210	1210	1210	830	905	720	875	985	955	955
650	1075	1175	1045	895	1175	1175	1175	1175	1175	1175	815	890	700	855	960	930	930
700	1065	1135	1035	895	1135	1135	1135	1135	1135	1135	805	865	685	840	935	910	910
750	1010	1010	945	885	1065	1065	1065	1065	1065	1065	795	845	670	830	920	895	895
800	825	825	780	740	1015	1015	1015	995	1015	995	790	830	660	825	910	870	870
850	535	535	535	535	975	975	975	880	975	880	780	810	645	815	890	850	850
900	345	345	345	345	900	900	900	900	900	900	705	790	...	810	865	830	830
950	205	205	205	205	560	685	755	755	520	740	750	775	...	775	775	775	775
1000	105	105	105	105	330	425	445	535	385	585	645	725	...	715	725	670	700
1050	...	...	...	...	...	380	275	400	280	380	620	720	...	695	720	585	665
1100	...	...	...	...	...	...	190	225	205	225	515	645	...	605	645	445	585
1150	...	...	...	...	...	...	105	205	140	150	390	550	...	475	550	345	495
1200	...	...	...	...	...	...	70	110	90	105	310	410	...	365	345	260	410
1250	...	...	...	...	...	...	...	...	...	...	220	365	...	280	245	200	325
1300	...	...	...	...	...	...	...	...	...	...	165	275	...	210	185	160	240
1350	...	...	...	...	...	...	...	...	...	...	125	205	...	165	135	115	160
1400	...	...	...	...	...	...	...	...	...	...	90	150	...	125	105	90	110
1450	...	...	...	...	...	...	...	...	...	...	70	115	...	95	80	60	75
1500	...	...	...	...	...	...	...	...	...	...	50	85	...	75	70	50	50

TABLE 2-900 CLASS 900 PRESSURE-TEMPERATURE RATINGS

Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon				C- 1/2Mo	1/2Cr- 1/2Mo, Ni-Cr- Mo	1Cr- 1/2Mo, 1 1/2Cr- 1/2Mo	2 1/4Cr- 1Mo	5Cr- 1/2Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	2220	2250	2085	1850	2085	2250	2250	2250	2250	2250	2160	2160	1800	2160	2160	2015	2015
200	2025	2250	1970	1685	2035	2250	2135	2150	2250	2250	1800	1860	1520	1830	1910	1815	1815
300	1970	2185	1915	1640	1955	2185	2020	2030	2185	2185	1585	1680	1360	1635	1765	1705	1705
400	1900	2115	1850	1585	1920	2115	1975	1945	2115	2115	1410	1540	1240	1485	1665	1600	1600
500	1795	1995	1745	1495	1865	1995	1925	1920	1995	1995	1310	1435	1145	1375	1555	1510	1510
600	1640	1815	1600	1370	1815	1815	1815	1815	1815	1815	1245	1355	1080	1310	1475	1435	1435
650	1610	1765	1570	1345	1765	1765	1765	1765	1765	1765	1225	1330	1050	1280	1440	1395	1395
700	1600	1705	1555	1345	1705	1705	1705	1705	1705	1705	1210	1295	1030	1260	1405	1370	1370
750	1510	1510	1420	1325	1595	1595	1595	1595	1595	1595	1195	1270	1010	1245	1385	1340	1340
800	1295	1295	1175	1110	1525	1525	1525	1525	1490	1525	1180	1245	985	1240	1370	1305	1305
850	805	805	805	805	1460	1460	1460	1460	1315	1460	1165	1215	965	1225	1330	1275	1275
900	515	515	515	515	1350	1350	1350	1350	1060	1350	1150	1180	...	1215	1295	1245	1245
950	310	310	310	310	845	1030	1130	1130	780	1110	1125	1160	...	1160	1160	1160	1160
1000	515	155	155	155	495	640	670	805	575	875	965	1090	...	1070	1090	1010	1050
1050	...	...	...	...	...	565	410	595	420	565	925	1080	...	1040	1080	875	1000
1100	...	...	...	...	...	...	290	340	310	340	770	965	...	905	965	670	875
1150	...	...	...	...	...	...	155	310	205	225	585	825	...	710	825	515	740
1200	...	...	...	...	...	...	105	165	135	155	465	620	...	545	515	390	620
1250	...	...	...	...	...	...	...	...	...	...	330	545	...	420	370	300	485
1300	...	...	...	...	...	...	...	...	...	...	245	410	...	320	280	235	360
1350	...	...	...	...	...	...	...	...	...	...	185	310	...	245	205	175	235
1400	...	...	...	...	...	...	...	...	...	...	145	225	...	185	155	135	165
1450	...	...	...	...	...	...	...	...	...	...	105	175	...	145	125	95	115
1500	...	...	...	...	...	...	...	...	...	...	70	125	...	115	105	70	70

(Table 2 continues on next page : Notes follow at end of Table)

TABLE 2-1500 CLASS 1500 PRESSURE-TEMPERATURE RATINGS
Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7	
Materials	Carbon Steel				Alloy Steels						Austenitic Steels							
					C- 1/2Mo	1/2Cr- 1/2Mo, Ni-Cr- Mo	1Cr- 1/2Mo, 1 1/4Cr- 1/2Mo	2 1/4Cr- 1Mo	5Cr- 1/2Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310	
Temp., °F																		
-20 to 100	3705	3750	3470	3085	3470	3750	3750	3750	3750	3750	3600	3600	3000	3600	3600	3600	3360	3360
200	3375	3750	3280	2810	3395	3750	3560	3580	3750	3750	3000	3095	2530	3050	3180	3025	3025	
300	3280	3640	3190	2735	3260	3640	3365	3385	3640	3640	2640	2795	2270	2725	2940	2845	2845	
400	3170	3530	3085	2645	3200	3530	3290	3240	3530	3530	2350	2570	2065	2470	2770	2665	2665	
500	2995	3325	2910	2490	3105	3325	3210	3200	3325	3325	2185	2390	1910	2290	2590	2520	2520	
600	2735	3025	2665	2285	3025	3025	3025	3025	3025	3025	2075	2255	1800	2185	2460	2390	2390	
650	2685	2940	2615	2245	2940	2940	2940	2940	2940	2940	2040	2220	1750	2135	2400	2330	2330	
700	2665	2840	2590	2245	2840	2840	2840	2840	2840	2840	2015	2160	1715	2100	2340	2280	2280	
750	2520	2520	2365	2210	2660	2660	2660	2660	2660	2660	1990	2110	1680	2075	2305	2230	2230	
800	2060	2060	1955	1850	2540	2540	2540	2540	2485	2540	1970	2075	1645	2065	2280	2170	2170	
850	1340	1340	1340	1340	2435	2435	2435	2435	2195	2435	1945	2030	1610	2040	2220	2125	2125	
900	860	860	860	860	2245	2245	2245	2245	1765	2245	1920	1970	...	2030	2160	2075	2075	
950	515	515	515	515	1405	1715	1885	1885	1305	1850	1870	1930	...	1930	1930	1930	1930	
1000	260	260	260	260	825	1115	1340	960	1460	1610	1820	...	1785	1820	1680	1750	1750	
1050	...	...	...	...	...	945	685	995	705	945	1545	1800	...	1730	1800	1460	1665
1100	...	...	...	...	...	...	480	565	515	565	1285	1610	...	1510	1610	1115	1460
1150	...	...	...	...	...	...	260	515	345	380	980	1370	...	1185	1370	860	1235
1200	...	...	...	...	...	...	170	275	225	260	770	1030	...	910	855	650	1030
1250	...	...	...	...	...	...	...	...	...	...	550	910	...	705	615	495	805
1300	...	...	...	...	...	...	...	...	...	...	410	685	...	530	465	395	600
1350	...	...	...	...	...	...	...	...	...	...	310	515	...	410	345	290	395
1400	...	...	...	...	...	...	...	...	...	...	240	380	...	310	255	225	275
1450	...	...	...	...	...	...	...	...	...	...	170	290	...	240	205	155	190
1500	...	...	...	...	...	...	...	...	...	...	120	205	...	190	170	120	120

TABLE 2-2500 CLASS 2500 PRESSURE-TEMPERATURE RATINGS
Pressures are in pounds per square inch, gage (psig)

Material Group	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.13	1.14	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Materials	Carbon Steel				Alloy Steels						Austenitic Steels						
					C- 1/2Mo	1/2Cr- 1/2Mo, Ni-Cr- Mo	1Cr- 1/2Mo, 1 1/4Cr- 1/2Mo	2 1/4Cr- 1Mo	5Cr- 1/2Mo	9Cr- 1Mo	Type 304	Type 316	Type 304L Type 316L	Type 321	Types 347, 348	Type 309	Type 310
Temp., °F																	
-20 to 100	6170	6250	5785	5145	5785	6250	6250	6250	6250	6250	6000	6000	5000	6000	6000	5600	5600
200	5625	6250	5470	4680	5660	6250	5930	5965	6250	6250	5000	5160	4220	5080	5300	5040	5040
300	5470	6070	5315	4560	5435	6070	5605	5640	6070	6070	4400	4660	3780	4540	4900	4740	4740
400	5280	5880	5145	4405	5330	5880	5485	5400	5880	5880	3920	4280	3440	4120	4620	4440	4440
500	4990	5540	4850	4150	5180	5540	5350	5330	5540	5540	3640	3980	3180	3820	4320	4200	4200
600	4560	5040	4440	3805	5040	5040	5040	5040	5040	5040	3460	3760	3000	3640	4100	3980	3980
650	4475	4905	4355	3740	4905	4905	4905	4905	4905	4905	3400	3700	2920	3560	4000	3880	3880
700	4440	4730	4320	3740	4730	4730	4730	4730	4730	4730	3360	3600	2860	3500	3900	3800	3800
750	4200	4200	3945	3685	4430	4430	4430	4430	4430	4430	3320	3520	2800	3460	3840	3720	3720
800	3430	3430	3260	3085	4230	4230	4230	4230	4145	4230	3280	3460	2740	3440	3800	3620	3620
850	2230	2230	2230	2230	4060	4060	4060	4060	3660	4060	3240	3380	2680	3400	3700	3540	3540
900	1430	1430	1430	1430	3745	3745	3745	3745	2945	3745	3200	3280	...	3380	3600	3460	3460
950	860	860	860	860	2345	2860	3145	3145	2170	3085	3120	3220	...	3220	3220	3220	3220
1000	430	430	430	430	1370	1770	1860	2230	1600	2430	2685	3030	...	2970	3030	2800	2915
1050	...	...	...	...	...	1570	1145	1660	1170	1570	2570	3000	...	2885	3000	2430	2770
1100	...	...	...	...	...	...	800	945	860	945	2145	2685	...	2515	2685	1860	2430
1150	...	...	...	...	...	...	430	860	570	630	1630	2285	...	1970	2285	1430	2060
1200	...	...	...	...	...	...	285	460	370	430	1285	1715	...	1515	1430	1085	1715
1250	...	...	...	...	...	...	...	...	...	...	915	1515	...	1170	1030	830	1345
1300	...	...	...	...	...	...	...	...	...	...	685	1145	...	885	770	660	1000
1350	...	...	...	...	...	...	...	...	...	...	515	860	...	685	570	485	660
1400	...	...	...	...	...	...	...	...	...	...	400	630	...	515	430	370	460
1450	...	...	...	...	...	...	...	...	...	...	285	485	...	400	345	260	315
1500	...	...	...	...	...	...	...	...	...	...	200	345	...	315	285	200	200

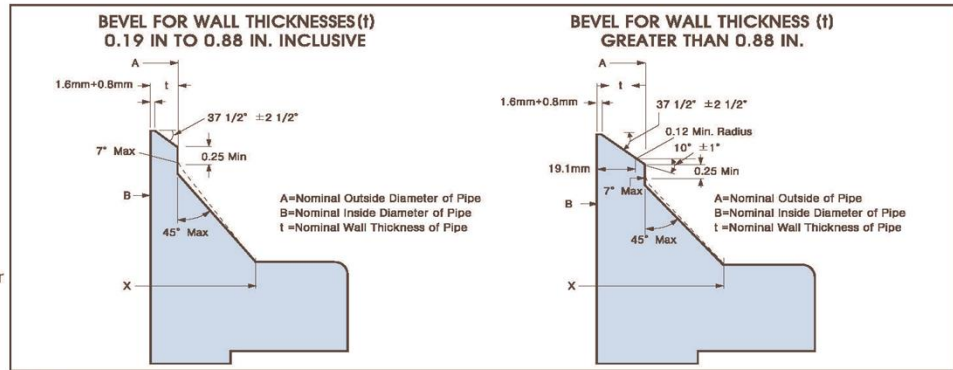
(Table 2 continues on next page : Notes follow at end of Table)

Notes to Tables 2

- NOTES:**
 (1) Provisions of Section 2 apply to all ratings.
 (2) Temperature notes for all Material Groups, Tables 2-75 through 2-1500 (see Table 1A for additional information and notes relating to specific materials):
 (a) permissible but not recommended for prolonged use above about 800°F
 (b) not to be used over 1000°F
 (c) not to be used over 850°F
 (d) not to be used over 650°F
 (e) permissible but not recommended for prolonged use above about 850°F
 (f) not to be used over 1050°F
 (g) permissible but not recommended for prolonged use above about 1100°F
 (h) not to be used over 1100°F
 (i) not to be used over 800°F
 (j) for service temperature 1050°F and above, should be used only when assurance is provided that grain size is not finer than ASTM No.6

WELDING ENDS

ANSI B16.5 FORGED FLANGES



Material Group	Materials (Spec. -Gr.)	Notes
1.1	A 105, A 216-WCB, A 515-70 A 516-70 A 350-LF2, A 537-CI.1	(a)(b) (a)(c) (d)
1.2	A 203-B, A 203-E, A 216-WCC A 350-LF3, A 352-LC2, A 352-LC3 A 382-LCC	(a)(b) ... (d)
1.3	A 352-LCB A 203-A, A 203-D, A 515-65 A 516-65	(a) (a)(b) (a)(c)
1.4	A 515-60 A 516-60 A 350-LF1	(a)(b) (a)(c) (d)
1.5	A 182-F1, A 204-A, A204-B, A217-WC-1 A 352-LC1	(e)(b) (d)
1.7	A 204-C A182-F2, A 217-WC4 A 217-WC5	(c) (b) (f)
1.9	A 182-F11, A 182-F12, A 387-11, CI.2 A 217-WC6	(g) (h)
1.10	A 182-F22, A 387-22, CI.2 A 217-WC9	(g) (h)
1.13	A 182-F5, A 182-F5a, A217-C5	...
1.14	A 182-F9, A 217-C12	...

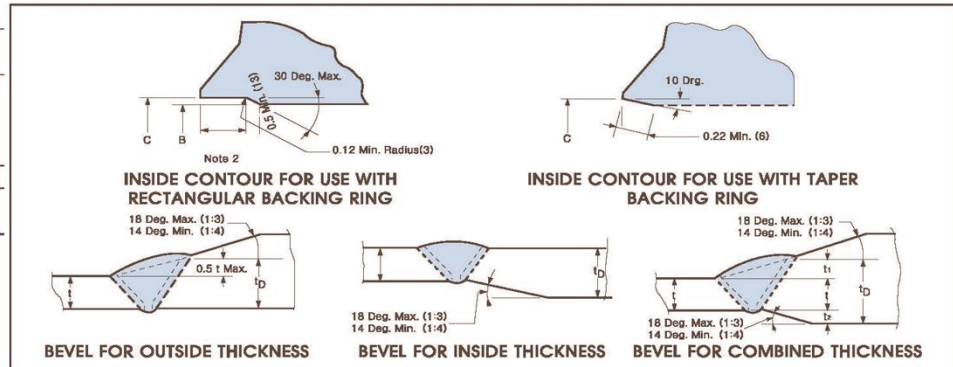
Material Group	Materials (Spec. -Gr.)	Notes
2.1	A 182-F304, A 182-F304H A 240-304, A 351 CF8 A 351-CF3 A 240-304H	... ... (i) ...
2.2	A 182-F316, A 182-F316H, A 240-316 A 240-317, A 351-CF8M A 351-CF3M A 240-316H	... ... (c) ...
2.3	A 182-F304L, A 240-304L A 182-F316L, A 240-316L	(i) (c)
2.4	A 182-F321, A 240-321 A 182-F321H, A 240-321H	(b) ...
2.5	A 182-F347, A 240-347 A 182-F347H, A240-347H A 182-F348, A 240-348 A 182-F348H, A240-F348H	(b) ... (b) ...
2.6	A 240-309S, A 351-CH8, A 351-CH20	...
2.7	A182-F310, A 240-310S A 351-CK20	(j) ...

Notes:

When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be employed or, alternatively, the greater outside diameter may be tapered, at the same maximum slope or less, from a point on the welding bevel equal to the OD at the mating pipe. Similarly, when the greater thickness is provided on the inside of the flange, it shall be taper-bored from the welding end at a slope not exceeding 1 to 3.

When flanges covered by this standard are intended for services with light wall, higher strength pipe, the thickness of the hub at the bevel may be greater than that of the pipe to which the flange is joined. Under these conditions a single taper hub may be provided and the outside diameter of the hub at the base (Dimension X) may also be modified.

The additional thickness may be provided on either inside or outside or partially on each side, but the total additional thickness shall not exceed one-half times the nominal wall thickness of intended mating pipe.



Notes:

- When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope
- Neither t_1 , t_2 , nor their sum (t_1+t_2) shall exceed $0.5t$.
- When the minimum specified yield strength of the sections to be joined are unequal, the value of t_3 shall at least equal t times the ratio of minimum specified yield strength of the pipe to minimum specified yield strength of the flange.