



BAB V

KESIMPULAN DAN REKOMENDASI

5.1 Kesimpulan

Dari hasil analisis yang telah diuraikan atau dijelaskan pada bab iv, maka dengan ini penulis dapat menarik kesimpulan diantaranya:

- 1) Kegagalan pipa *steam* 17 bar yang terjadi yaitu berupa putus dalam arah longitudinal.
- 2) Dari hasil pengamatan fraktografi bahwa kerusakan yang terjadi pada pipa diakibatkan oleh patah *fatigue* di area lasan. Jika dilihat dari segi permukaan patahannya, kegagalan di area lasan pipa tersebut termasuk dalam kategori patah getas.
- 3) Pada kondisi operasi normal pipa *steam* 17 bar dalam menerima beban statik tidak cukup untuk membuat pipa putus. Karena tegangan kerjanya lebih rendah dibandingkan dengan kekuatan tarik sambungan las pipa tersebut. Dimana tegangan longitudinal maksimum yang bekerja adalah 11,8 MPa, sedangkan kekuatan tarik sambungan las tersebut adalah 219,30 MPa.
- 4) Tegangan longitudinal yang didapatkan dari hasil pemodelan dinamik yaitu 301,8 MPa. Harga besaran ini lebih tinggi dibandingkan dengan kekuatan tarik sambungan las pipa yang mengalami kegagalan. Artinya bahwa kegagalan pipa *steam* 17 bar tersebut diakibatkan oleh beban dinamik (fenomena *slug flow*).

5.2 Rekomendasi

Untuk menghindari terjadinya kegagalan yang serupa pada pipa *steam* 17 bar dikemudian hari, perlu dilakukan:








- 1) Perbaiki atau ganti *gate valve* 10 inci yang mengalami *passing steam*.
- 2) Perbaiki atau ganti *safety valve* yang rusak.
- 3) Perbaiki atau ganti *steam trap* yang rusak.
- 4) Melakukan pemantauan getaran pipa baik secara kontinu atau dengan interval yang terjadwal.
- 5) Melakukan pemantauan kavasitas kondensat yang ada didalam pipa *steam* secara berkala.

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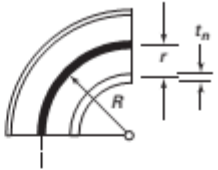
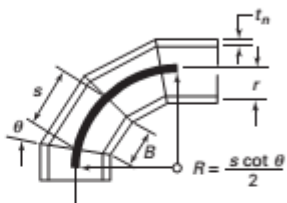
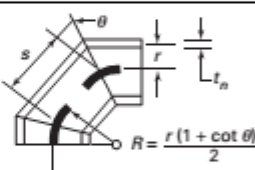
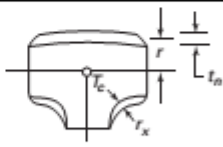
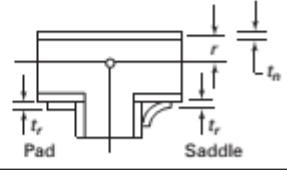
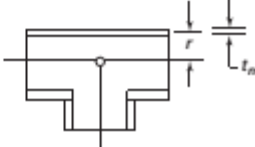
Tabel 1 *Longitudinal weld joint efficiency factor* (ASME B31.1)

No.	Type of joint	Type of Seam	Examination	Factor <i>E</i>
1	Furnace butt weld, continuous weld 	Straight	As required by listed specification	0.60 [Note (1)]
2	Electric resistance weld 	Straight or spiral	As required by listed specification	0.85 [Note (1)]
3	Electric fusion weld			
	(a) Single butt weld (without filler metal) 	Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.85 1.00 [Note (2)]
	(b) Single butt weld (with filler metal) 	Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.80 1.00 [Note (2)]
	(c) Double butt weld (without filler metal) 	Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
	(d) Double butt weld (with filler metal) 	Straight or spiral	As required by listed specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]
4	API 5L Submerged arc weld (SAW) Gas metal arc weld (GMAW) Combined GMAW, SAW 	Straight with one or two seams Spiral	As required by specification Additionally 100% volumetric examination (RT or UT)	0.90 1.00 [Note (2)]

NOTES:

- (1) It is not permitted to increase the longitudinal weld joint efficiency factor by additional examination for joint 1 or 2.
- (2) RT (radiographic examination) shall be in accordance with the requirements of para. 136.4.5 or the material specification, as applicable. UT (ultrasonic examination) shall be in accordance with the requirements of para. 136.4.6 or the material specification, as applicable.

Tabel 2 *Stress Intensification Factors* (ASME B31.1)

Description	Flexibility Characteristic, h	Flexibility Factor, k	Stress Intensification Factor, i	Sketch
Welding elbow or pipe bend [Notes (1), (2), (3), (4), (5)]	$\frac{t_n R}{r^2}$	$\frac{1.65}{h}$	$\frac{0.9}{h^{2/3}}$	
Closely spaced miter bend [Notes (1), (2), (3), (5)] $s < r(1 + \tan \theta)$ $B \geq 6 t_n$ $\theta \leq 22\frac{1}{2}$ deg	$\frac{s t_n \cot \theta}{2r^2}$	$\frac{1.52}{h^{3/6}}$	$\frac{0.9}{h^{2/3}}$	
Widely spaced miter bend [Notes (1), (2), (5), (6)] $s \geq r(1 + \tan \theta)$ $\theta \leq 22\frac{1}{2}$ deg	$\frac{t_n (1 + \cot \theta)}{2r}$	$\frac{1.52}{h^{3/6}}$	$\frac{0.9}{h^{2/3}}$	
Welding tee per ASME B16.9 [Notes (1), (2), (7)]	$\frac{3.1 t_n}{r}$	1	$\frac{0.9}{h^{2/3}}$	
Reinforced fabricated tee [Notes (1), (2), (8), (9)]	$\frac{(t_n + \frac{t_r}{2})^{3/2}}{r (t_n)^{3/2}}$	1	$\frac{0.9}{h^{2/3}}$	
Unreinforced fabricated tee [Notes (1), (2), (9)]	$\frac{t_n}{r}$	1	$\frac{0.9}{h^{2/3}}$	

Tebel 3 Allowable Stresses in Tension for Metals (ASME B31.1)

Material	Spec. No.	P-No. or S-No. (5)	Grade	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Min. Temp.		
						Tensile	Yield	to 100	200	300
Carbon Steel										
Pipes and Tubes (2)										
A 285 Gr. A	A 134	1	...	(8b)(57)	| B	45	24	15.0	14.6	14.2
A 285 Gr. A	A 672	1	A45	(57)(59)(67)	| B	45	24	15.0	14.6	14.2
Butt weld Smls & ERW	API 5L	S-1	A25	(8a)	|| -20	45	25	15.0	15.0	14.5
	API 5L	S-1	A25	(57)(59)	| B	45	25	15.0	15.0	14.5
...	A 179	1	...	(57)(59)	-20	47	26	15.7	15.0	14.2
Type F	A 53	1	A	(8a)(77)	|| 20	48	30	16.0	16.0	16.0
...	A 139	S-1	A	(8b)(77)	| A	48	30	16.0	16.0	16.0
...	A 587	1	...	(57)(59)	-20	48	30	16.0	16.0	16.0
...	A 53	1	A	(57)(59)	} B	48	30	16.0	16.0	16.0
...	A 106	1	A	(57)						
...	A 135	1	A	(57)(59)						
...	A 369	1	FPA	(57)						
...	API 5L	S-1	A	(57)(59)(77)						
A 285 Gr. B	A 134	1	...	(8b)(57)	| B	50	27	16.7	16.4	16.0
A 285 Gr. B	A 672	1	A50	(57)(59)(67)	| B	50	27	16.7	16.4	16.0
A 285 Gr. C	A 134	1	...	(8b)(57)	| A	55	30	18.3	18.3	17.7
...	A 524	1	II	(57)	-20	55	30	18.3	18.3	17.7
...	A 333	1	1	} (57)(59)	-50	55	30	18.3	18.3	17.7
...	A 334	1	1							
A 285 Gr. C	A 671	1	CA55	(59)(67)	A	} 55	30	18.3	18.3	17.7
A 285 Gr. C	A 672	1	A55	(57)(59)(67)	A					
A 516 Gr. 55	A 672	1	C55	(57)(67)	C					
A 516 Gr. 60	A 671	1	CC60	(57)(67)	C	60	32	20.0	19.5	18.9
A 515 Gr. 60	A 671	1	CB60	} (57)(67)	B	60	32	20.0	19.5	18.9
A 515 Gr. 60	A 672	1	B60							
A 516 Gr. 60	A 672	1	C60								C
...	A 139	S-1	B	(8b)	| A	60	35	20.0	20.0	20.0
...	A 135	1	B	(57)(59)	B	} 60	35	20.0	20.0	20.0
...	A 524	1	I	(57)	-20					
...	A 53	1	B	(57)(59)	} B	60	35	20.0	20.0	20.0
...	A 106	1	B	(57)						
...	A 333	} 1	6	(57)	} -50	60	35	20.0	20.0	20.0
...	A 334			(57)						
...	A 369			1							FPB	(57)	-20
...	A 381	S-1	Y35	...	A	} 60	35	20.0	20.0	20.0
...	API 5L	S-1	B	(57)(59)(77)	B					

Tebel 4 Allowable Stresses in Tension for Metals (ASME B31.1)

Basic Allowable Stress S, ksi (1), at Metal Temperature, °F (7)														Grade	Spec. No.
400	500	600	650	700	750	800	850	900	950	1000	1050	1100			
														Carbon Steel Pipes and Tubes (2)	
13.7	13.0	11.8	11.6	11.5	10.3	9.0	7.8	6.5	...	...	...	...	...	A 134
13.7	13.0	11.8	11.6	11.5	10.3	9.0	7.8	6.5	4.5	2.5	1.6	1.0	A45	A 672	
13.8	...	...	...	...	...	...	...	...	...	...	...	...	A25	API 5L
13.8	...	...	...	...	...	...	...	...	...	...	...	...	A25	API 5L
13.5	12.8	12.1	11.8	11.5	10.6	9.2	7.9	6.5	4.5	2.5	1.6	1.0	...	A 179	
16.0	...	...	...	...	...	...	...	...	...	...	...	...	A	A 53
...	...	...	...	...	...	...	...	...	...	...	...	...	A	A 139
16.0	16.0	14.8	14.5	14.4	10.7	9.3	7.9	...	...	...	...	...	...	A 587
16.0	16.0	14.8	14.5	14.4	10.7	9.3	7.9	6.5	4.5	2.5	1.6	1.0	A A A FPA A	A 53 A 106 A 135 A 369 API 5L	
15.4	14.6	13.3	13.1	13.0	11.2	9.6	8.1	6.5	...	...	...	...	...	A 134
15.4	14.6	13.3	13.1	13.0	11.2	9.6	8.1	6.5	4.5	2.5	1.6	1.0	A 50	A 672	
17.2	16.2	14.8	14.5	14.4	12.0	10.2	8.3	6.5	...	...	...	...	...	A 134
17.2	16.2	14.8	14.5	14.4	12.0	10.2	8.3	6.5	4.5	2.5	...	...	II	A 524
17.2	16.2	14.8	14.5	14.4	12.0	10.2	8.3	6.5	4.5	2.5	1.6	1.0	I CA55 A55 C55	A 333 A 334 A 671 A 672 A 672	
17.2	16.2	14.8	14.5	14.4	12.1	10.2	8.4	6.5	4.5	2.5	1.6	1.0	...	A 671	
18.3	17.3	15.8	15.5	15.4	13.0	10.8	8.7	6.5	4.5	2.5	...	...	CC60 CB60	A 671 A 671
18.3	17.3	15.8	15.5	15.4	13.0	10.8	8.7	6.5	4.5	2.5	1.6	1.0	B60 C60	A 672 A 672	
...	...	...	...	...	...	...	...	...	...	...	...	...	B	A 139
20.0	18.9	17.3	17.0	16.5	13.0	10.8	8.7	6.5	4.5	2.5	...	...	B I	A 135 A 524
20.0	18.9	17.3	17.0	16.5	13.0	10.8	8.7	6.5	4.5	2.5	1.6	1.0	B B 6 6 FPB Y35 B	A 53 A 106 A 333 A 334 A 369 A 381 API 5L	

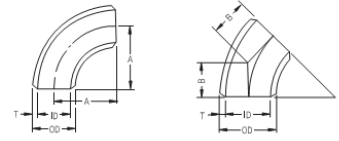
Tabel 5 Spesifikasi pipa (ASME B36.10)

NPS	U.S. Customary Units			Schedule No.	SI Units			
	OD, in.	Wall, in.	W_{pe} , lb/ft		DN	OD, mm	Wall, mm	W_{pe} , kg/m
8	8.625	0.109 (1)	9.92	5S	200	219.1	2.77 (1)	14.78
8	8.625	0.148 (1)	13.41	10S	200	219.1	3.76 (1)	19.97
8	8.625	0.322	28.58	40S	200	219.1	8.18	42.55
8	8.625	0.500	43.43	80S	200	219.1	12.70	64.64
10	10.750	0.134 (1)	15.21	5S	250	273.1	3.40 (1)	22.61
10	10.750	0.165 (1)	18.67	10S	250	273.1	4.19 (1)	27.79
10	10.750	0.365	40.52	40S	250	273.1	9.27	60.31
10	10.750	0.500 (2)	54.79	80S	250	273.1	12.70 (2)	81.56
12	12.750	0.156 (1)	21.00	5S	300	323.9	3.96 (1)	31.25
12	12.750	0.180 (1)	24.19	10S	300	323.9	4.57 (1)	35.99
12	12.750	0.375 (2)	49.61	40S	300	323.9	9.53 (2)	73.88
12	12.750	0.500 (2)	65.48	80S	300	323.9	12.70 (2)	97.47
14	14.000	0.156 (1)	23.09	5S	350	355.6	3.96 (1)	34.34
14	14.000	0.188 (1), (2)	27.76	10S	350	355.6	4.78 (1), (2)	41.36
14	14.000	0.375 (2)	54.62	40S	350	355.6	9.53 (2)	81.33
14	14.000	0.500 (2)	72.16	80S	350	355.6	12.70 (2)	107.40
16	16.000	0.165 (1)	27.93	5S	400	406.4	4.19 (1)	41.56
16	16.000	0.188 (1), (2)	31.78	10S	400	406.4	4.78 (1), (2)	47.34
16	16.000	0.375 (2)	62.64	40S	400	406.4	9.53 (2)	93.27
16	16.000	0.500 (2)	82.85	80S	400	406.4	12.70 (2)	123.31
18	18.000	0.165 (1)	31.46	5S	450	457	4.19 (1)	46.79
18	18.000	0.188 (1), (2)	35.80	10S	450	457	4.78 (1), (2)	53.31
18	18.000	0.375 (2)	70.65	40S	450	457	9.53 (2)	...
18	18.000	0.500 (2)	93.54	80S	450	457	12.70 (2)	...
20	20.000	0.188 (1)	39.82	5S	500	508	4.78 (1)	59.32
20	20.000	0.218 (1), (2)	46.10	10S	500	508	5.54 (1), (2)	68.65
20	20.000	0.375 (2)	78.67	40S	500	508	9.53 (2)	117.15
20	20.000	0.500 (2)	104.23	80S	500	508	12.70 (2)	155.13
22	22.000	0.188 (1)	43.84	5S	550	559	4.78 (1)	65.33
22	22.000	0.218 (1), (2)	50.76	10S	550	559	5.54 (1), (2)	75.62
22	22.000	...	...	40S	550	559	...	...
22	22.000	...	...	80S	550	559	...	...
24	24.000	0.218 (1)	55.42	5S	600	610	5.54 (1)	82.58
24	24.000	0.250 (1)	63.47	10S	600	610	6.35 (1)	94.53
24	24.000	0.375 (2)	94.71	40S	600	610	9.53 (2)	141.12
24	24.000	0.500 (2)	125.61	80S	600	610	12.70 (2)	187.07
30	30.000	0.250 (1)	79.51	5S	750	762	6.35 (1)	118.34
30	30.000	0.312 (1)	99.02	10S	750	762	7.92 (1)	147.29
30	30.000	...	...	40S	750	762	...	...
30	30.000	...	...	80S	750	762	...	...

Tabel 6 Spesifikasi Elbow

**90° Elbow (Long, Short)
45° Elbow (Long)**

STD, Sch40, X-S, Sch80, Sch160, XX-S



ASME B16.9

Nominal Pipe Size	Outside Diameter O.D	Center to End			STD		Sch40	
		Long		Short	T	I.D	T	I.D
		A	B	A				
1/2	0.840	1.50	0.62		0.109	0.622	0.109	0.622
3/4	1.050	1.50	0.75		0.113	0.824	0.113	0.824
1	1.315	1.50	0.88	1.00	0.133	1.049	0.133	1.049
1-1/4	1.660	1.88	1.00	1.25	0.140	1.380	0.140	1.380
1-1/2	1.900	2.25	1.12	1.50	0.145	1.610	0.145	1.610
2	2.375	3.00	1.38	2.00	0.154	2.067	0.154	2.067
2-1/2	2.875	3.75	1.75	2.50	0.203	2.469	0.203	2.469
3	3.500	4.25	2.00	3.00	0.216	3.068	0.216	3.068
3-1/2	4.000	5.25	2.25	3.50	0.226	3.548	0.226	3.548
4	4.500	6.00	2.50	4.00	0.237	4.026	0.237	4.026
5	5.563	7.50	3.12	5.00	0.258	5.047	0.258	5.047
6	6.625	9.00	3.75	6.00	0.280	6.065	0.280	6.065
8	8.625	12.00	5.00	8.00	0.322	7.981	0.322	7.981
10	10.750	15.00	6.25	10.00	0.365	10.020	0.365	10.020
12	12.750	18.00	7.50	12.00	0.375	12.000	0.406	11.938
14	14.000	21.00	8.75	14.00	0.375	13.250	0.438	13.124
16	16.000	24.00	10.00	16.00	0.375	15.250	0.500	15.000
18	18.000	27.00	11.25	18.00	0.375	17.250	0.562	16.876
20	20.000	30.00	12.50	20.00	0.375	19.250	0.594	18.812

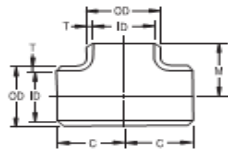
(Unit : inch)

X-S		Sch80		Sch160		XX-S		Nominal Pipe Size
T	I.D	T	I.D	T	I.D	T	I.D	
0.147	0.546	0.147	0.546	0.188	0.464	0.294	0.252	1/2
0.154	0.742	0.154	0.742	0.219	0.612	0.308	0.434	3/4
0.179	0.957	0.179	0.957	0.250	0.815	0.358	0.599	1
0.191	1.278	0.191	1.278	0.250	1.160	0.382	0.896	1-1/4
0.200	1.500	0.200	1.500	0.281	1.338	0.400	1.100	1-1/2
0.218	1.939	0.218	1.939	0.344	1.687	0.436	1.503	2
0.276	2.323	0.276	2.323	0.375	2.125	0.552	1.771	2-1/2
0.300	2.900	0.300	2.900	0.438	2.624	0.600	2.800	3
0.318	3.364	0.318	3.364					3-1/2
0.337	3.826	0.337	3.826	0.531	3.438	0.674	3.152	4
0.375	4.813	0.375	4.813	0.625	4.313	0.750	4.063	5
0.432	5.761	0.432	5.761	0.719	5.187	0.864	4.897	6
0.500	7.625	0.500	7.625	0.906	6.813	0.875	6.875	8
0.500	9.750	0.500	9.750	1.125	8.500	1.000	8.750	10
0.500	11.750	0.688	11.374	1.312	10.126	1.000	10.750	12
0.500	13.000	0.750	12.500	1.406	11.188			14
0.500	15.000	0.844	14.312	1.594	12.812			16
0.500	17.000	0.938	16.124	1.781	14.438			18
0.500	19.000	1.031	17.938	1.969	16.062			20

Tabel 7 Spesifikasi sambungan T (Straight and Reducing)

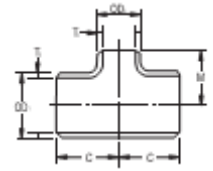
Tee (Straight)

STD, Sch40, X-S, Sch80, Sch160, XX-S



Tee (Reducing)

Sch5s, Sch10s, Sch40s, Sch80s



ASME B16.9 (Unit : mm)

Nominal Pipe Size	Outside Diameter O.D	Center to End		STD		Sch40	
		Run C	Outlet M	T	I.D	T	I.D
		1/2	0.840	1.00	1.00	0.109	0.622
3/4	1.050	1.12	1.12	0.113	0.824	0.113	0.824
1	1.315	1.50	1.50	0.133	1.049	0.133	1.049
1-1/4	1.660	1.88	1.88	0.140	1.380	0.140	1.380
1-1/2	1.900	2.25	2.25	0.145	1.610	0.145	1.610
2	2.375	2.50	2.50	0.154	2.067	0.154	2.067
2-1/2	2.875	3.00	3.00	0.203	2.469	0.203	2.469
3	3.500	3.38	3.38	0.216	3.068	0.216	3.068
3-1/2	4.000	3.75	3.75	0.226	3.548	0.226	3.548
4	4.500	4.12	4.12	0.237	4.026	0.237	4.026
5	5.563	4.88	4.88	0.258	5.047	0.258	5.047
6	6.625	5.62	5.62	0.280	6.065	0.280	6.065
8	8.625	7.00	7.00	0.322	7.981	0.322	7.981
10	10.750	8.50	8.50	0.365	10.020	0.365	10.020
12	12.750	10.00	10.00	0.375	12.000	0.406	11.938
14	14.000	11.00	11.00	0.375	13.250	0.438	13.124
16	16.000	12.00	12.00	0.375	15.250	0.500	15.000
18	18.000	13.50	13.50	0.375	17.250	0.562	16.876
20	20.000	15.00	15.00	0.375	19.250	0.594	18.812
22	22.000	16.50	16.50	0.375	21.250		
24	24.000	17.00	17.00	0.375	23.250	0.688	22.624

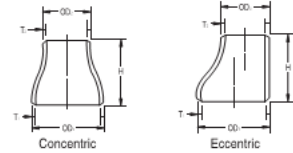
ASME B16.9, MSS SP-43

Nominal Pipe Size	Outside Diameter		Center to End		40S	
	OD1	OD2	Run C	Outlet M	T1	T2
5 X 5 X 4	141.3	114.3	124	105	6.55	6.02
5 X 5 X 3-1/2	141.3	101.6	124	95	6.55	5.74
5 X 5 X 3	141.3	88.9	124	86	6.55	5.49
5 X 5 X 2-1/2	141.3	73.0	124	76	6.55	5.16
6 X 6 X 5	168.3	141.3	143	124	7.11	6.55
6 X 6 X 4	168.3	114.3	143	105	7.11	6.02
6 X 6 X 3-1/2	168.3	101.6	143	95	7.11	5.74
6 X 6 X 3	168.3	88.9	143	86	7.11	5.49
8 X 8 X 6	219.1	168.3	178	143	8.18	7.11
8 X 8 X 5	219.1	141.3	178	124	8.18	6.55
8 X 8 X 4	219.1	114.3	178	105	8.18	6.02
10 X 10 X 8	273.0	219.1	216	178	9.27	8.18
10 X 10 X 6	273.0	168.3	216	143	9.27	7.11
10 X 10 X 5	273.0	141.3	216	124	9.27	6.55
12 X 12 X 10	323.8	273.0	254	216	9.53	9.27
12 X 12 X 8	323.8	219.1	254	178	9.53	8.18
12 X 12 X 6	323.8	168.3	254	143	9.53	7.11
14 X 14 X 12	355.6	323.8	279	254	9.53	9.53
14 X 14 X 10	355.6	273.0	279	216	9.53	9.27
14 X 14 X 8	355.6	219.1	279	178	9.53	8.18
16 X 16 X 14	406.4	355.6	305	279	9.53	9.53
16 X 16 X 12	406.4	323.8	305	254	9.53	9.53
16 X 16 X 10	406.4	273.0	305	216	9.53	9.27
18 X 18 X 16	457.0	406.4	343	305	9.53	9.53
18 X 18 X 14	457.0	355.6	343	279	9.53	9.53

Tabel 8 Spesifikasi *reducer*

Reducer

STD, Sch40, X-S, Sch80, Sch160, XX-S



ASME B16.9

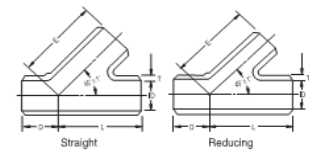
Nominal Pipe Size	Outside Diameter		End to End H	STD		Sch40	
	OD1	OD2		T1	T2	T1	T2
4 X 3	4.500	3.500	4.00	0.237	0.216	0.237	0.216
4 X 2-1/2	4.500	2.880	4.00	0.237	0.203	0.237	0.203
4 X 2	4.500	2.380	4.00	0.237	0.154	0.237	0.154
5 X 4	5.560	4.500	5.00	0.258	0.237	0.258	0.237
5 X 3-1/2	5.560	4.000	5.00	0.258	0.226	0.258	0.226
5 X 3	5.560	3.500	5.00	0.258	0.216	0.258	0.216
5 X 2-1/2	5.560	2.875	5.00	0.258	0.203	0.258	0.203
6 X 5	6.620	5.560	5.50	0.280	0.258	0.280	0.258
6 X 4	6.620	4.500	5.50	0.280	0.237	0.280	0.237
6 X 3-1/2	6.620	4.000	5.50	0.280	0.226	0.280	0.226
6 X 3	6.620	3.500	5.50	0.280	0.216	0.280	0.216
6 X 2-1/2	6.620	2.880	5.50	0.280	0.203	0.280	0.203
8 X 6	8.620	6.620	6.00	0.322	0.280	0.322	0.280
8 X 5	8.620	5.560	6.00	0.322	0.258	0.322	0.258
8 X 4	8.620	4.500	6.00	0.322	0.237	0.322	0.237
8 X 3-1/2	8.620	4.000	6.00	0.322	0.226	0.322	0.226
10 X 8	10.750	8.620	7.00	0.365	0.322	0.365	0.322
10 X 6	10.750	6.620	7.00	0.365	0.280	0.365	0.280
10 X 5	10.750	5.560	7.00	0.365	0.258	0.365	0.258
10 X 4	10.750	4.500	7.00	0.365	0.237	0.365	0.237
12 X 10	12.750	10.750	8.00	0.375	0.365	0.406	0.365
12 X 8	12.750	8.620	8.00	0.375	0.322	0.406	0.322
12 X 6	12.750	6.620	8.00	0.375	0.280	0.406	0.280
12 X 5	12.750	5.560	8.00	0.375	0.258	0.406	0.258
14 X 12	14.000	12.750	13.00	0.375	0.375	0.438	0.375
14 X 10	14.000	10.750	13.00	0.375	0.365	0.438	0.365

								(Unit : inch)	
X-S		Sch80		Sch160		XX-S		Nominal Pipe Size	
T1	T2	T1	T2	T1	T2	T1	T2		
0.337	0.300	0.337	0.300	0.531	0.438	0.674	0.600	4 X 3	
0.337	0.276	0.337	0.276	0.531	0.375	0.674	0.552	4 X 2-1/2	
0.337	0.218	0.337	0.218	0.531	0.344	0.674	0.436	4 X 2	
0.375	0.337	0.375	0.337	0.625	0.531	0.750	0.674	5 X 4	
0.375	0.318	0.375	0.318	0.625	0.531	0.750	0.600	5 X 3-1/2	
0.375	0.300	0.375	0.300	0.625	0.438	0.750	0.600	5 X 3	
0.375	0.276	0.375	0.276	0.625	0.375	0.750	0.552	5 X 2-1/2	
0.432	0.375	0.432	0.375	0.719	0.625	0.864	0.750	6 X 5	
0.432	0.337	0.432	0.337	0.719	0.531	0.864	0.674	6 X 4	
0.432	0.318	0.432	0.318	0.719	0.531	0.864	0.674	6 X 3-1/2	
0.432	0.300	0.432	0.300	0.719	0.438	0.864	0.600	6 X 3	
0.432	0.276	0.432	0.276	0.719	0.375	0.864	0.552	6 X 2-1/2	
0.500	0.432	0.500	0.432	0.906	0.719	0.875	0.864	8 X 6	
0.500	0.375	0.500	0.375	0.906	0.625	0.875	0.750	8 X 5	
0.500	0.337	0.500	0.337	0.906	0.531	0.875	0.674	8 X 4	
0.500	0.318	0.500	0.318	0.906	0.531	0.875	0.674	8 X 3-1/2	
0.500	0.500	0.594	0.500	1.125	0.906	1.000	0.875	10 X 8	
0.500	0.432	0.594	0.432	1.125	0.719	1.000	0.864	10 X 6	
0.500	0.375	0.594	0.375	1.125	0.625	1.000	0.750	10 X 5	
0.500	0.337	0.594	0.337	1.125	0.531	1.000	0.674	10 X 4	
0.500	0.500	0.688	0.594	1.312	1.125	1.000	1.000	12 X 10	
0.500	0.500	0.688	0.500	1.312	0.906	1.000	0.875	12 X 8	
0.500	0.432	0.688	0.432	1.312	0.719	1.000	0.864	12 X 6	
0.500	0.375	0.688	0.375	1.312	0.625	1.000	0.750	12 X 5	
0.500	0.500	0.750	0.688	1.406	1.312	1.000	1.000	14 X 12	
0.500	0.500	0.750	0.594	1.406	1.125	1.000	1.000	14 X 10	

Tabel 9 Spesifikasi *fitting Y lateral*

Lateral - A

STD, XS (Type A)



MAKER STD

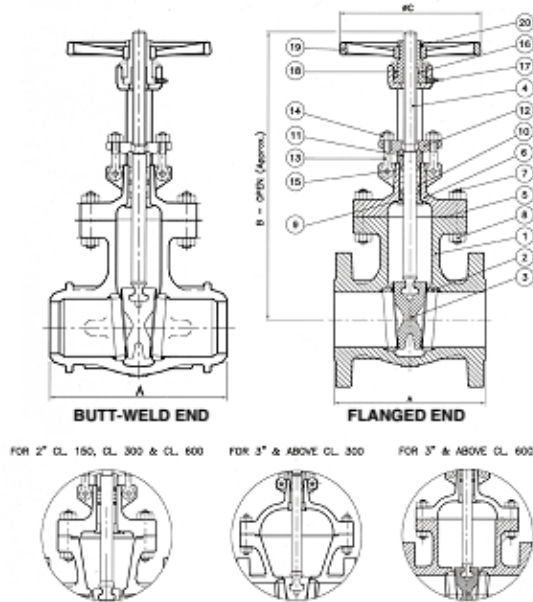
Nominal Pipe Size of Run	Center to End Dimension	
	L & E	D
1	3.50	1.75
1-1/4	4.25	2.00
1-1/2	5.00	2.50
2	6.00	3.25
2-1/2	7.00	3.50
3	7.75	3.75
3-1/2	8.38	4.00
4	8.50	4.50
5	11.00	4.75
6	12.50	5.25
8	15.25	6.25
10	18.00	7.00
12	21.50	8.00
14	25.00	10.00
16	28.50	12.00
18	32.00	13.00
20	35.00	14.00
24	41.25	16.25

STD		X-S	
T	I.D	T	I.D
0.133	1.049	0.179	0.957
0.140	1.380	0.191	1.278
0.145	1.610	0.200	1.500
0.154	2.067	0.218	1.939
0.203	2.469	0.276	2.323
0.216	3.068	0.300	2.900
0.226	3.548	0.318	3.364
0.237	4.026	0.337	3.826
0.258	5.047	0.375	4.813
0.280	6.065	0.432	5.761
0.322	7.981	0.500	7.625
0.365	10.020	0.500	9.750
0.375	12.000	0.500	11.750
0.375	13.250	0.500	13.000
0.375	15.250	0.500	15.000
0.375	17.250	0.500	17.000
0.375	19.250	0.500	19.000
0.375	23.250	0.500	23.000

Pressure-temperature ratings : Laterals are rated for either 40% of the maximum allowable working pressure for the size and weight schedule of the mating pipe, or 100% of the maximum allowable working pressure for the size and weight schedule of the mating pipe in the latter case. ASME B31.3 is used to calculate reinforcement requirements unless otherwise specified.
 Wall Thickness Conform to ASME B 36.10M Specifications

Tabel 10 Spesifikasi gate valve

Gate Valves - ASME Classes 150, 300 & 600 Figure Numbers 113-8, 133-8 & 163-8



Standard Materials of Construction

Sl. No.	Description	Material
01	Body	ASTM A216 Gr. WCB
02	Body Seat Ring	ASTM A105 + HF*
03	Wedge	ASTM A216 Gr. WCB + 13% Cr. Steel
04	Stem	ASTM A182 Gr. F6a
	Gasket - CL.150	ASTM A308
05	Gasket - CL.300 & 600	Spirally-wound SS 304 with graphite filler
06	Bonnet	ASTM A216 Gr. WCB
07	Stud	ASTM A193 Gr. B7
08	Stud Nut	ASTM A194 Gr. 2H
09	Back-seat Bush	13% Cr. Steel
10	Packing	Graphite with braided end rings
11	Gland	Steel
12	Gland Flange	ASTM A105 / ASTM A216 Gr. WCB
13	Eye Bolt	Cr. - Mo Steel
14	Eye Bolt Nut	ASTM A194 Gr. 2H
15	Groove Pin	Steel
16	Yoke Sleeve (Stem Nut)	ASTM A439 Type D2
17	Grease Fitting	Steel
18	Retainer Nut	Steel / Ductile Iron / Malleable Iron
19	Handwheel	Steel / Ductile Iron / Malleable Iron
20	Handwheel Nut	SS 304
	Nameplate	SS 304

* HF - Hard-Faced with Stellite #6 or equivalent
For other body / bonnet materials, refer page 5

Dimensions (in mm, unless specified) & Weights (in kg)

Valve Size	Class 150						Class 300						Class 600					
	A		B	C	Approx. Wt.		A		B	C	Approx. Wt.		A		B	C	Approx. Wt.	
	FL	B/W			FL	B/W	FL	B/W			FL	B/W						
50 (2")	178	216	376	203	21	19	216	216	399	203	25	23	292	292	399	203	42	36
65 (2 1/2")	191	241	480	229	32	27	241	241	505	229	48	34	-	-	-	-	-	-
80 (3")	203	283	480	229	35	27	283	283	505	229	53	41	356	356	541	254	67	63
100 (4")	229	305	584	254	53	43	305	305	604	254	78	55	432	432	635	305	119	112
125 (5")	254	381	750	254	75	64	381	381	850	356	135	105	-	-	-	-	-	-
150 (6")	267	403	790	305	87	77	403	403	850	356	158	111	559	559	874	457	252	225
200 (8")	292	419	996	356	139	118	419	419	1039	406	234	186	660	660	1044	457	418	365
250 (10")	330	457	1205	406	210	198	457	457	1265	457	355	284	787	787	1285	508	652	554
300 (12")	356	502	1410	457	302	271	502	502	1460	508	495	400	838	838	1476	610	1100	984
350 (14")	381	572	1539	508	410	365	572	572	1590	508	750	620	889	889	1565	610	1600	1465
400 (16")	406	610	1752	508	520	490	610	610	1791	610	958	850	991	991	2062	762	1955	1760
450 (18")	432	660	1956	610	690	665	660	660	2126	686	1310	1075	1092	1092	2062	762	2075	1840
500 (20")	457	711	2159	610	900	865	711	711	2261	686	1640	1525	1194	1194	3048	762	2150	1960
600 (24")	508	813	2565	686	1410	1375	813	813	2654	762	2460	2075	1397	1397	3150	762	3620	3180
700 (28")	610	991	3160	762	2060	1750	-	-	-	-	-	-	-	-	-	-	-	-
750 (30")	610	914	3429	762	3100	2850	1397	1397	4267	1016	4750	-	-	-	-	-	-	-
850 (34")	711	-	3650	762	3350	2950	-	-	-	-	-	-	-	-	-	-	-	-
900 (36")	711	-	3734	762	3980	3000	1727	-	3975	-	-	-	-	-	-	-	-	-
1050 (42")	813	1118	4200	-	-	4500	-	-	-	-	-	-	2438	-	4420	-	-	-
1200 (48")	864	1118	4990	-	-	6000	-	-	-	-	-	-	-	-	-	-	-	-
1500 (60")	1143	-	6175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

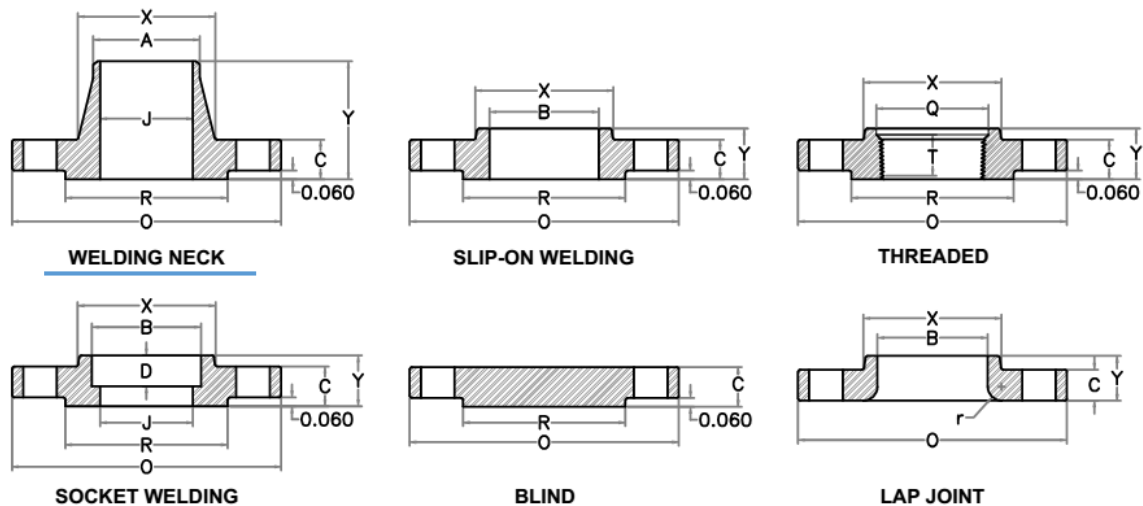
FL - Flanged ; B/W - Butt-weld. * Depends on flange dimensions. Intermediate sizes 22", 26", 32", 38", 40", 44", 46" in Class 150 are also offered.
Class 600 gate valves can also be given in pressure seal bonnet design, in sizes from 80mm (3") up to 300mm (12"). For details of pressure seal bonnet arrangement, see page 18.

Tabel 11 *Thermal expansion for materials*

		$A = \text{Mean Coefficient of Thermal Expansion, } 10^{-6} \text{ mm/mm/}^{\circ}\text{C}$ $B = \text{Linear Thermal Expansion, mm/m}$														} in Going From 20°C to Indicated Temperature [Note (1)]	
Material	Coef- ficient	Temperature Range 20°C to															
		-200	-100	-50	20	50	75	100	125	150	175	200	225	250	275		
Group 1 carbon and low alloy steels [Note (2)]	A	9.9	10.7	11.1	11.5	11.8	11.9	12.1	12.3	12.4	12.6	12.7	12.9	13.0	13.2		
	B	-2.2	-1.3	-0.8	0	0.4	0.7	1.0	1.3	1.6	2.0	2.3	2.6	3.0	3.4		
Group 2 low alloy steels [Note (3)]	A	10.8	11.7	12.0	12.6	12.8	13.0	13.1	13.2	13.4	13.5	13.6	13.7	13.8	13.9		
	B	-2.4	-1.4	-0.8	0	0.4	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.2	3.6		
5Cr-1Mo steels	A	10.1	10.8	11.2	11.5	11.8	12.0	12.1	12.3	12.4	12.5	12.6	12.6	12.7	12.8		
	B	-2.2	-1.3	-0.8	0	0.4	0.7	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.3		
9Cr-1Mo steels	A	9.0	9.8	10.1	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6		
	B	-2.0	-1.2	-0.7	0	0.3	0.6	0.9	1.2	1.4	1.7	2.0	2.3	2.6	3.0		
Straight chromium stainless steels																	
12Cr to 13Cr steels	A	9.1	9.9	10.2	10.6	10.9	11.0	11.1	11.3	11.4	11.4	11.5	11.6	11.6	11.7		
	B	-2.0	-1.2	-0.7	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0		
15Cr to 17Cr steels	A	8.1	8.8	9.1	9.6	9.7	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7		
	B	-1.8	-1.1	-0.6	0	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.2	2.4	2.7		
27Cr steels	A	7.7	8.5	8.7	9.0	9.2	9.2	9.3	9.4	9.4	9.5	9.5	9.6	9.6	9.7		
	B	-1.7	-1.0	-0.6	0	0.3	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5		
Austenitic stainless steels (304, 305, 316, 317, 321, 347, 348 19-9DL XM-15, etc.)	A	13.5	14.3	14.7	15.3	15.6	15.9	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.5		
	B	-3.0	-1.7	-1.0	0	0.5	0.9	1.3	1.7	2.2	2.6	3.1	3.5	4.0	4.5		
Other austenitic stainless steels (309, 310, 315, XM-19, etc.)	A	12.8	13.6	14.1	14.7	15.0	15.2	15.4	15.6	15.7	15.9	16.0	16.1	16.3	16.4		
	B	-2.8	-1.6	-1.0	0	0.4	0.8	1.2	1.6	2.0	2.5	2.9	3.3	3.7	4.2		
Gray cast iron	A	...	...	...	9.8	10.1	10.2	10.4	10.5	10.7	10.8	11.0	11.1	11.2	11.4
	B	...	...	...	0	0.3	0.6	0.8	1.1	1.4	1.7	2.0	2.3	2.6	2.9
Ductile cast iron	A	...	8.8	9.5	10.3	10.5	10.7	10.9	11.1	11.3	11.6	11.8	12.0	12.2	12.4		
	B	...	-1.1	-0.7	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.5	2.8	3.1		

		$A = \text{Mean Coefficient of Thermal Expansion, } 10^{-6} \text{ mm/mm/}^{\circ}\text{C}$ $B = \text{Linear Thermal Expansion, mm/m}$																		} in Going From 20°C to Indicated Temperature [Note (1)]		
		Temperature Range 20°C to																				
		300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800
	A	13.3	13.4	13.6	13.7	13.8	14.0	14.1	14.2	14.4	14.5	14.6	14.7	14.8	14.9	15.0	15.1	15.1	15.2	15.3	15.3	15.4
	B	3.7	4.1	4.5	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.2	8.6	9.0	9.4	9.9	10.3	10.7	11.1	11.6	12.0
	A	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.6	14.7	14.8	14.8	14.9	15.0	15.0	15.1	15.1	15.2	15.2	15.3	15.3	15.3
	B	3.9	4.3	4.7	5.1	5.5	5.9	6.3	6.7	7.1	7.5	7.9	8.3	8.7	9.1	9.5	9.9	10.3	10.7	11.1	11.1	11.5
	A	12.8	12.9	13.0	13.0	13.1	13.2	13.2	13.3	13.4	13.4	13.5	13.6	13.6	13.7	13.7	13.8	13.9	13.9	14.0	14.0	14.1
	B	3.6	3.9	4.3	4.6	5.0	5.3	5.7	6.1	6.4	6.8	7.2	7.5	7.9	8.3	8.7	9.0	9.4	9.8	10.2	10.6	11.0
	A	11.7	11.8	11.9	11.9	12.0	12.1	12.2	12.3	12.3	12.4	12.5	12.6	12.7	12.7	12.8	12.9	13.0	13.1	13.3	13.4	13.6
	B	3.3	3.6	3.9	4.2	4.6	4.9	5.2	5.6	5.9	6.3	6.6	7.0	7.3	7.7	8.1	8.5	8.9	9.3	9.7	10.1	10.6
	A	11.7	11.8	11.8	11.9	11.9	12.0	12.0	12.1	12.1	12.2	12.2	12.3	12.3	12.4	12.5	12.5	12.5	12.5	12.5	12.6	12.6
	B	3.3	3.6	3.9	4.2	4.5	4.9	5.2	5.5	5.8	6.2	6.5	6.8	7.2	7.5	7.8	8.2	8.5	8.8	9.2	9.5	9.8
	A	10.8	10.8	10.9	11.0	11.0	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.5	11.5	11.5	11.6	11.6	11.7	11.7	11.8	11.9
	B	3.0	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.0	6.3	6.6	7.0	7.3	7.6	7.9	8.2	8.6	8.9	9.3
	A	9.7	9.8	9.9	9.9	10.0	10.0	10.1	10.2	10.2	10.3	10.4	10.4	10.5	10.5	10.6	10.6	10.7	10.7	10.8	10.8	10.9
	B	2.7	3.0	3.3	3.5	3.8	4.1	4.3	4.6	4.9	5.2	5.5	5.8	6.1	6.4	6.7	7.0	7.2	7.6	7.9	8.2	8.5
	A	17.7	17.8	17.9	18.0	18.1	18.2	18.3	18.4	18.4	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3	19.4	19.4	19.4
	B	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.3	8.9	9.4	9.9	10.4	10.9	11.4	12.0	12.5	13.1	13.6	14.1	14.7	15.2
	A	16.5	16.6	16.6	16.7	16.8	16.9	17.0	17.1	17.2	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	18.0	18.1	18.2	18.3
	B	4.6	5.0	5.5	5.9	6.4	6.8	7.3	7.8	8.2	8.7	9.2	9.7	10.2	10.6	11.1	11.7	12.2	12.7	13.2	13.7	14.3
	A	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	13.0	...	...	...	...	...	...	...	...	...	...
	B	3.2	3.6	3.9	4.2	4.6	5.0	5.3	5.7	6.1	6.5	6.9	...	...	...	...	...	...	...	...	...	...

Tabel 12 ASME B16.5 Class 300 flange dimensions



ASME B16.5 CLASS 300 FLANGE DIMENSIONS

GENERAL NOTE: Dimensions are in inches.

1 Nominal Pipe Size	2 Outside Diameter of Flange O	3 Thickness of Flange Min. C	4 Diameter of Raised Face R	5 Diameter of Hub at Base (Note 1.) X	6 Hub Diameter Beginning of Chamfer Welding Neck A	7-9 Length Through Hub			10 Thread Length Threaded Min. T	11-13 Bore			14 Corner Radius of Bore of Lapped Flange and Pipe r	15 Counter-bore Threaded Flange Min. Q	16 Depth of Socket D	17-18 Drilling	
						7 Threaded Slip-On Socket Welding Y	8 Lapped Y	9 Welding Neck Y		11 Slip-On Socket Welding Min. B	12 Lapped Min. B	13 Welding Neck Socket Welding J				17 Diameter of Bolt Circle	18 Number and Diameter of Bolt Holes
1/2	3.75	0.56	1.38	1.50	0.84	0.88	0.88	2.06	0.62	0.88	0.90		0.12	0.93	0.38	2.62	4-0.62
3/4	4.62	0.62	1.69	1.88	1.05	1.00	1.00	2.25	0.62	1.09	1.11	S	0.12	1.14	0.44	3.25	4-0.75
1	4.88	0.69	2.00	2.12	1.32	1.06	1.06	2.44	0.69	1.36	1.38	E	0.12	1.41	0.50	3.50	4-0.75
1-1/4	5.25	0.75	2.50	2.50	1.66	1.06	1.06	2.56	0.81	1.70	1.72	E	0.19	1.75	0.56	3.88	4-0.75
1-1/2	6.12	0.81	2.88	2.75	1.90	1.19	1.19	2.69	0.88	1.95	1.97		0.25	1.98	0.62	4.50	4-0.88
2	6.50	0.88	3.62	3.31	2.38	1.31	1.31	2.75	1.12	2.44	2.46	B	0.31	2.50	0.69	5.00	8-0.75
2-1/2	7.50	1.00	4.12	3.94	2.88	1.50	1.50	3.00	1.25	2.94	2.97	O	0.31	3.00	0.75	5.88	8-0.88
3	8.25	1.12	5.00	4.62	3.50	1.69	1.69	3.12	1.25	3.57	3.60	R	0.38	3.63	0.81	6.62	8-0.88
3-1/2	9.00	1.19	5.50	5.25	4.00	1.75	1.75	3.19	1.44	4.07	4.10	E	0.38	4.13	*0.88	7.25	8-0.88
4	10.00	1.25	6.19	5.75	4.50	1.88	1.88	3.38	1.44	4.57	4.60		0.44	4.63	*0.94	7.88	8-0.88
5	11.00	1.38	7.31	7.00	5.56	2.00	2.00	3.88	1.69	5.66	5.69	S	0.44	5.69	*0.94	9.25	8-0.88
6	12.50	1.44	8.50	8.12	6.63	2.06	2.06	3.88	1.81	6.72	6.75	C	0.50	6.75	*1.06	10.62	12-0.88
8	15.00	1.62	10.62	10.25	8.63	2.44	2.44	4.38	2.00	8.72	8.75	H	0.50	8.75	*1.25	13.00	12-1.00
10	17.50	1.88	12.75	12.62	10.75	2.62	3.75	4.62	2.19	10.88	10.92	E	0.50	10.88	*1.31	15.25	16-1.12
12	20.50	2.00	15.00	14.75	12.75	2.88	4.00	5.12	2.38	12.88	12.92	D	0.50	12.94	*1.56	17.75	16-1.25
14	23.00	2.12	16.25	16.75	14.00	3.00	4.38	5.62	2.50	14.14	14.18	U	0.50	14.19	*1.62	20.25	20-1.25
16	25.50	2.25	18.50	19.00	16.00	3.25	4.75	5.75	2.69	16.16	16.19	L	0.50	16.19	*1.75	22.50	20-1.38
18	28.00	2.38	21.00	21.00	18.00	3.50	5.12	6.25	2.75	18.18	18.20	E	0.50	18.19	*1.94	24.75	24-1.38
20	30.50	2.50	23.00	23.12	20.00	3.75	5.50	6.38	2.88	20.20	20.25	S	0.50	20.19	*2.12	27.00	24-1.38
24	36.00	2.75	27.25	27.62	24.00	4.19	6.00	6.62	3.25	24.25	24.25		0.50	24.19	*2.50	32.00	24-1.62

- Notes:
- This dimension is for the base end of the hub, which may be straight or tapered. Taper shall not exceed 7° on threaded, slip-on, socket-welding, and lapped flanges.
 - Lap Joints (10°+) made with Slip-On Welding length through hub are nonstandard.
 - Blind flanges may be made with or without hubs. Hubs are nonstandard.
 - The flange dimensions illustrated are for .06 in. raised face (except lapped); for requirements of other facings, see the table on facings.
 - For welding end and bevel, see the figure on welding end contours.
 - When these flanges are required with flat face, either the full thickness or thickness with raised face removed may be furnished. Removing the raised face may make the length through the hub nonstandard.
 - For thread of flange, see tables on threads.
 - Socket welding flanges larger than NPS 3 in. are marked with a (*), and are not B16 standard flanges.
 - The raised face shall have a finish from 125 μ in. to 250 μ in. roughness.