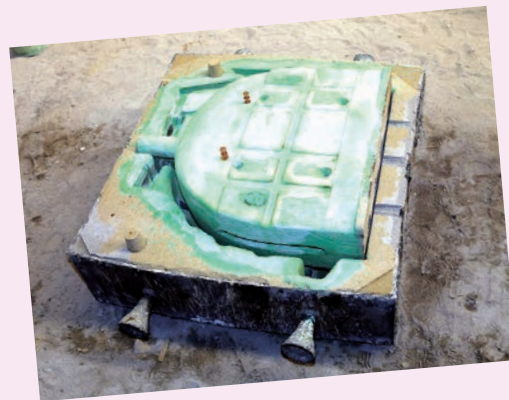


CONFORMANCE STANDARDS  
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# CONFORMANCE STANDARDS

## KJS VALVES CONFORM TO THE FOLLOWING STANDARDS AS APPLICABLE TO CUSTOMER REQUIREMENTS.

<b>API Spec 6D Latest Edition</b>	: API Specification for Pipeline Valves
<b>API Standard 598 Latest Edition</b>	: Valve Inspection and Test
<b>API Standard 600 Latest Edition</b>	: Steel Gate Valves, Flanged and Butt-welding Ends
<b>API Standard 603 Latest Edition</b>	: Class 150, Cast Corrosion-Resistant Flanged-End Gate Valves
<b>API Standard 605 Latest Edition</b>	: Large-Diameter Carbon Steel Flanges
<b>ASME B16.5 Latest Edition</b>	: Steel Pipe Flanges and Flanged Fittings
<b>ASME B16.10 Latest Edition</b>	: Face-to-Face and End-to-End Dimensions of Ferrous Valves
<b>ASME B16.25 Latest Edition</b>	: Butt-welding Ends
<b>ASME B16.34 Latest Edition</b>	: Valves-Flanged, Threaded, And Welding End
<b>MSS Standard Practice SP-6 Latest Edition</b>	: Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
<b>MSS Standard Practice SP-25 Latest Edition</b>	: Standard Marking System for Valves, Fittings, Flanges and Unions
<b>MSS Standard Practice SP-44 Latest Edition</b>	: Steel Pipe Line Flanges
<b>MSS Standard Practice SP-45 Latest Edition</b>	: By-Pass and Drain Connection Standard
<b>BS 1414 Latest Edition</b>	: Steel wedge gate valves (flange and butt-welding ends)
<b>BS 1868 Latest Edition</b>	: Steel check valves (flange and butt-welding ends)
<b>BS 1873 Latest Edition</b>	: Steel globe and globe stop and check valves (flange and butt-welding ends)
<b>BS 5352 Latest Edition</b>	: Steel wedge gate, globe and check valves (50mm & smaller)
<b>BS 6364 Latest Edition</b>	: Valve for cryogenic service
<b>JIS B2003 Latest Edition</b>	: General Rules for Inspection of Valves
<b>JIS B2201 Latest Edition</b>	: Pressure Ratings for Ferrous Material Pipe Flanges
<b>JIS B2203 Latest Edition</b>	: Tolerances for Pipe Flanges
<b>JIS B2210 Latest Edition</b>	: Basic Dimensions of Ferrous Material Pipe Flanges
<b>JIS B2071 Latest Edition</b>	: 10 kgf/cm <sup>2</sup> Cast Steel Flanged Glove Valves
<b>JIS B2073 Latest Edition</b>	: 10 kgf/cm <sup>2</sup> Cast Steel Flanged Gate Valves (Outside Screw Type)
<b>JIS B2074 Latest Edition</b>	: 10 kgf/cm <sup>2</sup> Cast Steel Flanged Swing Check Valves
<b>JIS B2081 Latest Edition</b>	: 20 kgf/cm <sup>2</sup> Cast Steel Flanged Glove Valves
<b>JIS B2083 Latest Edition</b>	: 20 kgf/cm <sup>2</sup> Cast Steel Flanged Gate Valves (Outside Screw Type)
<b>JIS B2084 Latest Edition</b>	: 20 kgf/cm <sup>2</sup> Cast Steel Flanged Swing Check Valves
<b>JPI-7S-15 Latest Edition</b>	: Steel Pipe Flanges for The Petroleum Industry
<b>JPI-7S-23 Latest Edition</b>	: Ring Joint Gaskets and Grooves for Petroleum Industry
<b>JPI-7S-24 Latest Edition</b>	: Standard Marking System for valves
<b>JPI-7S-39 Latest Edition</b>	: Valve Inspection and Test
<b>JPI-7S-46 Latest Edition</b>	: Cast Steel Flanged Valves for the Petroleum Industry (Class 150,300)
<b>JPI-7S-47 Latest Edition</b>	: Cast Steel Valves for the Petroleum Industry, Flanged or Butt-welding Ends (Class 600 to 2500)
<b>API</b>	: American Petroleum Institute
<b>ANSI</b>	: American National Standards Institute
<b>ASTM</b>	: American Society for Testing and Materials
<b>ASME</b>	: American Society of Mechanical Engineers
<b>ASS</b>	: Manufacturers Standardization society of the Valve and Fitting Industry
<b>BS</b>	: British Standards Institution
<b>JIS</b>	: Japanese Industrial Standards
<b>JPI</b>	: Japan Petroleum Institute
<b>NACE</b>	: National Association of corrosion Engineers
<b>AWS</b>	: American welding Society

# MATERIAL COMPARISONS FOR ASTM & JIS(CASTING & FORGING)

General Classification	"ASTM" Symbols		"JIS" Symbols		Service Temp	
	Castings	Forgings	Castings	Forgings		
HIGH - TEMPERATURE	Cast Iron	A126 - Class B		G5501 - FC20	205℃	
	Cast Iron	A126 - Class C		G5501 - FC25	250℃	
	Carbon Steel	A216 - WCA		G5151 - SCPH1	420℃	
	Carbon Steel	A216 - WCB	A105	G5151 - SCPH2	G3202 - SFVC 2A	425℃
	½ Mo Steel	A217 - WC1	A182 - F1	G5151 - SCPH11	G3203 - SFVA F1	455℃
	1¼ Cr - ½Mo	A217 - WC6	A182 - F11	G5151 - SCPH21	G3203 - SFVA F11A	593℃
	2¼ Cr - 1Mo	A217 - WC9	A182 - F22	G5151 - SCPH32	G3203 - SFCA F22A	593℃
	5Cr - ½Mo	A217 - C5	A182 - F5a	G5151 - SCPH61	G3203 - SFVA F5D	650℃
LOW - TEMPERATURE	9Cr - 1Mo	A217 - C12	A182 - F9		G3203 - SFVA F9	650℃
	Al Steel	A352 - LCB, LCC	A350 - LF2	G5121 - SCPL1	G3205 - SFL2	-46℃
	½ Mo Steel	A352 - LC1		G5121 - SCPL11		-59℃
	2½ Ni Steel	A352 - LC2		G5121 - SCPL21		-73℃
STAINLESS STEEL	3½ Ni Steel	A352 - LC3	A350 - LF3	G5121 - SCPL31	G3205 - SFL3	-101℃
	13Cr - ½Mo	A217 - CA15	A182 - F6a	G5121 - SCS1	G4303 - 410	550℃
	18Cr - 8Ni(CO.03)	A351 - CF3	A182 - F304L	G5121 - SCS19A	G3214 - SUS F304L	800℃
	18Cr - 8Ni(CO.08)	A351 - CF8	A182 - F304	G5121 - SCS13A	G3214 - SUS F304	800℃
	18Cr - 8Ni - 2Mo(CO.03)	A351 - CF3M	A182 - F316L	G5121 - SCS16A	G3214 - SUS F316L	800℃
	18Cr - 8Ni - 2Mo(CO.08)	A351 - CF8M	A182 - F316	G5121 - SCS14A	G3214 - SUS F316	800℃
	18Cr - 8Ni - Ti		A182 - F321		G3214 - SUS F321	800℃
	18Cr - 8Ni - Cb	A351 - CF8C	A182 - F347	G5121 - SCS21	G3214 - SUS F347	800℃
	22Cr - 12Ni	A351 - CH20		G5121 - SCS17		1200℃
	23Cr - 19Ni	A351 - CK20		G5121 - SCS18		1200℃
	19Cr - 27Ni - 2Mo - 3Cu	A351 - CN7M		G5121 - SCS23		1200℃

General Classification	"ASTM" Symbols	"JIS" Symbols	Service Temp
● HIGH - TEMPERATURE(BOLT)			
Mild Steel		G3101 - SS41	260℃
Carbon Steel	A307 - B	G4051 - S25C	204℃
5Cr - ½Mo	A193 - B5	G4107 - SNB5	600℃
1Cr - ??Mo	A193 - B7	G4107 - SNB7	550℃
Cr - Mo - Va	A193 - B16	G4107 - SNB16	600℃
18Cr - 8Ni	A193 - B8	G4303 - SUS304	800℃
18Cr - 10Ni - Cb	A193 - B8C	G4303 - SUS347	800℃
18Cr - 10Ni - Ti	A193 - B8T	G4303 - SUS321	800℃
18Cr - 12Ni - 2Mo	A193 - B8M	G4303 - SUS316	800℃
15Cr - 25Ni - Mo - Ti - V - B	A453 - 660		540℃

General Classification	"ASTM" Symbols	"JIS" Symbols	Service Temp
● HIGH - TEMPERATURE(BOLT)			
Cr - Mo	A320 - L7		-101℃
18Cr - 8Ni	A320 - B8	G4303 - SUS304	-196℃
18Cr - 10Ni - Cb	A320 - B8C	G4303 - SUS347	-196℃
18Cr - 10Ni - Ti	A320 - B8T	G4303 - SUS321	-196℃
18Cr - 12Ni - 2Mo	A320 - B8M	G4303 - SUS316	-196℃
● NUT			
Carbon Steel(C 0.15)		G4051 - S20C	420℃
Carbon Steel(C 0.40)	A194 - 2H	G4051 - S45C	550℃
Carbon Mo Steel	A194 - 4		600℃
18Cr - 8Ni	A194 - 8	G4303 - SUS304	800℃
18Cr - 10Ni - Cb	A194 - 8C	G4303 - SUS347	800℃
18Cr - 10Ni - Ti	A194 - 8T	G4303 - SUS321	800℃
18Cr - 12Ni - 2Mo	A194 - 8M	G4303 - SUS316	800℃

Body Materials	Temperature Degress F.	Bolts Material Specifications	Nuts
Carbon Steel(Grade WCB)	-20 to 800	ASTM A193 Gr B7	ASTM A194 Gr 2H
Carbon Steel(Grade LCB)	-50 to 650	ASTM A320 Gr L7	ASTM A194 Gr 4
Carbon Moly(Grade WC1)	-20 to 850	ASTM A193 Gr B7	ASTM A194 Gr 2H
1¼Cr - ½Mo(Grade WC6)	-20 to 1000	ASTM A193 Gr B7	ASTM A194 Gr 2H
2¼Cr - 1Mo(Grade WC9)	-20 to 1000	ASTM A193 Gr B7	ASTM A193 Gr B7
	1000 to 1050	ASTM A193 Gr B16	ASTM A194 Gr 4
5Cr - ½Mo(Grade C5)	-20 to 1000	ASTM A193 Gr B7	ASTM A194 Gr 2H
	1000 to 1100	ASTM A193 Gr B16	ASTM A194 Gr 4
9Cr - 1Mo(Grade C12)	-20 to 1000	ASTM A193 Gr B7	ASTM A194 Gr 8H
	1000 to 1100	ASTM A193 Gr B16	ASTM A194 Gr 2
Type 304(Grade CF8)	-425 to 100	ASTM A320 Gr B8	ASTM A194 Gr 8
	100 to 1500	ASTM A193 Gr B8	ASTM A194 Gr 8
Type 316(Grade CF8M)	-425 to 100	ASTM A320 Gr B8	ASTM A194 Gr 8
	100 to 1500	ASTM A193 Gr B8M	ASTM A194 Gr 8M
3½Ni(Grade LC3)	-150 to -50	ASTM A320 Gr B7 With Charpy Test or 8M	ASTM A194 Gr 8
	-50 to 650	ASTM A193 Gr B7	ASTM A194 Gr 2H

# MATERIAL PROPERTIES

## CASTING MATERIALS

### CHEMICAL PROPERTIES

	Carbon Steel	CA-15	High Temp.	High Temp.	304-S. S.	316-S. S.	HASTESLOY-B	304L-S. S.	316L-S. S.	Low Temp.	HIGH	TEMP
ASTM Steel	A-216	A-217	A-217	A-217	A-351	A-351	A-494	A-351	A-351	A-352	A-217	A-217
Grade	WCB	CA-15	WC6	WC9	CF8	CF8M	N-12MV	CF3	CF3M	LCB	C-5	C-12
C% Max.	0.30	0.15	0.20	0.18	0.08	0.08	0.12	0.03	0.03	0.03	0.20	0.20
Mn%	1.00Max	1.00	0.50-0.80	0.40-0.70	1.50	1.50	1.00	1.50	1.50	1.00	0.40-0.70	0.35-0.65
p% Max.	0.04	0.040	0.04	0.04	0.04	0.04	0.040	0.04	0.04	0.05	0.040	0.040
S% Max.	0.045	0.040	0.045	0.045	0.04	0.04	0.030	0.04	0.04	0.06	0.045	0.045
Ni%	0.50	1.00	-	-	8.00	9.00	Bal	8.00-12.0	9.00-13.0	-	-	-
Cr%	0.40	11.5-14.0	1.00-1.50	2.00-2.75	18.0-21.0	18.0-21.0	1.00	17.0-21.0	17.0-21.0	-	4.0-6.50	8.00-10.00
Mo%	0.25	-	0.45-0.65	0.90-1.20	-	2.00-3.00	26.0-30.0	-	2.00-3.00	-	0.45-0.65	0.90-1.20
Cu	0.0	-	-	-	-	-	-	-	-	-	-	-
Si	0.30	1.50	0.60	0.60	2.00	2.00	1.00	2.00	1.50	0.60	0.75	1.00
Fe	-	-	-	-	-	-	4.0-6.0	-	-	-	-	-
V	-	-	-	-	-	-	0.20-0.60	-	-	-	-	-

### PHYSICAL PROPERTIES

Tensile Strength Min. Ksi Mpa	70 485	90-115 621-793	70 485	70 485	70 485	70 485	76 525	70 485	70 485	65 450	90-115 621-793	90-115 621-793
Yield Point Min. Ksi Mpa	30 205	65 448	40 275	40 275	28 195	30 205	40 275	30 205	30 205	35 240	60 414	60 414
Elongation in 2 inch (50mm) % Min.	22	18	20	20	35	30	6	35	30	24	18	18
Reduction of Area % Min.	35	30	35	35	-	-	-	-	-	35	35	35

## WROUGHT MATERIALS

### CHEMICAL PROPERTIES

	11-13% Cr	Ductile	Carbon Steel	B - 8F	321 - S. S.	304 - S. S.	316 - S. S.	304L - S. S.	316L - S. S.	Hard Facing	Bolts	Nuts
ASTM Std.	A-182	A-439	ASTM	A-320	A-182	A-182	A-182	A-182	A-182	KLS	A-193	A-194
Grade	F6a	D2C	A-105	B-8F	F-321	F-304	F-316	F-304L	F-316L	HF-6R	B7	2H
C% Max.	0.15	0.29	0.22-0.35	0.15	0.08	0.08	0.08	0.035	0.035	1.05	0.38-0.48	0.04
Si% Max.	1.00	1.00-3.00	0.35	1.00	1.00	1.00	1.00	1.00	1.00	1.11	0.15-0.35	-
Mn% Max.	1.00	1.80-2.40	0.60-1.05	2.00	2.00	2.00	2.00	2.00	2.00	0.04	0.75-1.00	-
p% Max.	0.04	0.08	0.04	0.20	0.030	0.04	0.04	0.040	0.040	-	0.04	0.04
S% Max.	0.03	-	0.05	0.150-0.350	0.030	0.03	0.03	0.030	0.030	-	0.04	0.05
Ni%	0.50	21.0-24.0	-	8.00-10.00	9.00-12.00	8.0-11.0	10.0-14.0	8.00-13.0	10.00-15.00	-	-	-
Cr%	11.5-14.5	0.50	-	17.00-19.00	17.00Min	18.0-20.0	16.0-18.0	18.0-20.0	16.00-18.00	28.3	0.80-1.10	-
Mo%	-	-	-	-	-	-	2.00-3.00	-	2.00-3.00	-	0.15-0.25	-
Ti%	-	-	-	-	C% × 5-0.06	-	-	-	-	-	-	-
Fe%	Bal.	-	-	-	-	-	-	-	-	0.30	Bal.	Bal.
W%	-	-	-	-	-	-	-	-	-	4.20	-	-
Co%	-	-	-	-	-	-	-	-	-	Bal.	-	-

### PHYSICAL PROPERTIES

Tensile Strength Min. Ksi Mpa	85 586	58 400	70 483	75 517	75 517	75 517	75 517	70 483	70 493	-	125 862	175 -
Yield Point Min. Ksi Mpa	55 379	28 193	36 248	30 207	30 207	30 207	30 207	25 172	25 172	-	105 724	- -
Elongation in 2 inch (50mm) % Min	18	20	22	35	45	30	30	30	30	-	16	-
Reduction of Area % Min.	35	45	30	50	50	50	50	50	30	-	50	-

# BUTT-WELDING ENDS

## Dimensions of Butt - Welding Ends

ASME B16.25 - 2004

Nominal Pipe Size	Schedule Number or Wall	Outside Diameter(Cast Steel Valves)		Nominal Inside Diameter		Machined Inside Diameter		Nominal Wall Thickness	
		A		B		C		T	
		inch	mm	inch	mm	inch	mm	inch	mm
2½	40	2.96	75	2.469	63	2.479	62.95	0.203	5.15
	80			2.323	59	2.351	59.70	0.276	7.00
	160			2.125	54	2.178	55.30	0.375	9.55
	XXS			1.771	45	1.868	47.45	0.552	14.00
3	40	3.59	91	3.068	78	3.081	78.25	0.216	5.50
	80			2.900	74	2.934	74.50	0.300	7.60
	160			2.624	67	2.692	68.40	0.438	11.15
	XXS			2.300	58	2.409	61.20	0.600	15.25
3½	40	4.12	105	3.548	90	3.564	90.55	0.226	5.75
	80			3.364	85	3.402	86.40	0.318	8.10
4	40	4.62	117	4.026	102	4.044	102.70	0.237	6.00
	80			3.826	97	3.869	98.25	0.337	8.55
	120			3.624	92	3.692	93.80	0.438	11.15
	160			3.438	87	3.530	89.65	0.531	13.50
	XXS			3.152	80	3.279	83.30	0.674	17.0
5	40	5.69	144	5.047	128	5.070	128.80	0.258	6.55
	80			4.813	122	4.866	123.60	0.375	9.55
	120			4.563	116	4.647	118.05	0.500	12.70
	160			4.313	110	4.428	112.45	0.625	15.90
	XXS			4.063	103	4.209	106.90	0.750	19.05
6	40	6.78	172	6.065	154	6.094	154.80	0.280	7.10
	80			5.761	146	5.828	148.05	0.432	10.95
	120			5.501	140	5.600	142.25	0.562	14.25
	160			5.187	132	5.326	135.30	0.719	18.25
	XXS			4.897	124	5.072	128.85	0.864	21.95
8	40	8.78	223	7.981	203	8.020	203.70	0.322	8.20
	60			7.813	198	7.873	199.95	0.406	10.30
	80			7.625	194	7.709	195.80	0.500	12.70
	100			7.437	189	7.544	191.60	0.594	15.10
	120			7.187	183	7.326	186.10	0.719	18.25
	140			7.001	178	7.163	181.95	0.812	20.60
	160			6.875	175	7.053	179.15	0.875	22.25
	XXS			6.813	173	6.998	177.75	0.906	23.00
10	40	10.94	278	10.020	255	10.070	255.80	0.365	9.25
	60			9.750	248	9.834	249.80	0.500	12.70
	80			9.562	243	9.670	245.60	0.594	15.10
	100			9.312	237	9.451	240.05	0.719	18.25
	120			9.062	230	9.232	234.50	0.844	21.45
	140			8.750	222	8.959	227.55	1.000	25.40
	160			8.500	216	8.740	222.00	1.125	28.60
12	STD	12.97	329	12.000	305	12.053	306.15	0.375	9.55
	40			11.938	303	11.999	304.75	0.406	10.30
	XS			11.750	298	11.834	300.60	0.500	12.70
	60			11.626	295	11.725	297.80	0.562	14.25
	80			11.374	289	11.505	292.25	0.688	17.50
	100			11.062	281	11.232	285.30	0.844	21.45
	120			10.750	273	10.959	278.35	1.000	25.40
	140			10.500	267	10.740	272.80	1.125	28.60
	160			10.126	257	10.413	264.50	1.312	33.30
14	STD	14.25	362	13.250	337	13.303	337.90	0.375	9.55
	40			13.124	333	13.192	335.10	0.438	11.15
	XS			13.000	330	13.084	332.35	0.500	12.70
	60			12.812	325	12.920	328.15	0.594	15.10
	80			12.500	318	12.646	321.20	0.750	19.05
	100			12.124	308	12.318	312.90	0.938	23.85
	120			11.812	300	12.044	305.90	1.094	27.80
	140			11.500	292	11.771	299.00	1.250	31.75
	160			11.188	284	11.498	292.05	1.406	35.70
16	STD	16.25	413	15.250	387	15.303	388.70	0.375	9.55
	40			15.000	381	15.084	383.15	0.500	12.70
	60			14.688	373	14.811	376.20	0.656	16.65
	80			14.312	364	14.482	367.85	0.844	21.45
	100			13.938	354	14.155	359.55	1.031	26.20
	120			13.562	344	13.826	351.20	1.219	30.95
	140			13.124	333	13.442	341.45	1.438	36.55
	160			12.812	325	13.170	334.50	1.594	40.50

# BUTT-WELDING ENDS

## Dimensions of Butt - Welding Ends

ASME B16.25 - 2004

Nominal Pipe Size	Schedule Number or Wall	Outside Diameter (Cast Steel Valves) A		Nominal Inside Diameter B		Machined Inside Diameter C		Nominal Wall Thickness T	
		inch	mm	inch	mm	inch	mm	inch	mm
18	STD	18.28	464	17.250	438	17.303	439.50	0.375	9.55
	XS			17.000	432	17.084	433.95	0.500	12.70
	40			16.876	429	16.975	431.15	0.562	14.25
	60			16.500	419	16.646	422.80	0.750	19.05
	80			16.124	410	16.318	414.50	0.938	23.85
	100			15.688	398	15.936	404.75	1.156	29.35
	120			15.250	387	15.553	395.05	1.375	34.95
	140			14.876	378	15.225	386.70	1.562	39.65
	160			14.438	367	14.842	377.00	1.781	45.25
20	STD	20.31	516	19.250	489	19.303	490.30	0.375	9.55
	XS			19.000	483	19.084	484.75	0.500	12.70
	40			18.812	478	18.920	480.55	0.594	15.10
	60			18.376	467	18.538	470.85	0.812	20.60
	80			17.938	456	18.155	461.15	1.031	26.20
	100			17.438	443	17.717	450.00	1.281	32.55
	120			17.000	432	17.334	440.30	1.500	38.10
	140			16.500	419	16.896	429.15	1.750	44.45
	160			16.062	408	16.513	419.45	1.969	50.00
22	STD	22.34	567	21.250	540	21.303	541.10	0.375	9.55
	XS			21.000	533	21.084	535.55	0.500	12.70
	60			20.250	514	20.428	518.85	0.875	22.25
	80			19.750	502	19.990	507.75	1.125	28.60
	100			19.250	489	19.553	496.65	1.375	34.95
	120			18.750	476	19.115	485.50	1.625	41.30
	140			18.250	464	18.678	474.40	1.875	47.65
	160			17.750	451	18.240	463.30	2.125	54.00
	24			STD	24.38	619	23.250	591	23.303
XS		23.000	584	23.084			586.35	0.500	12.70
30		22.876	581	22.975			583.55	0.562	14.25
40		22.624	575	22.755			578.00	0.688	17.50
60		22.062	560	22.263			565.50	0.969	24.60
80		21.562	548	21.826			554.40	1.219	30.95
100		20.938	532	21.280			540.50	1.531	38.90
120		20.376	518	20.788			528.00	1.812	46.00
140		19.876	505	20.350			516.90	2.062	52.35
160	19.312	491	19.857	504.35	2.344	59.55			
26	10	26.38	670	25.376	645	25.413	645.50	0.312	7.90
	20			25.000	635	25.084	637.15	0.500	12.70
28	10	28.38	721	27.376	695	27.413	696.30	0.312	7.90
	20			27.000	686	27.084	687.95	0.500	12.70
	30			26.750	679	26.865	682.35	0.625	15.90
30	10	30.38	772	29.376	746	29.413	747.10	0.312	7.90
	20			29.000	737	29.084	738.75	0.500	12.70
	30			28.750	730	28.865	733.15	0.625	15.90
32	10	32.50	825	31.376	797	31.413	797.90	0.312	7.90
	20			31.000	787	31.084	789.55	0.500	12.70
	30			30.750	781	30.865	783.95	0.625	15.90
	40			30.624	778	30.755	781.20	0.688	17.50
34	10	34.50	876	33.376	848	33.413	848.70	0.312	7.90
	20			33.000	838	33.084	840.35	0.500	12.70
	30			32.750	832	32.865	833.75	0.625	15.90
	40			32.624	829	32.755	832.00	0.688	17.50
36	10	36.50	927	35.376	899	35.413	899.50	0.312	7.90
	20			35.000	889	35.084	891.15	0.500	12.70
	30			34.750	883	34.865	885.55	0.625	15.90
	40			34.500	876	34.646	880.00	0.750	19.05

### NOTES

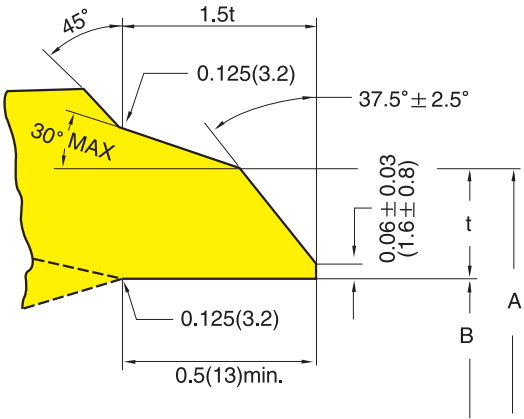
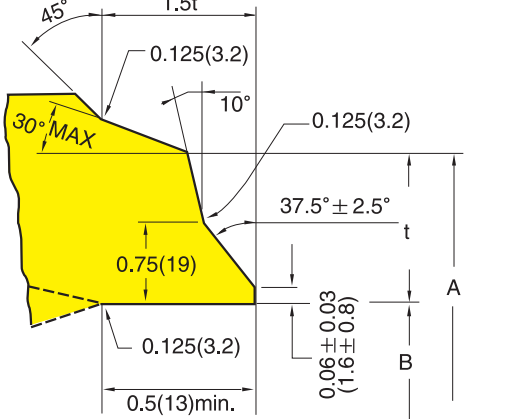
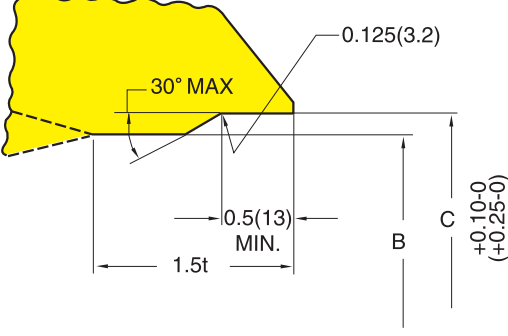
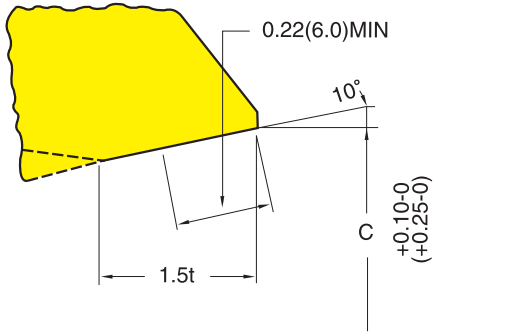
STC - standard wall thickness  
 XS - extra - strong wall thickness  
 XXS - double extra - strong wall thickness



# BUTT-WELDING ENDS

## STANDARD PREPARATION OF VALVE BUTT WELDING ENDS

ASME B16.25 - 2004

TYPE_A	TYPE_B
 <p>For Wall Thickness(t) 0.188(4.8) to 0.875(22.2) Inclusive</p>	 <p>For Wall Thickness(t) Greater Than 0.875(22.2)</p>
TYPE_C	TYPE_D
 <p>Inside Contour for Use with Rectangular Backing Ring</p>	 <p>Inside Contour for Use with Taper Backing Ring</p>

### FORMULA

Dimension C for the bore of pipe, valve, welding neck flanges and pipe fittings when using continuous rectangular or taper backing rings is determined by the following formula:

$$C = A - 0.031(0.787) - 1.75t - 0.010(0.254)$$

where

A = Nominal outside diameter of pipe  
 0.031(0.787) = Minus tolerance on OD of pipe (As covered by ASTM Specification having the more restrictive requirements such as A106, A335, etc.)

1.75 = Minimum wall of 87 1/2 percent of nominal wall (permitted by ASTM specification having the more restrictive requirements such as A106, A335, etc.) multiplied by two to convert into terms of diameter.

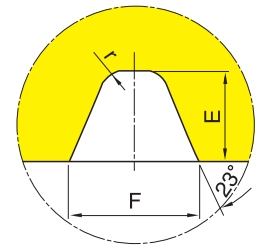
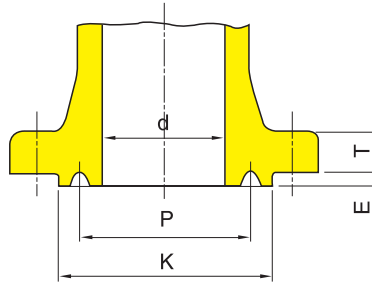
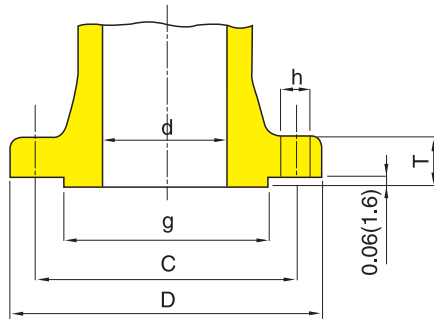
t = Nominal wall thickness of pipe in inches

0.010(0.254) = Plus machining tolerance on Bore C.

Linear dimensions are in inches with metric valves shown in millimeters in parenthesis.

# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 150 Steel Flange Valves and Fittings



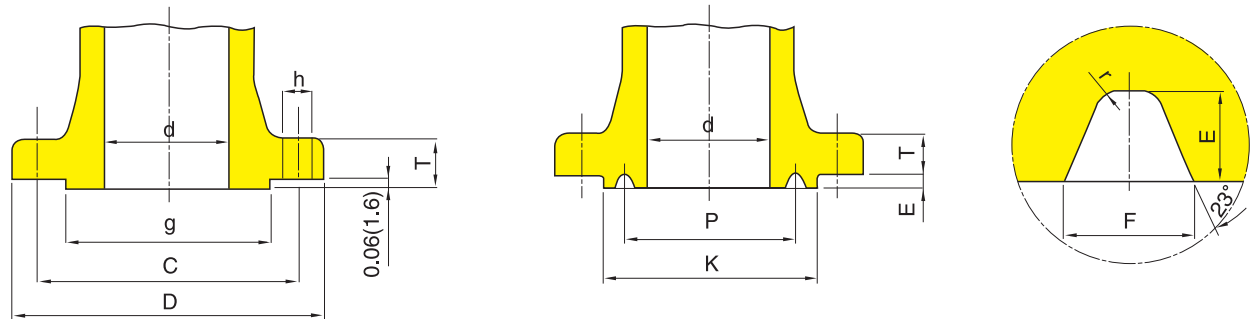
ASME B16.5 - 2004

Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange		Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h	K			P	E		F	r	
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15	0.50 13	3.50 89	1.38 34.9	- -	0.44 11.5	2.38 60.3	0.62 16	4	1/2	- -	- -	-	- -	- -	- -
3/4 20	0.75 19	3.88 98	1.69 42.9	- -	0.50 13.0	2.75 69.9	0.62 16	4	1/2	- -	- -	-	- -	- -	- -
1 25	1.00 25	4.25 108	2.00 50.8	0.44' 11.3'	0.56 14.5	3.12 79.4	0.62 16	4	1/2	2.50 63.5	1.875 47.63	R15	0.25 6.35	0.344 8.74	0.03 0.8
1 1/4 32	1.25 32	4.62 117	2.50 63.5	0.50' 13.0'	0.62 16.0	3.50 88.9	0.62 16	4	1/2	2.88 73.0	2.250 57.15	R17	0.25 6.35	0.344 8.74	0.03 0.8
1 1/2 40	1.50 38	5.00 127	2.88 73.0	0.56' 14.5'	0.69 17.5	3.88 98.4	0.62 16	4	1/2	3.25 82.5	2.562 65.09	R19	0.25 6.35	0.344 8.74	0.03 0.8
2 50	2.00 51	6.00 152	3.62 92.1	0.62' 16.0'	0.75 19.5	4.75 120.6	0.75 20	4	5/8	4.00 102	3.250 82.55	R22	0.25 6.35	0.344 8.74	0.03 0.8
2 1/2 65	2.50 64	7.00 178	4.12 104.8	0.69' 17.5'	0.88 22.5	5.50 139.7	0.75 20	4	5/8	4.75 121	4.00 101.60	R25	0.25 6.35	0.344 8.74	0.03 0.8
3 80	3.00 76	7.50 191	5.00 127.0	0.75' 19.5'	0.94 24.0	6.00 152.4	0.75 20	4	5/8	5.25 133	4.50 144.30	R29	0.25 6.35	0.344 8.74	0.03 0.8
3 1/2 90	3.50 89	8.50 216	5.50 139.7	0.8' 20.5'	0.94 24.0	7.00 177.8	0.75 20	8	5/8	6.06 154	5.188 131.76	R33	0.25 6.35	0.344 8.74	0.03 0.8
4 100	4.00 102	9.00 229	6.19 157.2	0.94 24.0	7.50 190.5	0.75 20	0.75 20	8	5/8	6.75 171	5.875 149.23	R36	0.25 6.35	0.344 8.74	0.03 0.8
5 125	5.00 127	10.00 254	7.31 185.7	0.94 24.0	8.50 215.9	0.88 23	0.88 23	8	3/4	7.62 194	6.750 171.45	R40	0.75 6.35	0.344 8.74	0.03 0.8
6 150	6.00 152	11.00 279	8.50 215.9	1.00 25.5	9.50 241.3	0.88 23	0.88 23	8	3/4	8.62 219	7.625 193.68	R43	0.25 6.35	0.344 8.74	0.03 0.8
8 200	8.00 203	13.50 343	10.62 269.9	1.12 29.0	11.75 298.4	0.88 23	0.88 23	8	3/4	10.75 273	9.750 247.65	R48	0.25 6.35	0.344 8.74	0.03 0.8
10 250	10.00 254	16.00 406	12.75 323.8	1.19 30.5	14.25 361.9	1.00 26	1.00 26	12	7/8	13.00 330	12.000 304.80	R52	0.25 6.35	0.344 8.74	0.03 0.8
12 300	12.00 305	19.00 483	15.00 381.0	1.25 32.0	17.00 431.8	1.00 26	1.00 26	12	7/8	16.00 406	15.000 381.00	R56	0.25 6.35	0.344 8.74	0.03 0.8
14 350	13.25 337	21.00 535	16.25 412.8	1.38 35.0	18.75 476.2	1.12 29	1.12 29	12	1	16.75 425	15.625 396.88	R59	0.25 6.35	0.344 8.74	0.03 0.8
16 400	15.25 387	23.50 595	18.50 469.9	1.44 37.0	21.25 539.7	1.12 29	1.12 29	16	1	19.00 483	17.875 454.03	R64	0.25 6.35	0.344 8.74	0.03 0.8
18 450	17.25 438	25.00 635	21.00 533.4	1.56 40.0	22.75 577.8	1.25 32	1.25 32	16	1 1/8	21.50 546	20.375 517.53	R68	0.25 6.35	0.344 8.74	0.03 0.8
20 500	19.25 489	27.50 700	23.00 584.2	1.69 43.0	25.00 635.0	1.25 32	1.25 32	20	1 1/8	23.50 597	22.000 558.80	R72	0.25 6.35	0.344 8.74	0.03 0.8
24 600	23.25 591	32.00 815	27.25 692.2	1.88 48.0	29.50 749.3	1.38 35	1.38 35	20	1 1/4	28.00 711	26.500 673.10	R76	0.25 6.35	0.344 8.74	0.03 0.8



# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 300 Steel Flange Valves and Fittings

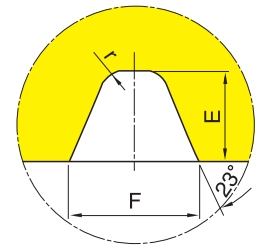
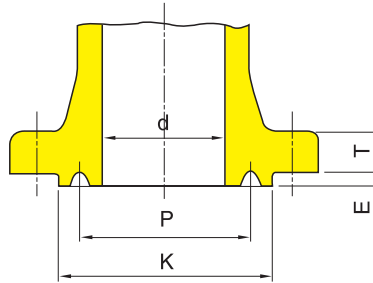
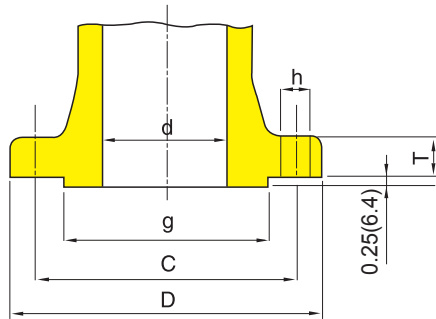


ASME B16.5 - 2004

Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange	Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h			K	P		E	F	r
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15	0.50 13	3.75 95	1.38 34.9	0.56 14.5	2.62 66.7	0.62 16	4	1/2	2.00 51.0	1.344 34.13	R11	0.219 5.56	0.281 7.14	0.03 0.8
3/4 20	0.75 19	4.62 117	1.69 42.9	0.62 16.0	3.25 82.5	0.75 20	4	5/8	2.50 63.5	1.688 42.86	R13	0.250 6.35	0.344 8.74	0.03 0.8
1 25	1.00 25	4.88 124	2.00 50.8	0.69 17.5	3.50 88.9	0.75 20	4	5/8	2.75 70.0	2.000 50.80	R16	0.750 6.35	0.344 8.74	0.03 0.8
1 1/4 32	1.25 32	5.25 133	2.50 63.5	0.75 19.5	3.88 98.4	0.75 20	4	5/8	3.12 79.5	2.375 60.33	R18	0.250 6.35	0.344 8.74	0.03 0.8
1 1/2 40	1.50 38	6.12 156	2.88 73.0	0.81 21.0	4.50 114.3	0.88 23	4	3/4	3.56 90.5	2.688 68.26	R20	0.250 6.35	0.344 8.74	0.03 0.8
2 50	2.00 51	6.50 165	3.62 92.1	0.88 22.5	5.00 127.0	0.75 20	8	5/8	4.25 108	3.250 82.55	R23	0.312 7.92	0.469 11.91	0.03 0.8
2 1/2 65	2.50 64	7.50 191	4.12 104.8	1.00 25.5	5.88 149.2	0.88 23	8	3/4	5.00 127	4.000 101.60	R26	0.312 7.92	0.469 11.91	0.03 0.8
3 80	3.00 76	8.25 210	4.00 127.0	1.12 29.0	6.62 168.3	0.88 23	8	3/4	5.75 146	4.875 123.83	R31	0.312 7.92	0.469 11.91	0.03 0.8
3 1/2 90	3.50 89	9.00 229	5.50 139.7	1.19 30.5	7.25 184.1	0.88 23	8	3/4	6.25 159	5.188 131.76	R34	0.312 7.92	0.469 11.91	0.03 0.8
4 100	4.00 102	10.00 254	6.19 157.2	1.25 32.0	7.88 200.0	0.88 23	8	3/4	6.88 175	5.875 149.23	R37	0.312 7.92	0.469 11.91	0.03 0.8
5 125	5.00 127	11.00 279	7.31 185.7	1.38 35.0	9.25 234.9	0.88 23	8	3/4	8.25 210	7.125 180.98	R41	0.312 7.92	0.469 11.91	0.03 0.8
6 150	6.00 152	12.50 318	8.50 215.9	1.44 37.0	10.62 269.9	0.88 23	12	3/4	9.50 241	8.312 211.14	R45	0.312 7.92	0.469 11.91	0.03 0.8
8 200	8.00 203	15.00 381	10.62 269.9	1.62 41.5	13.00 330.2	1.00 26	12	7/8	11.88 302	10.265 269.88	R49	0.312 7.92	0.469 11.91	0.03 0.8
10 250	10.00 254	17.50 445	12.75 323.8	1.88 48.0	15.25 387.3	1.12 29	16	1	14.00 356	12.750 323.85	R53	0.312 7.92	0.469 11.91	0.03 0.8
12 300	12.00 305	20.50 520	15.00 381.0	2.00 51.0	17.75 450.8	1.25 32	16	1 1/8	16.25 413	15.000 381.00	R57	0.312 7.92	0.469 11.91	0.03 0.8
14 350	13.25 337	23.00 585	16.25 412.8	2.12 54.0	20.25 514.3	1.25 32	20	1 1/8	18.00 457	16.500 419.10	R61	0.312 7.92	0.469 11.91	0.03 0.8
16 400	15.25 387	25.50 650	18.50 469.9	2.25 57.5	22.50 571.5	1.38 35	20	1 1/4	20.00 508	18.500 469.90	R65	0.312 7.92	0.469 11.91	0.03 0.8
18 450	17.00 432	28.00 710	21.00 533.4	2.38 60.5	24.75 628.6	1.38 35	24	1 1/4	22.62 575	21.000 533.40	R69	0.312 7.92	0.469 11.91	0.03 0.8
20 500	19.00 483	30.50 775	23.00 584.2	2.50 63.5	27.00 685.8	1.38 35	24	1 1/4	25.00 635	23.000 584.20	R73	0.375 9.52	0.531 13.49	0.06 1.5
24 600	23.00 584	36.00 915	27.25 692.2	2.75 70.0	32.00 812.8	1.62 42	24	1 1/2	30.38 749	27.250 692.15	R77	0.438 11.13	0.656 16.66	0.06 1.5

# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 600 Steel Flange Valves and Fittings

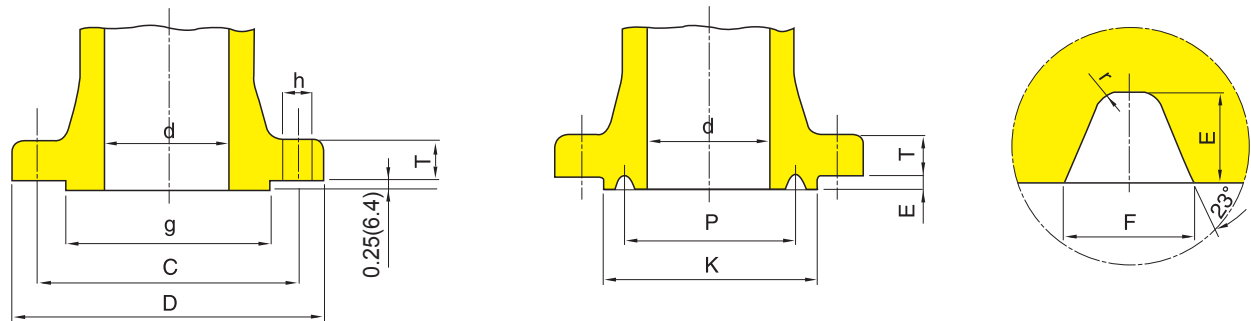


ASME B16.5 - 2004

Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange	Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h			K	P		E	F	r
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15	0.50 13	3.75 95	1.38 34.9	0.56 14.5	2.62 66.7	0.62 16	4	1/2	2.00 51.0	1.344 34.13	R11	0.219 5.56	0.281 7.14	0.03 0.8
3/4 20	0.75 19	4.62 117	1.69 42.9	0.62 16.0	3.25 82.5	0.75 20	4	5/8	2.50 63.5	1.688 42.86	R13	0.250 6.35	0.344 8.74	0.03 0.8
1 25	1.00 25	4.88 124	2.00 50.8	0.69 17.5	3.50 88.9	0.75 20	4	5/8	2.75 70.0	2.000 50.80	R16	0.250 6.35	0.344 8.74	0.03 0.8
1 1/4 32	1.25 32	5.25 133	2.50 63.5	0.81 21.0	3.88 98.4	0.75 20	4	5/8	3.12 79.5	2.375 60.33	R18	0.250 6.35	0.344 8.74	0.03 0.8
1 1/2 40	1.50 38	6.12 156	2.88 73.0	0.88 22.5	4.50 114.3	0.88 23	4	3/4	3.56 90.5	2.688 68.26	R20	0.250 6.35	0.344 8.74	0.03 0.8
2 50	2.00 51	6.50 165	3.62 92.1	1.00 25.5	5.00 127.0	0.75 20	8	5/8	4.25 108	3.250 82.55	R23	0.312 7.92	0.469 11.91	0.03 0.8
2 1/2 65	2.50 64	7.50 191	4.12 104.8	1.12 29.0	5.88 149.2	0.88 23	8	3/4	5.00 127	4.000 101.60	R26	0.312 7.92	0.469 11.91	0.03 0.8
3 80	3.00 76	8.25 210	5.00 127.0	1.25 32.0	6.62 168.3	0.88 23	8	3/4	5.75 146	4.875 123.83	R31	0.312 7.92	0.469 11.91	0.03 0.8
3 1/2 90	3.50 89	9.00 229	5.50 139.7	1.38 35.0	7.25 184.1	1.00 26	8	7/8	6.25 159	5.188 131.76	R34	0.312 7.92	0.469 11.91	0.03 0.8
4 100	4.00 102	10.75 273	6.19 157.2	1.50 38.5	8.50 215.9	1.00 26	8	7/8	6.88 175	5.875 149.23	R37	0.312 7.92	0.469 11.91	0.03 0.8
5 125	5.00 127	13.00 330	7.31 185.7	1.75 44.5	10.50 266.7	1.12 29	8	1	8.25 210	7.125 180.98	R41	0.312 7.92	0.469 11.91	0.03 0.8
6 150	6.00 152	14.00 356	8.50 215.9	1.88 48.0	11.50 292.1	1.12 29	12	1	9.50 241	8.312 211.14	R45	0.312 7.92	0.469 11.91	0.03 0.8
8 200	7.88 200	16.50 419	10.62 269.9	2.19 56.0	13.75 349.2	1.25 32	12	1 1/8	11.88 302	10.265 269.88	R49	0.312 7.92	0.469 11.91	0.03 0.8
10 250	9.75 248	20.00 510	12.75 328.8	2.50 63.5	17.00 431.8	1.38 35	16	1 1/4	14.00 356	12.750 323.85	R53	0.312 7.92	0.469 11.91	0.03 0.8
12 300	11.75 298	22.00 560	15.00 381.0	2.62 67.0	19.25 488.9	1.38 35	20	1 1/4	16.25 413	15.000 381.00	R57	0.312 7.92	0.469 11.91	0.03 0.8
14 350	12.88 327	23.75 605	16.25 412.8	2.75 70.0	20.75 527.0	1.5 39	20	1 3/8	18.00 457	16.500 419.10	R61	0.312 7.92	0.469 11.91	0.03 0.8
16 400	14.75 375	27.00 685	18.50 469.9	3.00 76.5	23.75 603.2	1.62 42	20	1/2	20.00 508	18.500 469.90	R65	0.312 7.92	0.469 11.91	0.03 0.8
18 450	16.50 419	29.25 745	21.00 533.4	3.25 83.0	25.75 654.0	1.75 45	20	1 5/8	22.62 575	21.000 533.40	R69	0.312 7.92	0.469 11.91	0.03 0.8
20 500	18.25 464	32.00 815	23.00 584.2	3.50 89.0	28.50 723.9	1.75 45	24	1 5/8	25.00 635	23.000 584.20	R73	0.375 9.52	0.531 13.49	0.06 1.5
24 600	22.00 559	37.00 940	27.25 692.2	4.00 102.0	33.00 838.2	2.00 51	24	1 7/8	30.38 749	27.250 692.15	R77	0.438 11.13	0.656 16.66	0.06 1.5

# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 900 Steel Flange Valves and Fittings



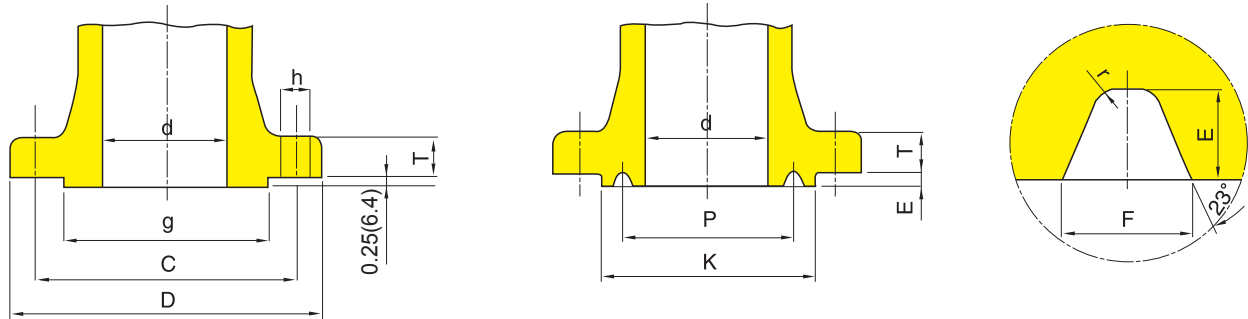
ASME B16.5 - 2004

Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange	Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h			K	P		E	F	r
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15														
3/4 20														
1 25														
1 1/4 32														
1 1/2 40														
2 50														
2 1/2 65														
3 80	2.88 73	9.50 241	5.00 127.0	1.50 38.5	7.50 190.5	1.00 26	8	3/8	6.12 156	4.875 123.83	R31	0.312 7.92	0.469 11.91	0.03 0.8
4 100	3.88 98	11.50 292	6.19 157.2	1.75 44.5	9.25 234.9	1.25 32	8	1/2	7.12 181	5.875 149.23	R37	0.312 7.92	0.469 11.91	0.03 0.8
5 125	4.75 121	13.75 349	7.31 185.7	2.00 51.0	11.00 279.4	1.38 35	8	1 1/4	8.50 216	7.125 180.98	R41	0.312 7.92	0.469 11.91	0.03 0.8
6 150	5.75 146	15.00 381	8.50 215.9	2.19 56.0	12.50 317.5	1.25 32	12	1 1/2	9.50 241	8.312 211.14	R45	0.312 7.92	0.469 11.91	0.03 0.8
8 200	7.50 191	18.50 470	10.62 269.9	2.50 63.5	15.50 393.7	1.50 39	12	1 3/8	12.12 308	10.625 269.88	R49	0.312 7.92	0.469 11.91	0.03 0.8
10 250	9.38 238	21.50 545	12.75 323.8	2.75 70.0	18.50 469.9	1.50 39	16	1 3/4	14.25 362	12.750 323.85	R53	0.312 7.92	0.469 11.91	0.03 0.8
12 300	11.12 283	24.00 610	15.00 381.0	3.12 79.5	21.00 533.4	1.50 39	20	1 3/4	16.50 419	15.000 381.00	R57	0.312 7.92	0.469 11.91	0.03 0.8
14 350	12.25 311	25.25 640	16.25 412.8	3.38 86.0	22.00 558.8	1.62 42	20	1 1/2	18.38 467	16.500 419.10	R62	0.438 11.13	0.656 16.66	0.06 1.5
16 400	14.00 356	27.75 705	18.50 469.9	3.50 89.0	24.25 615.9	1.75 45	20	1 5/8	20.62 524	18.500 469.90	R66	0.438 11.13	0.656 16.66	0.06 1.5
18 450	15.75 400	31.00 785	21.00 533.4	4.00 102.0	27.00 685.8	2.00 51	20	1 3/4	23.38 594	21.000 533.40	R70	0.500 12.70	0.781 19.84	0.06 1.5
20 500	17.50 445	33.75 855	23.00 584.2	4.25 108.0	29.50 749.3	2.12 54	20	2	25.50 648	23.000 584.20	R74	0.500 12.70	0.781 19.84	0.06 1.5
24 600	21.00 533	41.00 104.0	27.25 692.2	5.50 140.0	35.50 901.7	2.62 67	20	2 1/2	30.38 772	27.250 692.15	R78	0.625 15.88	1.062 26.97	0.09 2.4

Use Class 1500 dimensions in these sizes.

# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 1500 Steel Flange Valves and Fittings

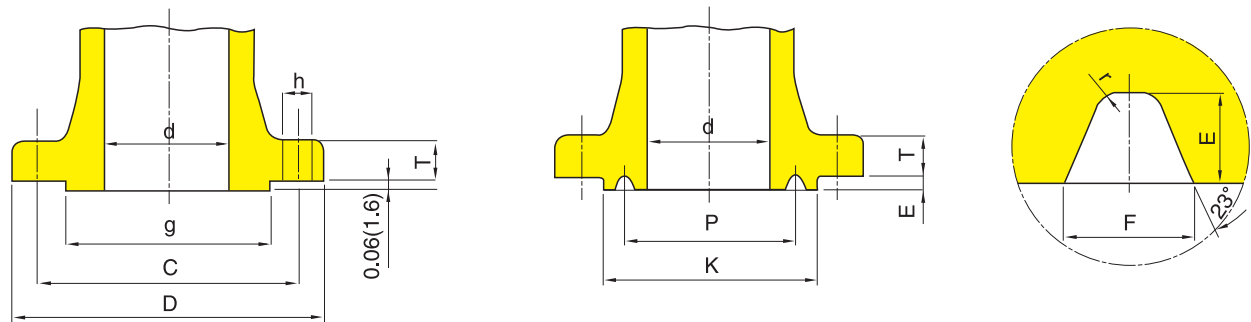


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Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange	Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h			K	P		E	F	r
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15	0.50 13	4.75 121	1.38 34.9	0.88 22.5	3.25 82.5	0.88 23	4	3/4	2.38 60.5	1.562 39.69	R12	0.250 6.35	0.344 8.74	0.03 0.8
3/4 20	0.69 17	4.12 130	1.69 42.9	1.00 25.5	3.50 88.9	0.88 23	4	3/4	2.62 66.5	1.750 44.45	R14	0.250 6.35	0.344 8.74	0.03 0.8
1 25	0.88 22	5.88 149	2.00 50.8	1.12 29.0	4.00 101.6	1.00 26	4	7/8	2.81 71.5	2.000 50.80	R16	0.250 6.35	0.344 8.74	0.03 0.8
1 1/4 32	1.12 29	6.25 159	2.50 63.5	1.12 29.0	4.38 111.1	1.00 26	4	7/8	3.19 81.0	2.375 60.33	R18	0.250 6.35	0.344 8.74	0.03 0.8
1 1/2 40	1.38 35	7.00 178	2.88 73.0	1.25 32.0	4.88 123.8	1.12 29	4	1	3.62 92.0	2.688 68.26	R20	0.250 6.35	0.344 8.74	0.03 0.8
2 50	1.88 48	8.50 216	3.62 92.1	1.50 38.5	6.50 165.1	1.00 26	8	7/8	4.88 124	3.750 95.25	R24	0.312 7.92	0.469 11.91	0.03 0.8
2 1/2 65	2.25 57	9.62 244	4.12 104.8	1.62 41.5	7.50 190.5	1.12 29	8	1	5.38 137	4.250 107.95	R27	0.312 7.92	0.469 11.91	0.03 0.8
3 80	2.75 70	10.50 267	5.00 127.0	1.88 48.0	8.00 203.2	1.25 32	8	1 1/8	6.62 168	5.375 136.53	R35	0.312 7.92	0.469 11.91	0.03 0.8
4 100	3.62 92	12.25 311	6.19 157.2	2.12 54.0	9.50 241.3	1.38 35	8	1 1/4	7.62 194	6.375 161.93	R39	0.312 7.92	0.469 11.91	0.03 0.8
5 125	4.38 111	14.75 375	7.31 185.7	2.88 73.5	11.5 292.1	1.62 42	8	1 1/2	9.00 229	7.625 193.68	R44	0.312 7.92	0.469 11.91	0.03 0.8
6 150	5.38 137	15.50 394	8.50 215.9	3.25 83.0	12.50 317.5	1.50 39	12	1 3/8	9.75 248	8.312 211.14	R46	0.375 9.52	0.531 13.49	0.06 1.5
8 200	7.00 178	19.00 483	10.62 269.9	3.62 92.0	15.50 393.7	1.75 45	12	1 5/8	12.50 318	10.625 269.88	R50	0.438 11.13	0.656 16.66	0.06 1.5
10 250	8.75 222	23.00 585	12.75 328.8	4.25 108.0	19.00 482.6	2.00 51	12	1 7/8	14.62 371	12.750 323.85	R54	0.438 11.13	0.656 16.66	0.06 1.5
12 300	10.38 264	26.50 675	15.00 381.0	4.88 124.0	22.50 571.5	2.12 54	16	2	17.25 438	15.00 381.00	R58	0.562 14.27	0.906 23.01	0.06 1.5
14 350	11.38 289	29.50 750	16.25 412.8	5.25 133.5	25.00 635.0	2.38 61	16	2 1/4	19.25 489	16.500 419.10	R63	0.625 15.88	1.062 26.97	0.09 2.4
16 400	13.00 330	32.50 825	18.50 469.9	5.75 146.5	27.75 704.8	2.62 67	16	2 1/2	21.50 546	18.500 469.90	R67	0.688 17.48	1.188 30.18	0.09 2.4
18 450	14.62 371	36.00 915	21.00 533.4	6.38 162.0	30.50 774.7	2.88 74	16	2 3/4	24.12 613	21.000 533.40	R71	0.688 17.48	1.188 30.18	0.09 2.4
20 500	16.38 416	38.75 985	23.00 584.2	7.00 178.0	32.75 831.8	3.12 80	16	3	26.50 673	23.000 584.20	R75	0.688 17.48	1.312 33.32	0.09 2.4
24 600	19.62 498	46.00 117.0	27.25 692.2	8.00 203.5	39.00 990.6	3.62 93	16	3 1/2	31.25 794	27.250 692.15	R79	0.812 20.62	1.438 36.53	0.09 2.4

# FLANGE DIMENSION & TEMPLATES FOR DRILLING

## Dimensions of Class 2500 Steel Flange Valves and Fittings



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Nominal Size	Inside Diam	OD of Flange	Raised Face Diam.	Thickness of Flange	Diam. of Bolt Circle	Diam. of Bolt Holes	No. of Bolt	Diam of Bolt	Facing Diam.	Pitch Diam.	Ring No.	Depth Groove	Width of Groove	Groove Fillet Radius
	d	D	g	T	C	h			K	P		E	F	r
inch mm	inch mm	inch mm	inch mm	inch mm	inch mm	inch mm			inch mm	inch mm		inch mm	inch mm	inch mm
1/2 15	0.44 11	5.25 133	1.39 34.9	1.19 30.5	3.50 88.9	0.88 23	4	3/4	2.56 65.0	1.688 42.86	R13	0.250 6.35	0.344 8.74	0.03 0.8
3/4 20	0.56 14	5.50 140	1.69 42.9	1.25 32.0	3.75 95.2	0.88 23	4	3/4	2.88 73.0	2.000 50.80	R16	0.250 6.35	0.344 8.74	0.03 0.8
1 25	0.75 19	6.25 159	2.00 50.8	1.38 35.0	4.25 107.9	1.00 26	4	7/8	3.25 82.5	2.375 60.33	R18	0.250 6.35	0.344 8.74	0.03 0.8
1 1/4 32	1.00 25	7.25 184	2.50 63.5	1.50 38.5	5.12 130.2	1.12 29	4	1	4.00 102	2.844 72.23	R21	0.312 7.92	0.469 11.91	0.03 0.8
1 1/2 40	1.12 29	8.00 203	2.88 73.0	1.75 44.5	5.75 146.0	1.25 32	4	1 1/8	4.50 114	3.250 82.55	R23	0.312 7.92	0.469 11.91	0.03 0.8
2 50	1.50 38	9.25 235	3.62 92.1	2.00 51.0	6.75 171.4	1.12 29	8	1	5.25 133	4.000 101.60	R26	0.312 7.92	0.469 11.91	0.03 0.8
2 1/2 65	1.88 48	10.50 267	4.12 104.8	2.25 57.5	7.75 196.8	1.25 32	8	1 1/8	5.88 149	4.375 111.13	R28	0.375 9.52	0.531 13.49	0.06 1.5
3 80	2.25 57	12.00 305	5.00 127.0	2.62 67.0	9.00 228.6	1.38 35	8	1 1/4	6.62 168	5.000 127.00	R32	0.375 9.52	0.531 13.49	0.06 1.5
4 100	2.88 73	14.00 356	6.19 157.2	3.00 76.5	10.75 273.0	1.62 42	8	1 1/2	8.00 203	6.188 157.16	R38	0.438 11.13	0.656 16.66	0.06 1.5
5 125	3.62 92	16.50 419	7.31 185.7	3.62 92.5	12.75 323.8	1.88 48	8	1 3/4	9.50 241	7.500 190.50	R42	0.500 12.70	0.781 19.84	0.06 1.5
6 150	4.38 111	19.00 483	8.50 215.9	4.25 108.0	14.5 368.3	2.12 54	8	2	11.00 279	9.000 228.600	R47	0.500 12.700	0.781 19.84	0.06 1.5
8 200	5.75 146	21.75 550	10.62 269.9	5.00 127.0	17.25 438.1	2.12 54	12	2	13.38 340	11.000 279.40	R51	0.562 14.27	0.906 23.01	0.06 1.5
10 250	7.25 184	26.50 675	12.75 323.8	6.50 165.5	21.25 539.7	2.62 67	12	2 1/2	16.75 425	13.500 342.90	R55	0.688 17.48	1.188 30.18	0.09 2.4
12 300	8.62 219	30.00 760	15.00 381.0	7.25 184.5	24.38 619.1	2.88 74	12	2 3/4	19.50 495	16.000 406.40	R60	0.688 17.48	1.312 33.32	0.09 2.4

# RELATIONSHIP BETWEEN NOMINAL PIPE SIZE AND INSIDE DIAMETER

**This Annex is a nonmandatory part of ASME/ANSI B16.34-2004 and is provided for information purposes only.**

The relationship between wall thickness and inside diameter shown in Table 3 is the basis for pressure rating of valves. By interpolation, a definitive design basis can be determined for any pressure-diameter-material combination. Following the evolution of standard dimensions for flanges in a series of rating classes, corresponding standard relationships were established between nominal pipe sizes and the inside diameter of fittings matching the rating class of the flanges.

These provided a useful design basis for the corresponding flanged end valves, subsequently extended in application to welding end valves, which in many cases are identical except for the pipe ends. Table A1 is based on the dimensions given in B16.5 dimensional tables as "Inside Diameter of Fitting." The values above nominal pipe size 24 for the lower pressure classes and above nominal pipe size 12 for Class 2500 are obtained by linear extrapolation.

**TABLE A1 INSIDE DIAMETER d.**

Nominal Pipe Size	Class													
	150		300		400		600		900		1500		2500	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
½	0.50	12.70	0.50	12.70	0.50	12.70	0.50	12.70	0.50	12.70	0.50	12.70	0.44	11.17
¾	0.75	19.05	0.75	19.05	0.75	19.05	0.75	19.05	0.69	17.52	0.69	17.52	0.56	14.22
1	1.00	25.40	1.00	25.40	1.00	25.40	1.00	25.40	0.87	22.09	0.87	22.09	0.75	19.05
1¼	1.25	31.75	1.25	31.75	1.25	31.75	1.25	31.75	1.12	28.44	1.12	28.44	1.00	25.40
1½	1.50	38.10	1.50	38.10	1.50	38.10	1.50	38.10	1.37	34.79	1.37	34.79	1.12	28.44
2	2.00	50.80	2.00	50.80	2.00	50.80	2.00	50.80	1.87	47.49	1.87	47.49	1.50	38.10
2½	2.50	63.50	2.50	63.50	2.50	63.50	2.50	63.50	2.25	57.15	2.25	57.15	1.87	47.49
3	3.00	76.20	3.00	76.20	3.00	76.20	3.00	76.20	2.87	72.89	2.75	69.85	2.25	57.15
4	4.00	101.60	4.00	101.60	4.00	101.60	4.00	101.60	3.87	98.29	3.62	91.94	2.87	72.89
5	5.00	127.00	5.00	127.00	5.00	127.00	5.00	127.00	4.75	120.65	4.37	110.99	3.62	91.94
6	6.00	152.40	6.00	152.40	6.00	152.40	6.00	152.40	5.75	146.05	5.37	136.39	4.37	110.99
8	8.00	203.20	8.00	203.20	8.00	203.20	7.87	199.89	7.50	190.50	7.00	177.80	5.75	146.05
10	10.00	254.00	10.00	254.00	10.00	254.00	9.75	247.65	9.37	237.99	8.75	222.25	7.25	184.15
12	12.00	304.80	12.00	304.80	12.00	304.80	11.75	298.45	11.12	282.44	10.37	263.39	8.62	218.94
14	13.25	336.55	13.25	336.55	13.12	333.24	12.87	326.89	12.25	311.15	11.37	288.79	9.50	241.30
16	15.25	387.35	15.25	387.35	15.00	381.00	14.75	374.65	14.00	355.60	13.00	330.20	10.87	276.09
18	17.25	438.15	17.00	431.80	17.00	431.80	16.50	419.10	15.75	400.05	14.62	371.34	12.25	311.15
20	19.25	488.95	19.00	482.60	18.87	479.29	18.25	463.55	17.50	444.50	16.37	415.79	13.50	342.90
22	21.25	539.75	21.00	533.40	20.75	527.05	20.12	511.81	19.25	488.95	18.00	457.20	14.87	377.69
24	23.25	590.55	23.00	584.20	22.62	574.54	22.00	558.80	21.00	533.40	19.62	498.34	16.25	412.75
26	25.25	641.35	25.00	635.00	24.50	622.30	23.75	603.25	22.75	577.85	21.25	539.75	17.62	447.54
28	27.25	692.15	27.00	685.80	26.37	669.79	25.50	647.70	24.50	622.30	23.00	584.20	19.00	482.60
30	29.25	742.95	29.00	736.60	28.25	717.55	27.37	695.19	26.25	666.75	24.62	625.34	20.37	517.39



# VALVE BODY MINIMUM WALL THICKNESS

Inside Diameter d. inch	Class															
	150		300		400		600		900		1500		2500		4500	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
0.12	0.10	2.54	0.10	2.54	0.11	2.79	0.11	2.79	0.11	2.79	0.12	3.04	0.14	3.55	0.20	5.08
0.25	0.10	2.54	0.11	2.79	0.11	2.79	0.12	3.04	0.13	3.30	0.15	3.81	0.19	4.82	0.30	7.62
0.37	0.11	2.79	0.11	2.79	0.12	3.04	0.13	3.30	0.14	3.55	0.17	4.31	0.23	5.84	0.40	10.16
0.44	0.11	2.79	0.11	2.79	0.12	3.04	0.13	3.30	0.15	3.81	0.18	4.57	0.25	6.34	0.44	11.17
0.50	0.11	2.79	0.12	3.04	0.12	3.04	0.13	3.30	0.16	4.06	0.19	4.82	0.27	6.85	0.50	12.70
0.56	0.11	2.79	0.12	3.04	0.12	3.04	0.14	3.55	0.16	4.06	0.20	5.08	0.29	7.36	0.54	13.71
0.62	0.11	2.79	0.12	3.04	0.13	3.30	0.14	3.55	0.17	4.31	0.22	5.58	0.31	7.87	0.59	14.98
0.69	0.11	2.79	0.13	3.30	0.14	3.55	0.15	3.81	0.18	4.57	0.23	5.84	0.33	8.38	0.64	16.25
0.75	0.12	3.04	0.15	3.81	0.16	4.06	0.16	4.06	0.20	5.08	0.24	6.09	0.35	8.89	0.69	17.52
0.87	0.15	3.81	0.17	4.31	0.18	4.57	0.18	4.57	0.22	5.58	0.26	6.60	0.39	9.90	0.79	20.06
1.00	0.16	4.06	0.19	4.82	0.19	4.82	0.19	4.82	0.25	6.35	0.28	7.11	0.44	11.17	0.88	22.35
1.12	0.17	4.31	0.19	4.82	0.19	4.82	0.19	4.82	0.25	6.35	0.31	7.87	0.50	12.70	0.98	24.89
1.25	0.19	4.82	0.19	4.82	0.19	4.82	0.19	4.82	0.26	6.60	0.34	8.63	0.53	13.46	1.08	27.43
1.37	0.19	4.82	0.19	4.82	0.20	5.08	0.20	5.08	0.28	7.11	0.38	9.65	0.57	14.47	1.18	29.97
1.50	0.19	4.82	0.19	4.82	0.22	5.58	0.22	5.58	0.29	7.36	0.39	9.90	0.62	15.74	1.28	32.51
1.87	0.21	5.33	0.22	5.58	0.23	5.84	0.24	6.09	0.31	7.87	0.44	11.17	0.75	19.05	1.57	39.87
2.00	0.22	5.58	0.25	6.35	0.25	6.35	0.25	6.35	0.31	7.87	0.46	11.68	0.79	20.06	1.67	42.41
2.25	0.22	5.58	0.25	6.35	0.26	6.60	0.26	6.60	0.34	8.63	0.50	12.70	0.88	22.35	1.87	47.49
2.50	0.22	5.58	0.25	6.35	0.28	7.11	0.28	7.11	0.36	9.14	0.56	14.22	0.95	24.13	2.06	52.32
2.75	0.22	5.58	0.27	6.85	0.29	7.36	0.29	7.36	0.39	9.90	0.62	15.74	1.04	26.41	2.26	57.40
2.87	0.22	5.58	0.27	6.85	0.30	7.62	0.30	7.62	0.41	10.41	0.63	16.00	1.09	27.68	2.36	59.94
3.00	0.22	5.58	0.28	7.11	0.31	7.87	0.31	7.87	0.42	10.66	0.66	16.76	1.14	28.95	2.45	62.23
3.50	0.25	6.35	0.29	7.36	0.34	8.63	0.34	8.63	0.47	11.93	0.75	19.05	1.29	32.76	2.85	72.39
3.62	0.25	6.35	0.29	7.36	0.35	8.89	0.36	9.14	0.48	12.19	0.75	19.05	1.34	34.03	2.95	74.93
3.87	0.25	6.35	0.30	7.62	0.36	9.14	0.37	9.39	0.50	12.70	0.81	20.57	1.42	36.06	3.14	79.75
4.00	0.25	6.35	0.31	7.87	0.38	9.65	0.38	9.65	0.51	12.95	0.83	21.08	1.47	37.33	3.24	82.29
4.37	0.25	6.35	0.32	8.12	0.39	9.90	0.41	10.41	0.56	14.22	0.91	23.11	1.59	40.38	3.53	89.66
4.75	0.26	6.60	0.34	8.63	0.42	10.66	0.43	10.92	0.59	14.98	0.98	24.89	1.72	43.68	3.83	97.28
5.00	0.28	7.11	0.34	8.63	0.44	11.17	0.44	11.17	0.63	16.00	1.02	25.90	1.81	45.97	4.02	102.10
5.37	0.28	7.11	0.36	9.14	0.44	11.17	0.46	11.68	0.66	16.76	1.09	27.68	1.93	49.02	4.31	109.47
5.75	0.28	7.11	0.37	9.39	0.44	11.17	0.49	12.44	0.72	18.28	1.16	29.46	2.06	52.32	4.61	117.09
6.00	0.28	7.11	0.38	9.65	0.44	11.17	0.50	12.70	0.74	18.79	1.21	30.73	2.15	54.61	4.81	122.17
7.00	0.30	7.62	0.41	10.41	0.50	12.70	0.57	14.47	0.83	21.08	1.41	35.81	2.51	63.75	5.59	141.98
7.25	0.30	7.62	0.42	10.66	0.51	12.95	0.59	14.98	0.86	21.84	1.44	36.57	2.59	65.78	5.79	147.06
7.50	0.30	7.62	0.43	10.92	0.53	13.46	0.61	15.49	0.88	22.35	1.48	37.59	2.66	67.56	5.99	152.14
7.87	0.31	7.87	0.44	11.17	0.55	13.97	0.62	15.74	0.92	23.36	1.55	39.37	2.78	70.61	6.28	159.51
8.00	0.31	7.87	0.44	11.17	0.56	14.22	0.63	16.00	0.93	23.62	1.59	40.38	2.83	71.88	6.38	162.05
8.62	0.32	8.12	0.46	11.68	0.60	15.24	0.68	17.27	1.00	25.40	1.69	42.92	3.03	76.96	6.87	174.49
8.75	0.32	8.12	0.47	11.93	0.61	15.49	0.69	17.52	1.01	25.65	1.72	43.68	3.08	78.23	6.97	177.03
9.00	0.33	8.38	0.47	11.93	0.63	16.00	0.70	17.78	1.03	26.16	1.76	44.70	3.17	80.51	7.16	181.86
9.37	0.33	8.38	0.48	12.19	0.65	16.51	0.74	18.79	1.06	26.92	1.83	46.48	3.29	83.56	7.45	189.23
9.50	0.33	8.38	0.48	12.19	0.65	16.51	0.74	18.79	1.09	27.68	1.85	46.99	3.34	84.83	7.56	192.02
9.75	0.34	8.63	0.49	12.44	0.67	17.01	0.75	19.05	1.12	28.44	1.90	48.26	3.42	86.86	7.75	196.85
10.00	0.34	8.63	0.50	12.70	0.69	17.52	0.77	19.55	1.13	28.70	1.94	49.27	3.51	89.15	7.95	201.93
10.37	0.35	8.89	0.51	12.95	0.70	17.78	0.80	20.32	1.18	29.97	2.00	50.80	3.64	92.45	8.24	209.29
10.87	0.36	9.14	0.53	13.46	0.71	18.03	0.84	21.33	1.24	31.49	2.10	53.34	3.81	96.77	8.64	219.45
11.00	0.36	9.14	0.53	13.46	0.72	18.28	0.85	21.59	1.24	31.49	2.12	53.84	3.85	97.79	8.73	221.74
11.12	0.36	9.14	0.54	13.71	0.72	18.28	0.85	21.59	1.25	31.75	2.15	54.61	3.89	98.80	8.83	224.28
11.37	0.37	9.39	0.55	13.97	0.73	18.54	0.87	22.09	1.29	32.76	2.19	55.62	3.98	101.09	9.02	229.10
11.75	0.37	9.39	0.56	14.22	0.75	19.05	0.91	23.11	1.33	33.78	2.27	57.65	4.11	104.39	9.32	236.72
12.00	0.38	9.65	0.56	14.22	0.75	19.05	0.92	23.36	1.35	34.29	2.31	58.67	4.19	106.42	9.52	241.80
12.25	0.38	9.65	0.57	14.47	0.76	19.30	0.93	23.62	1.38	35.05	2.36	59.94	4.27	108.45	9.71	246.63
12.87	0.39	9.90	0.59	14.98	0.79	20.06	0.97	24.63	1.44	36.57	2.47	62.73	4.49	114.04	10.21	259.33
13.00	0.40	10.16	0.61	15.49	0.81	20.57	0.97	24.63	1.46	37.08	2.50	63.50	4.52	114.80	10.30	261.62
13.12	0.40	10.16	0.61	15.49	0.81	20.57	0.99	25.14	1.47	37.33	2.52	64.00	4.57	116.07	10.40	264.16
13.25	0.41	10.41	0.62	15.74	0.81	20.57	1.00	25.40	1.48	37.59	2.54	64.51	4.62	117.34	10.50	266.70
13.50	0.41	10.41	0.63	16.00	0.82	20.82	1.01	25.65	1.51	38.35	2.59	65.78	4.69	119.12	10.70	271.78
14.00	0.42	10.66	0.65	16.51	0.84	21.33	1.03	26.16	1.56	39.62	2.69	68.32	4.86	123.44	11.09	281.68
14.62	0.43	10.92	0.66	16.76	0.86	21.84	1.09	27.68	1.63	41.40	2.81	71.37	5.08	129.03	11.58	294.13
14.75	0.43	10.92	0.67	17.01	0.87	22.09	1.09	27.68	1.64	41.65	2.82	71.62	5.13	130.30	11.68	296.67
14.87	0.43	10.92	0.67	17.01	0.88	22.35	1.11	28.19	1.65	41.91	2.84	72.13	5.16	131.06	11.78	299.21
15.00	0.43	10.92	0.68	17.27	0.89	22.35	1.11	28.19	1.67	42.41	2.88	73.15	5.20	132.08	11.87	301.49
15.25	0.44	11.17	0.69	17.52	0.89	22.60	1.13	28.70	1.69	42.92	2.91	73.91	5.30	134.62	12.07	306.57
15.75	0.45	11.43	0.70	17.78	0.90	22.86	1.17	29.71	1.75	44.45	3.00	76.20	5.47	138.93	12.46	316.48

# VALVE BODY MINIMUM WALL THICKNESS

Inside Diameter d. inch	Class															
	150		300		400		600		900		1500		2500		4500	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
16.00	0.45	11.43	0.71	18.03	0.91	23.11	1.18	29.97	1.77	44.95	3.06	77.72	5.54	140.71	12.66	321.56
16.37	0.46	11.68	0.72	18.28	0.93	23.62	1.21	30.37	1.81	45.97	3.12	79.24	5.68	144.27	12.95	328.93
16.50	0.46	11.68	0.73	18.54	0.93	23.62	1.22	30.98	1.82	46.22	3.14	79.75	5.72	145.28	13.05	331.47
17.00	0.46	11.68	0.75	19.05	0.94	23.87	1.25	31.75	1.86	47.24	3.24	82.29	5.90	149.86	13.44	341.37
17.25	0.47	11.93	0.75	19.05	0.97	24.63	1.27	32.25	1.90	48.26	3.28	83.31	5.98	151.89	13.64	346.45
17.50	0.47	11.93	0.76	19.30	0.98	24.89	1.29	32.76	1.91	48.51	3.33	84.58	6.07	154.17	13.84	351.53
17.62	0.48	12.19	0.76	19.30	0.98	24.89	1.29	32.76	1.94	49.27	3.35	85.09	6.11	155.19	13.93	353.82
18.00	0.48	12.19	0.78	19.81	1.00	25.40	1.31	33.27	1.96	49.78	3.42	86.86	6.24	158.49	14.23	361.44
18.25	0.49	12.44	0.78	19.81	1.02	25.90	1.34	34.03	2.01	51.05	3.47	88.13	6.32	160.52	14.42	366.26
18.87	0.50	12.70	0.80	20.32	1.06	26.92	1.38	35.05	2.07	52.57	3.58	90.93	6.53	165.86	14.91	378.71
19.00	0.50	12.70	0.81	20.57	1.07	27.17	1.39	35.30	2.07	52.57	3.61	91.69	6.58	167.13	15.01	381.25
19.25	0.50	12.70	0.82	20.82	1.07	27.17	1.40	35.56	2.10	53.34	3.65	92.71	6.66	169.16	15.21	386.33
19.62	0.51	12.95	0.83	21.08	1.09	27.68	1.43	36.32	2.15	54.61	3.72	94.48	6.79	172.46	15.50	393.70
20.00	0.51	12.95	0.84	21.33	1.10	27.94	1.46	37.08	2.17	55.11	3.79	96.26	6.92	175.76	15.80	401.31
20.12	0.51	12.95	0.84	21.33	1.10	27.94	1.47	37.33	2.20	55.88	3.81	96.77	6.96	176.78	15.89	403.60
20.37	0.51	12.95	0.85	21.59	1.11	28.19	1.48	37.59	2.23	56.64	3.86	98.04	7.05	179.07	16.09	408.68
20.75	0.52	13.20	0.86	21.84	1.12	28.44	1.51	38.35	2.27	57.65	3.93	99.82	7.17	182.11	16.39	416.30
21.00	0.53	13.46	0.88	22.35	1.13	28.70	1.53	38.86	2.28	57.91	3.97	100.83	7.26	184.40	16.58	421.13
21.25	0.53	13.46	0.88	22.35	1.14	28.95	1.54	39.11	2.32	58.92	4.02	102.10	7.34	186.43	16.78	426.21
22.00	0.54	13.71	0.91	23.11	1.17	29.71	1.59	40.38	2.40	60.96	4.15	105.41	7.60	193.04	17.37	441.19
22.62	0.55	13.97	0.93	23.62	1.19	30.22	1.63	41.40	2.46	62.48	4.27	108.45	7.81	198.37	17.85	453.39
22.75	0.55	13.97	0.93	23.62	1.20	30.48	1.64	41.65	2.48	62.99	4.30	109.22	7.86	199.64	17.96	456.18
23.00	0.56	14.22	0.94	23.87	1.20	30.48	1.66	42.16	2.50	63.50	4.33	109.98	7.94	201.67	18.15	461.01
23.25	0.57	14.47	0.95	24.13	1.21	30.73	1.68	42.67	2.53	64.26	4.39	111.50	8.03	203.96	18.35	466.09
23.75	0.58	14.73	0.96	24.38	1.23	31.24	1.70	43.18	2.58	65.53	4.40	113.79	8.20	208.28	18.74	475.99
24.00	0.58	14.73	0.97	24.63	1.24	31.49	1.72	43.68	2.61	66.29	4.53	115.06	8.28	210.31	18.94	481.07
24.25	0.58	14.73	0.98	24.89	1.26	32.00	1.74	44.19	2.64	67.05	4.57	116.07	8.37	212.59	19.13	485.90
24.62	0.59	14.93	0.99	25.14	1.27	32.25	1.77	44.95	2.67	67.81	4.64	117.85	8.49	215.64	19.43	493.52
25.00	0.59	14.98	1.00	25.40	1.28	32.51	1.79	45.46	2.71	68.83	4.71	119.63	8.62	218.94	19.97	507.23
25.25	0.60	14.98	1.01	25.65	1.29	32.76	1.81	45.97	2.74	69.59	4.76	120.90	8.71	221.23	19.92	505.96
25.50	0.61	15.49	1.02	25.90	1.30	33.02	1.82	46.22	2.76	70.10	4.80	121.92	8.79	223.26	20.11	510.79
26.00	0.61	15.49	1.04	26.41	1.32	33.52	1.85	46.99	2.82	71.62	4.90	124.46	8.96	227.58	20.51	520.95
26.25	0.62	15.74	1.05	26.67	1.33	33.78	1.88	47.75	2.84	72.13	4.94	125.47	9.05	229.87	20.70	525.78
26.37	0.62	15.74	1.05	26.67	1.34	34.03	1.89	48.00	2.86	72.64	4.96	125.98	9.09	230.88	20.80	528.32
27.00	0.62	15.74	1.07	27.17	1.36	34.54	1.93	49.02	2.92	74.16	5.08	129.03	9.30	236.22	21.29	540.76
27.25	0.62	15.74	1.08	27.43	1.37	34.79	1.95	49.53	2.95	74.93	5.13	130.30	9.39	238.50	21.49	545.84
27.37	0.63	16.00	1.08	27.43	1.37	34.79	1.96	49.78	2.96	75.18	5.15	130.18	9.43	239.52	21.59	548.38
28.00	0.64	16.25	1.10	27.94	1.39	35.30	2.00	50.80	3.03	76.96	5.26	133.60	9.65	245.11	22.08	560.83
28.25	0.65	16.51	1.11	28.19	1.40	35.56	2.01	51.05	3.05	77.47	5.31	134.87	9.73	247.14	22.27	565.65
29.00	0.66	16.76	1.14	28.95	1.43	36.32	2.07	52.57	3.13	79.50	5.45	138.43	9.99	253.74	22.86	580.64
29.25	0.66	16.76	1.14	28.95	1.44	36.57	2.08	52.83	3.16	80.26	5.49	139.44	10.07	255.77	23.06	585.72
30.00	0.67	17.01	1.17	29.71	1.47	37.33	2.13	54.10	3.23	82.04	5.63	143.00	10.33	262.38	23.65	600.71
31.00	0.69	17.52	1.20	30.48	1.51	38.35	2.20	55.88	3.34	84.83	5.82	147.82	10.67	271.01	24.43	620.52
32.00	0.71	18.03	1.23	31.24	1.54	39.11	2.27	57.65	3.44	87.37	6.00	152.40	11.01	279.65	25.22	640.58
33.00	0.72	18.28	1.27	32.25	1.58	40.13	2.34	59.43	3.55	90.17	6.19	157.22	11.35	288.29	26.00	660.40
34.00	0.74	18.79	1.30	33.02	1.62	41.14	2.40	60.96	3.65	92.17	6.37	161.79	11.69	296.92	26.79	680.46
35.00	0.75	19.05	1.33	33.78	1.65	41.91	2.47	62.73	3.76	95.50	6.55	166.37	12.03	305.56	27.57	700.27
36.00	0.77	19.55	1.37	34.79	1.69	42.92	2.54	64.51	3.86	98.04	6.74	171.19	12.37	314.19	28.36	720.34
37.00	0.79	20.06	1.40	35.56	1.73	43.94	2.61	66.29	3.97	100.83	6.92	175.76	12.71	322.83	29.14	740.15
38.00	0.80	20.32	1.43	36.32	1.79	45.46	2.68	68.07	4.07	103.37	7.11	180.59	13.05	331.47	29.93	760.22
39.00	0.82	20.82	1.47	37.33	1.83	46.48	2.74	69.59	4.18	106.17	7.29	185.16	13.40	340.36	30.71	780.03
40.00	0.84	21.33	1.50	38.10	1.88	47.75	2.81	71.37	4.28	108.71	7.48	189.99	13.74	348.99	31.50	800.10
41.00	0.85	21.59	1.53	38.86	1.92	48.76	2.88	73.15	4.38	111.25	7.66	194.56	14.08	357.63	32.28	819.91
42.00	0.87	22.09	1.56	39.62	1.96	49.78	2.95	74.93	4.49	114.04	7.85	199.39	14.42	366.26	33.07	839.97
43.00	0.88	22.35	1.60	40.64	2.01	51.05	3.01	76.45	4.59	116.58	8.03	203.96	14.76	374.90	33.85	859.79
44.00	0.90	22.86	1.63	41.40	2.05	52.07	3.08	78.23	4.70	119.38	8.21	208.53	15.10	383.54	34.63	879.60
45.00	0.92	23.36	1.66	42.16	2.10	53.34	3.15	80.01	4.80	121.92	8.40	213.36	15.44	392.17	35.42	899.66
46.00	0.9	23.62	1.70	43.18	2.14	54.35	3.22	81.78	4.91	124.71	8.58	217.93	15.78	400.81	36.20	919.48
47.00	0.95	24.13	1.73	43.94	2.19	55.62	3.29	83.56	5.01	127.35	8.77	222.75	16.12	409.44	36.99	939.54
48.00	0.97	24.63	1.76	44.70	2.23	56.64	3.35	85.09	5.12	130.04	8.95	227.33	16.46	418.08	37.77	959.35
49.00	0.98	24.89	1.80	45.72	2.27	57.65	3.42	86.86	5.22	132.58	9.14	232.15	16.80	426.72	38.56	979.42
50.00	1.00	25.40	1.83	46.48	2.31	58.92	3.49	88.64	5.32	135.12	9.32	236.72	17.15	435.61	39.34	999.23

# TEMPERATURE CONVERSION

C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F
-273	-459.4			-17.2	1	33.8	16.1	61	141.8	149	300	572	482	900	1652
-268	-450			-16.7	2	35.6	16.7	62	143.6	154	310	590	488	910	1670
-262	-440			-16.1	3	37.4	17.2	63	145.4	160	320	608	493	920	1688
-257	-430			-15.6	4	39.2	17.8	64	147.2	166	330	626	499	930	1706
-251	-420			-15.0	5	41.0	18.3	65	149.0	171	340	644	504	940	1724
-246	-410			-14.4	6	42.8	18.9	66	150.8	177	350	662	510	950	1742
-240	-400			-13.9	7	44.6	19.4	67	152.6	182	360	680	516	960	1760
-234	-390			-13.3	8	46.4	20.0	68	154.4	188	370	698	521	970	1778
-229	-380			-12.8	9	48.2	20.6	69	156.2	193	380	716	527	980	1796
-223	-370			-12.2	10	50.5	21.1	70	158.0	199	390	734	532	990	1814
-218	-360			-11.7	11	51.8	21.7	71	159.8	204	400	752	538	1000	1832
-212	-350			-11.1	12	536	22.2	72	161.6	210	410	770	549	1010	1868
-207	-340			-10.6	13	55.4	22.8	73	163.4	216	420	788	560	1040	1904
-201	-330			-10.0	14	57.2	23.3	74	165.2	221	430	806	571	1060	1940
-196	-320			-9.4	15	59.0	23.9	75	167.0	227	440	844	582	1080	1976
-190	-310			-8.9	16	60.8	24.4	76	168.8	232	450	842	593	1100	2012
-184	-300			-8.3	17	62.6	25.0	77	170.6	238	460	860	604	1120	2048
-179	-290			-7.8	18	64.4	25.6	78	172.4	243	470	878	616	1140	2084
-173	-280			-7.2	19	66.2	26.1	79	174.2	249	480	896	627	1160	2120
-169	-273	-459.4		-6.7	20	68.0	26.7	80	176.0	254	490	914	638	1180	2156
-168	-270	-454		-6.1	21	69.8	27.2	81	177.8	260	500	932	649	1200	2192
-162	-260	-436		-5.6	22	71.6	27.8	82	179.6	266	510	950	660	1220	2228
-157	-250	-418		-5.0	23	73.4	28.3	83	181.4	271	520	968	671	1240	2264
-151	-240	-400		-4.4	24	75.2	28.9	84	183.2	277	530	986	682	1260	2300
-146	-230	-382		-3.9	25	77.0	29.4	85	185.0	282	540	1004	693	1280	2336
-140	-220	-364		-3.3	26	78.8	30.0	86	186.8	288	550	1022	704	1300	2372
-134	-210	-346		-2.8	27	80.6	30.6	87	188.6	293	560	1040	732	1350	2462
-129	-200	-328		-2.2	28	82.4	31.1	88	190.4	299	570	1058	760	1400	2552
-123	-190	-310		-1.7	29	84.2	31.7	89	192.2	304	580	1076	788	1450	2642
-118	-180	-292		-1.1	30	86.0	32.2	90	194.0	310	590	1094	816	1500	2732
-112	-170	-274		-0.6	31	87.8	32.8	91	195.8	316	600	1112	843	1550	2822
-107	-160	-256		0.0	32	89.6	33.3	92	197.6	321	610	1130	871	1600	2912
-101	-150	-238		0.6	33	91.4	33.9	93	199.4	327	620	1148	899	1650	3002
-96	-140	-220		1.1	34	93.2	34.4	94	201.2	331	630	1166	927	1700	3092
-90	-130	-202		1.7	35	95.0	35.0	95	203.0	338	640	1184	954	1750	3182
-84	-120	-184		2.2	36	96.8	35.6	96	204.8	343	650	1202	982	1800	3272
-79	-110	-166		2.8	37	98.6	36.1	97	206.6	349	660	1220	1010	1850	3362
-73	-100	-148		3.3	38	100.4	36.7	98	208.4	354	670	1238	1038	1900	3452
-68	-90	-130		3.9	39	102.2	37.2	99	210.2	360	680	1256	1066	1950	3542
-62	-80	-112		4.4	40	104.0	37.8	100	212.0	366	690	1274	1093	2000	3632
-57	-70	-94		5.0	41	105.8	43	110	230	371	700	1292	1121	2050	3722
-51	-60	-76		5.6	42	107.6	49	120	248	377	710	1310	1149	2100	3812
-46	-50	-58		6.1	43	109.4	54	130	266	382	720	1328	1177	2150	3902
-40	-40	-40		6.7	44	111.2	60	140	284	388	730	1346	1204	2200	3992
-34	-30	-22		7.2	45	113.0	66	150	302	393	740	1364	1232	2250	4082
-29	-20	-4		7.8	46	114.8	71	160	320	399	750	1382	1260	2300	4172
-23	-10	14		8.3	47	116.6	77	170	338	404	760	1400	1288	2350	4262
-17.8	0	32		8.9	48	118.4	82	180	356	410	770	1418	1316	2400	4352
				9.4	49	120.2	88	190	374	416	780	1436	1343	2450	4442
				10.0	50	122.0	93	200	392	421	790	1454	1371	2500	4532
				10.6	51	123.8	99	210	410	427	800	1472	1399	2550	4622
				11.1	52	125.6	100	212	414	432	810	1490	1427	2600	4712
				11.7	53	127.4	104	220	428	438	820	1508	1454	2650	4802
				12.2	54	129.2	110	230	446	443	830	1526	1482	2700	4892
				12.8	55	131.0	116	240	464	449	840	1544	1510	2750	4982
				13.3	56	132.8	121	250	482	454	850	1562	1538	2800	5072
				13.9	57	134.6	127	260	500	460	860	1580	1566	2850	5162
				14.4	58	136.4	132	270	518	466	870	1598	1593	2900	5252
				15.0	59	138.2	138	280	536	471	880	1616	1621	2950	5342
				15.6	60	140.0	143	290	554	477	890	1634	1649	3000	5432

$$C = \frac{5}{9} (F - 32) \quad F = \frac{9}{5} C + 32$$

# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 150/PN 20

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	A182-F5a
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)				A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)	A217-C5(4)
Temperature, °C										
-29 to 38	19.6	19.8	18.4	16.3	18.4	19.8	19.8	19.8	20.0	20.0
50	19.2	19.5	18.2	16.0	18.4	19.5	19.5	19.5	19.5	19.5
100	17.7	17.7	17.4	14.9	17.7	17.7	17.7	17.7	17.7	17.7
150	15.8	15.8	15.8	14.4	15.8	15.8	15.8	15.8	15.8	15.8
200	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
250	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
300	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
350	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
375	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
400	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
425	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
450	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
475	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
500	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
538	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
550						1.4(a)	1.4(a)	1.4(a)	1.4(a)	1.4(a)
575						1.4(a)	1.4(a)	1.4(a)	1.4(a)	1.4(a)
600						1.4(a)	1.4(a)	1.4(a)	1.4(a)	1.4(a)
625							1.4(a)	1.4(a)	1.4(a)	1.4(a)
650							1.1(a)	1.1(a)	1.2(a)	0.9(a)

GENERAL NOTE : a) Flanged end valve ratings terminate at 538 °C

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	20.0	20.0	19.0	19.0	15.9	19.0	19.0	19.0	19.0
50	19.5	19.5	18.3	18.4	15.3	18.6	18.7	18.5	18.5
100	17.7	17.7	15.7	16.2	13.3	17.0	17.4	16.5	16.6
150	15.8	15.8	14.2	14.8	12.0	15.7	15.8	15.3	15.3
200	13.8	13.8	13.2	13.7	11.2	13.8	13.8	13.8	13.8
250	12.1	12.1	12.1	12.1	10.5	12.1	12.1	12.1	12.1
300	10.2	10.2	10.2	10.2	10.0	10.2	10.2	10.2	10.2
350	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
375	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
400	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
425	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
450	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
475	3.7	3.7	3.7	3.7		3.7	3.7	3.7	3.7
500	2.8	2.8	2.8	2.8		2.8	2.8	2.8	2.8
538	1.4	1.4	1.4	1.4		1.4	1.4	1.4	1.4
550	1.4(a)	1.4(a)	1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
575	1.4(a)	1.4(a)	1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
600	1.4(a)	1.4(a)	1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
625	1.4(a)	1.4(a)	1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
650	1.4(a)	1.4(a)	1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
675			1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
700			1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
725			1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.4(a)	1.4(a)
750			1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.3(a)	1.3(a)
775			1.4(a)	1.4(a)		1.4(a)	1.4(a)	1.0(a)	1.0(a)
800			1.2(a)	1.2(a)		1.2(a)	1.2(a)	0.8(a)	0.8(a)

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6  
 (8) Use annealed material only  
 (9) Use solution annealed material only

- (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)  
 (18) For welding end valves Flanged end ratings terminate at 1000°F(540°C)

# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 300/PN 50

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)			A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)		A217-C5(4)
Temperature, °C										
-29 to 38	51.1	51.7	48.0	42.6	48.0	51.7	51.7	51.7	51.7	51.7
50	50.1	51.7	47.5	41.8	48.0	51.7	51.7	51.7	51.7	51.7
100	46.6	51.5	45.3	38.8	47.9	51.5	51.5	51.5	51.5	51.5
150	45.1	50.2	43.9	37.6	47.3	50.3	49.7	50.3	50.3	50.3
200	43.8	48.6	42.5	36.4	45.8	48.6	48.0	48.6	48.6	48.6
250	41.9	46.3	40.8	34.9	44.5	46.3	46.3	46.3	46.3	46.3
300	39.8	42.9	38.7	33.2	42.9	42.9	42.9	42.9	42.9	42.9
350	37.6	40.0	36.4	31.2	40.3	40.3	40.3	40.3	40.3	40.3
375	36.4	37.8	35.0	30.4	38.9	38.9	38.9	38.9	38.9	38.9
400	34.7	34.7	32.6	29.3	36.5	36.5	36.5	36.5	36.5	36.5
425	28.8	28.8	27.3	25.8	35.2	35.2	35.2	35.2	35.2	35.2
450	23.0	23.0	21.6	21.4	33.7	33.7	33.7	33.7	33.7	33.7
475	17.4	17.1	15.7	14.1	31.7	31.7	31.7	31.7	31.7	27.9
500	11.8	11.6	11.1	10.3	24.1	26.7	25.7	28.2	23.6	21.4
538	5.9	5.9	5.9	5.9	11.3	13.9	14.9	18.4	11.3	13.7
550										
575						12.6	12.7	15.6	11.3	12.0
600						7.2	8.8	10.5	10.1	8.9
625							6.1	6.9	7.1	6.2
650							4.3	4.5	5.3	4.0
650							2.8	2.8	3.1	2.4

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	51.7	51.7	49.6	49.6	41.4	49.6	49.6	49.6	49.6
50	51.7	51.7	47.8	48.1	40.0	48.6	48.8	48.3	48.4
100	51.5	51.5	40.9	42.2	34.8	44.2	45.3	43.1	43.4
150	50.3	50.3	37.0	38.5	31.4	41.0	42.5	40.0	40.0
200	48.6	48.6	34.5	35.7	29.2	38.3	39.9	37.8	37.6
250	46.3	46.3	32.5	33.4	27.5	36.0	37.8	36.1	35.8
300	42.9	42.9	30.9	31.6	26.1	34.1	36.1	34.8	34.5
350	40.3	40.3	29.6	30.3	25.1	32.6	34.8	33.8	33.3
375	38.9	38.9	29.0	29.9	24.8	32.0	34.2	33.4	32.9
400	36.5	36.5	28.4	29.4	24.3	31.6	33.9	33.1	32.4
425	35.2	35.2	28.0	29.1	23.9	31.1	33.6	32.6	32.1
450	33.7	33.7	27.4	28.8	23.4	30.8	33.5	32.2	31.7
475	31.7	31.7	26.9	28.7		30.5	31.7	31.7	31.2
500	28.2	28.2	26.5	28.2		28.2	28.2	28.2	28.2
538	17.5	25.2	24.4	25.2		25.2	25.2	25.2	25.2
550	15.0	25.0	23.6	25.0		25.0	25.0	25.0	25.0
575	10.5	24.0	20.8	24.0		24.0	22.2	22.2	22.2
600	7.2	19.5	16.9	19.9		20.3	21.6	16.8	16.8
625	5.0	14.6	13.8	15.8		15.8	18.3	12.5	12.5
650	3.5	9.9	11.3	12.7		12.6	14.1	9.4	9.4
675			9.3	10.3		9.9	12.4	7.2	7.2
700			8.0	8.4		7.9	10.1	5.5	5.5
725			6.8	7.0		6.3	7.9	4.3	4.3
750			5.8	5.9		5.0	5.9	3.4	3.4
775			4.6	4.6		4.0	4.6	2.7	2.7
800			3.5	3.5		3.1	3.5	2.1	2.1

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6

- (8) Use annealed material only  
 (9) Use solution annealed material only  
 (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)

# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 600/PN 100

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	A182-F5a
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)				A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)	A217-C5(4)
Temperature, °C										
-29 to 38	102.1	103.4	96.0	85.1	96.0	103.4	103.4	103.4	103.4	103.4
50	100.2	103.4	94.9	83.5	96.0	103.4	103.4	103.4	103.4	103.4
100	93.2	103.0	90.7	77.7	95.9	103.0	103.0	103.0	103.0	103.0
150	90.2	100.3	87.9	75.1	94.7	100.3	99.5	100.3	100.3	100.3
200	87.6	97.2	85.1	72.8	91.6	97.2	95.9	97.2	97.2	97.2
250	83.9	92.7	81.6	69.8	89.0	92.7	92.7	92.7	92.7	92.7
300	79.6	85.7	77.4	66.4	85.7	85.7	85.7	85.7	85.7	85.7
350	75.1	80.0	72.8	62.5	80.4	80.4	80.4	80.4	80.4	80.4
375	72.7	75.7	69.9	60.7	77.6	77.6	77.6	77.6	77.6	77.6
400	69.4	69.4	65.2	58.7	73.3	73.3	73.3	73.3	73.3	73.3
425	57.5	57.5	54.6	51.5	70.0	70.0	70.0	70.0	70.0	70.0
450	46.0	46.0	43.2	42.7	67.7	67.7	67.7	67.7	67.7	67.7
475	34.9	34.2	31.3	28.2	63.4	63.4	63.4	63.4	63.4	55.7
500	23.5	23.2	22.1	20.6	48.1	53.4	51.5	56.5	47.1	42.8
538	11.8	11.8	11.8	11.8	22.7	27.9	29.8	36.9	22.7	27.4
550						25.2	25.4	31.3	22.7	24.1
575						14.4	17.6	21.1	20.1	17.8
600							12.2	13.8	14.2	12.5
625							8.5	8.9	10.6	8.0
650							5.7	5.7	6.1	4.7

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	103.4	103.4	99.3	99.3	82.7	99.3	99.3	99.3	99.3
50	103.4	103.4	95.6	96.2	80.0	97.1	97.5	96.6	96.7
100	103.0	103.0	81.7	84.4	69.6	88.5	90.6	86.2	86.8
150	100.3	100.3	74.0	77.0	62.8	82.0	84.9	80.0	80.0
200	97.2	97.2	69.0	71.3	58.3	76.6	79.9	75.5	75.2
250	92.7	92.7	65.0	66.8	54.9	72.0	75.6	72.1	71.5
300	85.7	85.7	61.8	63.2	52.1	68.3	72.2	69.6	68.9
350	80.4	80.4	59.3	60.7	50.1	65.2	69.5	67.6	66.6
375	77.6	77.6	58.1	59.8	49.5	64.1	68.4	66.8	65.7
400	73.3	73.3	56.9	58.9	48.6	63.2	67.8	66.1	64.8
425	70.0	70.0	56.0	58.3	47.7	62.3	67.2	65.3	64.2
450	67.7	67.7	54.8	57.7	46.8	61.7	66.9	64.4	63.4
475	63.4	63.4	53.9	57.3		61.1	63.4	63.4	62.5
500	56.5	56.5	53.0	56.5		56.5	56.4	56.5	56.5
538	35.0	50.0	48.9	50.0		50.0	50.0	50.0	50.0
550	30.0	49.8	47.1	???		49.8	49.8	49.8	49.8
575	20.9	47.9	41.7	47.9		47.9	47.9	44.4	44.4
600	14.4	39.0	33.8	39.8		40.5	42.9	33.5	33.5
625	9.9	29.2	27.6	31.6		31.6	36.6	25.0	25.0
650	7.1	19.9	22.5	25.3		25.3	28.1	18.7	18.7
675			18.7	20.6		19.8	25.2	14.5	14.5
700			16.1	16.8		15.8	20.0	11.0	11.0
725			13.5	14.0		12.7	15.4	8.7	8.7
750			11.6	11.7		10.0	11.7	6.8	6.8
775			9.0	9.0		8.0	9.0	5.4	5.3
800			7.0	7.0		6.3	7.0	4.2	4.1

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6

- (8) Use annealed material only  
 (9) Use solution annealed material only  
 (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)



# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 900/PN 150

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	A182-F5a
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)			A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)		A217-C5(4)
Temperature, °C										
-29 to 38	153.2	155.1	144.1	127.7	144.1	155.1	155.1	155.1	155.1	155.1
50	150.4	155.1	142.4	125.3	144.1	155.1	155.1	155.1	155.1	155.1
100	139.8	154.6	136.0	116.5	143.8	154.6	154.4	154.6	154.6	154.6
150	135.2	150.5	131.8	112.7	142.0	150.6	149.2	150.6	150.6	150.6
200	131.4	145.8	127.6	109.2	137.4	145.8	143.9	145.8	145.8	145.8
250	125.8	139.0	122.3	104.7	133.5	139.0	139.0	139.0	139.0	139.0
300	119.5	128.6	116.1	99.5	128.6	128.6	128.6	128.6	128.6	128.6
350	112.7	120.1	109.2	93.7	120.7	120.7	120.7	120.7	120.7	120.7
375	109.1	113.5	104.9	91.1	116.5	116.5	116.5	116.5	116.5	116.5
400	104.2	104.2	97.9	88.0	109.8	109.8	109.8	109.8	109.8	109.8
425	86.3	86.3	81.9	77.3	105.1	105.1	105.1	105.1	105.1	105.1
450	69.0	69.0	64.8	64.1	101.4	101.4	101.4	101.4	101.4	101.4
475	52.3	51.3	47.0	42.3	95.1	95.1	95.1	95.1	95.1	95.1
500	35.3	34.7	33.2	30.9	72.2	80.1	77.2	84.7	70.7	64.1
538	17.7	17.7	17.7	17.7	34.0	41.8	44.7	55.3	34.0	41.1
550						37.8	38.1	46.9	34.0	36.1
575						21.5	26.4	31.6	30.2	26.7
600							18.3	20.7	21.3	18.7
625							12.8	13.4	15.9	12.0
650							8.5	8.5	9.2	7.1

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	155.1	155.1	99.3	148.9	124.1	148.9	148.9	148.9	148.9
50	155.1	155.1	95.6	144.3	120.1	145.7	146.3	144.9	145.1
100	154.6	154.6	81.7	126.6	104.4	132.7	135.9	129.3	130.2
150	150.6	150.6	74.0	115.3	94.2	122.9	127.4	120.0	120.0
200	145.8	145.8	69.0	107.0	87.5	114.9	119.8	113.3	112.8
250	139.0	139.0	65.0	100.1	82.4	108.1	113.4	108.2	107.3
300	128.6	128.6	61.8	94.9	78.2	102.4	108.3	104.4	103.4
350	120.7	120.7	59.3	91.0	75.2	97.8	104.3	101.4	99.9
375	116.5	116.5	58.1	89.6	74.3	96.1	102.6	100.1	98.6
400	109.8	109.8	56.9	88.3	72.9	94.8	101.7	99.2	97.3
425	105.1	105.1	56.0	87.4	71.6	93.4	100.8	97.9	96.4
450	101.4	101.4	54.8	86.5	70.2	92.5	100.4	96.5	95.1
475	95.1	95.1	53.9	86.0		91.6	95.1	95.1	93.7
500	84.7	84.7	53.0	84.7		84.7	84.7	84.7	84.7
538	52.5	75.2	48.9	75.2		75.2	75.2	75.2	75.2
550	45.0	74.8	47.1	74.8		74.8	74.8	74.8	74.8
575	31.4	71.8	41.7	???		71.8	71.8	66.5	66.5
600	21.5	58.5	33.8	59.7		60.8	64.2	50.3	50.3
625	14.9	43.8	27.6	47.4		47.4	54.9	37.5	37.5
650	10.6	29.8	22.5	38.0		37.9	42.5	28.1	28.1
675			18.7	31.0		29.6	37.6	21.7	21.7
700			16.1	25.1		23.7	29.8	16.5	16.5
725			13.5	21.0		19.0	23.2	13.0	13.0
750			11.6	17.6		15.0	17.6	10.2	10.2
775			9.0	13.7		11.9	13.7	8.1	8.0
800			7.0	10.5		9.4	10.5	6.3	6.2

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6

- (8) Use annealed material only  
 (9) Use solution annealed material only  
 (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)

# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 1500/PN 250

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	A182-F5a
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)				A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)	A217-C5(4)
Temperature, °C										
-29 to 38	255.3	258.6	240.1	212.8	240.1	258.6	258.6	258.6	258.6	258.6
50	250.6	258.6	237.3	208.9	240.1	258.6	25.6	258.6	258.6	258.6
100	233.0	257.6	226.7	194.2	239.7	257.6	257.4	257.6	257.6	257.6
150	225.4	250.8	219.7	187.8	236.7	250.8	248.7	250.8	250.8	250.8
200	219.0	243.2	212.7	182.1	229.0	243.4	239.8	243.4	243.4	243.4
250	209.7	231.8	203.9	174.6	222.5	231.8	231.8	231.8	231.8	231.8
300	199.1	214.4	193.4	165.9	214.4	214.4	214.4	214.4	214.4	214.4
350	187.8	200.1	182.0	156.2	201.1	201.1	201.1	201.1	201.1	201.1
375	181.8	189.2	174.9	151.8	194.1	194.1	194.1	194.1	194.1	194.1
400	173.6	173.6	163.1	146.7	183.1	183.1	183.1	183.1	183.1	183.1
425	143.8	143.8	136.5	128.8	175.1	175.1	175.1	175.1	175.1	175.1
450	115.0	115.0	107.9	106.8	169.0	169.0	169.0	169.0	169.0	169.0
475	87.2	85.4	78.3	70.5	158.2	158.2	158.2	158.2	158.2	139.3
500	58.8	57.9	55.4	51.5	120.3	133.4	128.6	140.9	117.8	106.9
538	29.5	29.5	29.5	29.5	56.7	69.7	74.5	92.2	56.7	68.6
550						63.0	63.5	78.2	56.7	60.2
575						35.9	44.0	52.6	50.3	44.4
600							30.5	34.4	35.6	31.2
625							21.3	22.3	26.5	20.0
650							14.2	14.2	15.4	11.8

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	258.6	258.6	248.2	248.2	206.8	248.2	248.2	248.2	248.2
50	258.6	258.6	239.1	240.6	200.1	242.8	243.8	241.5	241.8
100	257.6	257.6	204.3	211.0	173.9	221.2	226.5	215.5	217.0
150	250.8	250.8	185.0	192.5	157.0	204.9	212.4	200.0	200.0
200	243.4	243.4	172.4	178.3	145.8	191.5	199.7	188.8	188.0
250	231.8	231.8	162.4	166.9	137.3	180.1	189.1	180.4	178.8
300	214.4	214.4	154.6	158.1	130.3	170.7	180.4	173.9	172.3
350	201.1	201.1	148.1	151.6	125.4	163.0	173.8	169.0	166.5
375	194.1	194.1	145.2	149.4	123.8	160.2	171.0	166.9	164.3
400	183.1	183.1	142.2	147.2	121.5	157.9	169.5	165.4	162.1
425	175.1	175.1	140.0	145.7	119.3	155.7	168.1	163.1	160.6
450	169.0	169.0	137.0	144.2	117.1	154.2	167.3	160.9	158.4
475	158.2	158.2	134.7	143.4		152.7	158.2	158.2	156.2
500	140.9	140.9	132.4	140.9		140.9	140.9	140.9	140.9
538	87.5	125.5	122.1	125.5		125.5	125.5	125.5	125.5
550	75.0	124.9	117.8	124.9		124.9	124.9	124.9	124.9
575	52.3	119.7	104.2	???		119.7	119.7	110.9	110.9
600	35.9	97.5	84.4	99.5		101.3	107.0	83.9	83.9
625	24.8	73.0	68.9	79.1		79.1	91.2	62.5	62.5
650	17.7	49.6	56.3	63.3		63.2	70.7	46.8	46.8
675			46.7	51.6		49.4	62.7	36.2	36.2
700			40.1	41.9		39.5	49.7	27.5	27.5
725			33.8	34.9		31.7	38.6	21.6	21.6
750			28.9	29.3		25.0	29.6	17.1	17.1
775			22.8	22.8		19.9	22.8	13.5	13.3
800			17.4	17.4		15.6	17.4	10.5	10.3

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6

- (8) Use annealed material only  
 (9) Use solution annealed material only  
 (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)

# ANSI PRESSURE TEMPERATURE RATINGS

## CLASS 2500/PN 420

(°C/Bar)

Material Group No.	1.1	1.2	1.3	1.4	1.5	1.7	1.9	1.10	1.11	1.13
Forgings	A105(1) (3) (5) A350-LF2(10)	A350-LF3(10)		A350-LF1(10)	A182-F1(2) (11)	A182-F2(12)	A182-F12(4) (14) A182-F11(4) (14)	A182-F22(14)	A182-F21(14)	A182-F5a
Castings	A216-WCB(1)	A216-WCC(1) A352-LC2(10) A352-LC3(10)	A352-LCB(10) A217-WC1(2) (11) A352-LC1(10)			A217-WC4(4) (12) A217-WC5(4) (13)	A217-WC6(4) (15)	A217-WC9(4) (15)		A217-C5(4)
Temperature, °C										
-29 to 38	425.5	430.9	400.1	212.8	400.1	430.9	430.9	430.9	430.9	430.9
50	417.7	430.9	395.6	208.9	400.1	430.9	430.9	430.9	430.9	430.9
100	388.3	429.4	377.8	194.2	399.5	429.4	429.0	429.4	429.4	429.4
150	375.6	418.1	366.1	187.8	394.5	418.2	414.5	418.2	418.2	418.2
200	365.0	405.4	354.4	182.1	381.7	405.4	399.6	405.4	405.4	405.4
250	349.5	386.2	339.8	174.6	370.9	386.2	386.2	386.2	386.2	386.2
300	331.8	357.1	322.4	165.9	357.1	357.1	357.1	357.1	357.1	357.1
350	313.0	333.5	303.3	156.2	335.3	355.3	335.3	335.3	335.3	335.3
375	303.1	315.3	291.4	151.8	323.2	323.2	323.2	323.2	323.2	323.2
400	289.3	289.3	271.9	146.7	304.9	304.9	304.9	304.9	304.9	304.9
425	239.7	239.7	227.5	128.8	291.6	291.6	291.6	291.6	291.6	291.6
450	191.7	191.7	179.9	106.8	281.8	281.8	281.8	281.8	281.8	281.8
475	145.3	142.4	130.6	70.5	263.9	263.9	263.9	263.9	263.9	232.1
500	97.9	96.5	92.3	51.5	200.5	222.4	214.4	235.0	196.3	178.2
538	49.2	49.2	49.2	29.5	94.6	116.2	124.1	153.7	94.6	114.3
550										
575						105.0	105.9	130.3	94.6	100.4
600						59.8	73.4	87.7	83.8	74.0
625							50.9	57.4	59.3	51.9
650							35.5	37.2	44.2	33.3
650							23.6	23.6	25.6	19.7

(°C/Bar)

Material Group No.	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7
Forgings	A182-F9	A182-F91 A335-P91	A182-F304(6) A182-F304H	A182-F316(6) A182-F316H	A182-F304L(16) A182-F316L	A182-F321(6) (12) A182-F321H	A182-F347(6) (12) A182-F347H A182-F348(6) (12) A182-F348H		A182-F310(6) (7)
Castings	A217-C12(4)	A217-C12A A387-91-CL2	A351-CF3(16) A351-CF8(6)	A351-CF3A(10) A351-CF8A(10) A351-CF3M(17) A351-CF8M(6)			A351-CF8(6)	A351-CH8(6) A351-CH20(6)	A351-CK20(6)
Temperature, °C									
-29 to 38	430.9	430.9	413.7	413.7	344.7	413.7	413.7	413.7	413.7
50	430.9	430.9	398.5	400.9	333.4	404.6	406.4	402.5	403.1
100	429.4	429.4	340.4	351.6	289.9	368.7	377.4	359.2	361.6
150	418.2	418.2	308.4	320.8	261.6	341.5	353.9	333.3	333.3
200	405.4	405.4	287.3	297.2	243.0	319.1	332.8	314.7	313.4
250	386.2	386.2	270.7	278.1	228.9	300.2	315.1	300.6	298.1
300	357.1	357.1	257.6	263.5	217.2	284.6	300.7	289.9	287.2
350	335.3	335.3	246.9	252.7	208.9	271.7	289.6	281.7	277.6
375	323.2	323.2	241.9	249.0	206.3	266.9	285.1	278.2	273.8
400	304.9	304.9	237.0	245.3	202.5	263.2	282.6	275.6	270.2
425	291.6	291.6	233.3	242.9	198.8	259.5	280.1	271.9	267.7
450	281.8	281.8	228.4	240.4	195.1	256.9	278.8	268.2	264.0
475	263.9	263.9	224.5	238.9		254.4	263.9	263.9	260.3
500	235.0	235.0	220.7	235.0		235.0	235.0	235.0	235.0
538	145.8	208.9	203.6	208.9		208.9	208.9	208.9	208.9
550	125.0	208.0	196.3	208.0		208.0	208.0	208.0	208.0
575	87.1	199.5	173.7	199.5		199.5	199.5	184.8	184.8
600	59.8	162.5	140.7	165.9		168.9	178.5	139.8	139.8
625	41.4	121.7	114.9	131.8		131.8	152.0	104.2	104.2
650	29.5	82.7	93.8	105.5		105.4	117.7	78.0	78.0
675			77.9	86.0		82.3	104.5	60.3	60.3
700			66.9	69.8		65.9	83.0	45.9	45.9
725			56.3	58.2		52.8	64.4	36.0	36.0
750			48.1	48.9		41.7	49.1	28.4	28.4
775			38.0	38.0		33.2	38.0	22.4	22.1
800			29.2	29.2		26.1	29.2	17.5	17.2

- Notes (1) Upon prolonged exposure to temperatures above about 800°F(425°C), the carbide phase of carbon steel may be converted to graphite.  
 (2) Upon prolonged exposure to temperatures above about 875°F(470°C), the carbide phase of carbon molybdenum steel may be converted to graphite.  
 (3) Only killed steel shall be used above 850°F(455°C)  
 (4) Use normalized and tempered material only.  
 (5) Permissible, but not recommended for prolonged usage above about 800°F(425°C)  
 (6) At temperatures over 1000°F(540°C) use only when the carbon is 0.04% or higher.  
 (7) For service temperatures of 1050°F(565°C) and above, assurance must be provided that grain size is not finer than ASTM No.6

- (8) Use annealed material only  
 (9) Use solution annealed material only  
 (10) Not to be used over 650°F(345°C)  
 (11) Permissible, but not recommended for prolonged upon above about 850°F(455°C)  
 (12) Not to be used over 1000°F(540°C)  
 (13) Not to be used over 1050°F(565°C)  
 (14) Permissible, but not recommended for prolonged upon above about 1100°F(595°C)  
 (15) Not to be used over 1100°F(595°C)  
 (16) Not to be used over 800°F(425°C)  
 (17) Not to be used over 850°F(455°C)

# HYDROSTATIC TEST PRESSURE TO ASME B16.34

Material			Test Pressures by Classes																											
Group No	Forging	Casting	150				300				600				900				1500				2500				4500			
			Shell		Seat / Backseat		Shell		Seat / Backseat		Shell		Seat / Backseat		Shell		Seat / Backseat		Shell		Seat / Backseat		Shell		Seat / Backseat		Shell		Seat / Backseat	
			kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi	kg/cm <sup>2</sup>	psi
1.1	A105 A350-LF2	A216-WCB	32.0	450	23.0	325	79.5	1125	58.5	825	156.5	2225	116.5	1650	236.0	3350	172.5	2450	392.0	5515	288.5	4100	652.5	9275	478.5	6800	1172.5	16675	860.0	12225
1.2	A350-LF3	A216-WCC A352-LC2 A352-LC3	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.3		A352-LCB	30	400	21	295	74	1050	54	775	148	2100	108	1535	222	3150	162	2299	368	5225	270	3828	615	8725	449	6386	1099.0	15625	806.5	11470
1.4	A350-LF1		26.5	375	19.5	275	67.0	950	49.5	700	133.0	1875	97.0	1375	195.5	2275	144.5	2050	327.0	4650	239.5	3400	543.5	7125	399.5	5675	977.5	13900	717.5	10200
1.5	A182-LF1	A217-WC1 A352-LC1	28.5	400	21.5	300	74.0	1050	54.5	775	148.0	2100	109.0	1550	221.5	3150	162.0	2300	367.5	5225	269.0	3825	612.0	8700	448.5	6375	1099.0	15625	806.5	11470
1.7	A182-F2	A217-WC4 A217-WC5	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.9	A182-F12 A182-F11	A217-WC6	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.10	A182-F22	A217-WC9	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.11	A182-F21		32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.13	A182-F5a	A217-C5	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
1.14	A182-F9	A217-C12	32.0	450	23.0	325	79.5	1125	58.5	825	158.5	2250	116.5	1650	237.5	3375	174.5	2475	395.5	5625	290.5	4125	659.5	9375	483.5	6875	1186.5	16875	870.5	12375
2.1	A182-F304 A182-F304H	A351-CF3 A351-CF8	30.0	425	23.0	325	77.5	1100	56.5	800	153.0	2175	112.5	1600	229.0	3250	169.0	2400	380.0	5400	279.5	3975	633.0	9000	464.5	6600	1139.5	16200	837.0	11900
2.2	A182-F316 A182-F316H	A351-CF3A A351-CF8A A351-CF3M A351-CF8M	30.0	425	23.0	325	77.5	1100	56.5	800	153.0	2175	112.5	1600	229.0	3250	169.0	2400	380.0	5400	279.5	3975	633.0	9000	464.5	6600	1139.5	16200	837.0	11900
2.3	A182-F304L A182-F316L		25.0	350	19.5	275	63.5	900	49.5	675	127.0	1800	93.5	1325	190.0	2700	141.0	2000	316.5	4500	232.5	3300	527.5	7500	387.0	5500	349.5	13500	696.5	9900
2.4	A182-F321 A182-F321H		30.0	425	23.0	325	77.5	1100	56.5	800	153.0	2175	112.5	1600	229.0	3250	169.0	2400	380.0	5400	279.5	3975	633.0	9000	464.5	6600	1139.5	16200	837.0	11900
2.5	A182-F347 A182-F347H A182-F348 A182-F348	A351-CF8C	30.0	425	23.0	325	77.5	1100	56.5	800	153.0	2175	112.5	1600	229.0	3250	169.0	2400	380.0	5400	279.5	3975	633.0	9000	464.5	6600	1139.5	16200	837.0	11900
2.6	A351-CH20	A351-CH20	28.5	400	21.5	300	72.5	1025	53.0	750	143.0	2025	106.0	1500	213.5	3025	157.0	2225	356.0	5050	261.0	3700	592.0	8400	435.0	6175	1065.5	15125	782.0	11100
2.7	A182-F310	A351-CK20	28.5	400	21.5	300	72.5	1025	53.0	750	143.0	2025	106.0	1500	213.5	3025	157.0	2225	356.0	5050	261.0	3700	592.0	8400	435.0	6175	1065.5	15125	782.0	11100
3.1	B462	A351-CM7M	25.0	350	19.5	275	63.5	900	47.5	675	127.0	1800	93.5	1325	190.0	2700	141.0	2000	316.5	4500	232.5	3300	527.5	7500	387.0	5500	949.5	13500	696.5	9900

Notes. All pressures are given as gauge pressure.

# CONVERSION TABLES

## STRESS

IN/m<sup>2</sup>=1MPa

kgf/m <sup>2</sup>	kgf/cm <sup>2</sup>	lbf/ft <sup>2</sup>	pa	Mpa(mm/mm <sup>2</sup> )
1	1×10 <sup>-2</sup>	2.048×10 <sup>-5</sup>	9.80665×10 <sup>-5</sup>	9.80665
1×10 <sup>-2</sup>	1	2.048×10 <sup>3</sup>	9.80665×10 <sup>-4</sup>	9.80665×10 <sup>-2</sup>
4.882×10 <sup>-6</sup>	4.882×10 <sup>-6</sup>	1	4.786×10 <sup>-6</sup>	4.786×10 <sup>-5</sup>
1.01972×10 <sup>-2</sup>	1.01972×10 <sup>-5</sup>	2.089×10 <sup>-2</sup>	1	1×10 <sup>-5</sup>
1.0972×10 <sup>-1</sup>	1.01972×10 <sup>-1</sup>	2.089×10 <sup>-4</sup>	1×10 <sup>5</sup>	1

## KINEMATIC VISCOSITY

1St=1 cm<sup>2</sup>/s

m <sup>2</sup> /s	ft <sup>2</sup> /s	cst	st
1	1.076×10	1×10 <sup>6</sup>	1×10 <sup>-4</sup>
9.290×10 <sup>-2</sup>	1	9.290×10 <sup>-4</sup>	9.290×10 <sup>-2</sup>
1×10 <sup>-6</sup>	1.076×10 <sup>5</sup>	1	1×10 <sup>-2</sup>
1×10 <sup>-4</sup>	1.076×10 <sup>-3</sup>	1×10 <sup>-2</sup>	1

## VOLUME

m <sup>3</sup>	in <sup>3</sup>	ft <sup>3</sup>	yd <sup>3</sup>	dm <sup>3</sup>	gal(British)	gal(U.S)	in <sup>3</sup>
1	61 024	35.31	1.308	1	0.220 0	0.264 2	61.02
1.639×10 <sup>-5</sup>	1	5.787×10 <sup>-4</sup>	2.143×10 <sup>-5</sup>	4.546	1	1.201	277.4
0.02832	1 728	1	0.03704	3.785	0.832 7	1	231
0.7646	46 656	27	1	0.016 39	3.605×10 <sup>-4</sup>	4.329×10 <sup>-3</sup>	1

## PRESSURE

1Pa=IN/m<sup>2</sup>

Mpa	kg f/cm <sup>2</sup>	lbf / in <sup>2</sup>	atm	mHg	in Hg	mH <sub>2</sub> O	ftH <sub>2</sub> O
1	10.20	145.0	9.869	7.501	295.3	102.0	334.6
0.098 07	1	14.22	0.967 8	0.735 6	28.96	10	32.81
0.006 895	0.070 31	1	0.068 05	0.051 71	2.036	0.703 1	2.307
0.101 3	1.033	14.70	1	0.76	29.92	10.33	33.90
0.133 3	1.360	19.34	1.316	1	39.37	13.60	44.60
0.003 386	0.034 53	0.4912	0.033 42	0.025 4	1	0.345 3	1.133
0.009806	0.01	1.422	0.096 78	0.073 55	2.896	1	3.281
0.002989	0.030 48	0.4335	0.029 50	0.022 42	0.882 7	0.304 8	1

## VISCOSITY

Poise=gc/m-s (CGS UNIT)	centipose. cP	kg/m-h	kg/m-s	lb/ft-s
1	100	0.1	360	0.0672
0.01	1	0.001	3.6	0.000672
10	1000.0	1	3600.0	0.672
0.00278	0.278	0.0278	1	0.000187
14.88	1488.0	1.488	5356.8	1

## VELOCITY

m/s	km/h	kn	ft/s	mil/h
1	3.6	1.944	3.281	2.237
0.277 8	1	0.540 0	0.911 3	0.621 4
0.514 4	151	1	1.688	1.151
0.304 8	1.097	0.592 5	1	0.681 8
0.447 0	1.609	0.869 0	1.467	1

## ENERGY

1J=1Ws, 1wh=3600Ws, 1cal=4.18605J

kgf-m	lbf-ft	j	kw-h	
1	7.231	9.807	2.724×10 <sup>-6</sup>	2.343×10 <sup>3</sup>
1.383×10 <sup>-1</sup>	1	1.356	3.766×10 <sup>-7</sup>	3.239×10 <sup>-4</sup>
1.0197×10 <sup>-1</sup>	7.376×10 <sup>-1</sup>	1	2.778×10 <sup>-7</sup>	2.389×10 <sup>-4</sup>
3.671×10 <sup>5</sup>	2.665×10 <sup>6</sup>	3.600×10 <sup>6</sup>	1	8.600×10 <sup>-2</sup>
4.269×10 <sup>2</sup>	3.087×10 <sup>3</sup>	4.186×10 <sup>3</sup>	1.163×10 <sup>3</sup>	1

## DENSITY

1g/cm<sup>3</sup>=1/tm<sup>3</sup>

g/cm <sup>3</sup>	kg/cm <sup>3</sup>	lb/in	lb/ft <sup>3</sup>	H./U.S.gat
1	1×10 <sup>-3</sup>	3.613×10 <sup>2</sup>	6.243×10	8.345
1×10 <sup>-3</sup>	1	3.613×10 <sup>5</sup>	6.243×10 <sup>2</sup>	8.345×10 <sup>3</sup>
2.768×10	2.768×10 <sup>-4</sup>	1	1.728×10 <sup>3</sup>	231
1.602×10 <sup>-2</sup>	1.602×10	5.787×10 <sup>-1</sup>	1	1.337×10 <sup>-1</sup>
1.198×10 <sup>-1</sup>	1.198×10 <sup>3</sup>	4.329×10 <sup>3</sup>	7.481	1

## LENGTH

m	cm	in	ft	yd	km	mile	Nautical Mile
1	100	39.37	3.281	1.094	1	0.6214	0.5400
0.01	1	0.3937	0.031 81	0.010 94	1.609	1	0.8690
0.0254	2.510	1	0.083 33	0.027 78	1.852	1.151	1
0.3048	30.48	12	1	0.333 3			
0.9144	91.44	36	3	1			

## AREA

m <sup>2</sup>	in <sup>2</sup>	ft <sup>2</sup>	yd <sup>2</sup>	km <sup>2</sup>	acre	mile <sup>2</sup>	ha
1	1550	10.76	1.196	1	247.1	0.386 1	100
6.452×10 <sup>-4</sup>	1	6.944×10 <sup>-2</sup>	7.716×10 <sup>-4</sup>	4.047×10 <sup>-3</sup>	1	1.562×10 <sup>-3</sup>	0.4047
0.09290	144	1	0.1111	2.590	640	1	259.0
0.8361	1296	9	1	0.01	2.471	3.861×10 <sup>-3</sup>	1

## POWER

K/W	PS	HP(British)	kgf-m/s	ft-lbf/s	Kcal/s	BTU/s(British)
1	1.360	1.340	102.0	737.6	0.238 9	0.918 0
0.735 5	1	0.985 9	75	542.5	0.175 7	0.697 3
0.746	1.014	1	76.07	550.2	0.178 2	0.707 2
0.009 807	0.013 33	0.013 15	1	7.233	0.002 343	0.009 297
0.001 356	0.001 843	0.001 817	0.138.3	1.0	0.003 239	0.001 285
4.186	5.691	426.9	3087.0	1	3.968	3.968
1.055	1.434	1.414	107.6	778.0	0.252 0	1

## FLOW

l / S	m <sup>3</sup> /h	m <sup>3</sup> /S	British gal/min	U.S gal/min	ft <sup>3</sup> /h	ft <sup>3</sup> /s
1	3.6	0.001	13.197	15.8514	127.14	0.03532
0.2778	1	0.02778	3.6658	4.4032	35.317	0.09801
1.000	3600.0	1	13197.0	15851.0	127150.0	35.3160
0.075775	0.27279	0.075775	1	1.2011	9.6342	0.02676
0.06309	0.2271	0.06304	0.8325	1	8.0208	0.02228
0.07865	0.02832	0.07865	0.1038	0.1247	1	0.02778
28.3153	101.935	0.02832	373.672	448.833	3600.0	1

## WEIGHT

kg	g	t(ton)France	lb	British ton	U.S ton
0.001	1	0.01	0.002205	0.00984	0.001102
1	1,000	0.001	2.2046	0.00984	0.001102
1,000	1×10 <sup>6</sup>	1	2,204.6	0.9842	1.1023
0.4536	453.6	0.04536	1	0.0446	0.0531
1,016.05	1,016,047	1.01605	2,240	1	1.12
907.185	907,185	0.90719	2,000	0.86289	1

## FORCE

1dyn=10N

kgf	lbf	N	dyn
1	2.205	9.80655	9.80665×10 <sup>5</sup>
4.536×10 <sup>-1</sup>	1	4.44822	4.44822×10 <sup>5</sup>
1.01972×10 <sup>-1</sup>	2.248×10 <sup>-1</sup>	1	1×10 <sup>5</sup>
1.01972×10 <sup>-6</sup>	2.248×10 <sup>-6</sup>	1×10 <sup>-5</sup>	1

# DATA FOR CALCULATION OF FLOW AND / OR PRESSURE DROP

$$K_v = C_v \times 0.85$$

$$\frac{m^3 / n}{\sqrt{kg / cm^2}}$$

A valve coefficient  $C_v$  is used to calculate pressure drop through a particular valve for a given flow rate. The coefficient of flow  $C_v$  expresses the rate of flow in gallons per minute at 60°F water with a pressure drop of 1 psig. across the valve.

The  $C_v$  coefficients for the various types and sizes, shown in table, have been determined from calculations and actual flow tests.

## FOR LIQUIDS

$$Q_L = C_v \sqrt{\frac{\Delta P}{G_L}} \quad \Delta P = G_L \left( \frac{Q_L}{C_v} \right)^2$$

WHERE :  $Q_L$  = Flow in U.S.Gallons per minute.  
 $\Delta P$  = ( $P_1 - P_2$ ) Pressure Drop in psi  
 $G_L$  = Specific Gravity of Liquid (Water = 1 at 60°F)

## FOR GASES

$$Q_g = 1360 C_v \sqrt{\frac{\Delta P}{G_g T}} \cdot \sqrt{\frac{P_1 + P_2}{2}}$$

$$\Delta P = P_1 - \sqrt{P_1^2 - 2G_g T \left( \frac{Q_g}{1360 C_v} \right)^2}$$

WHERE :  $Q_g$  = Volumetric Flow of Gas(SCFH)  
 $G_g$  = Specific Gravity of Gas at Standard Conditions (Air at atm. and 60°F = 1)  
 $T$  = Absolute Temperature of Gas (°F + 460)

## FOR STEAM

$$W = \frac{2.1}{1 + 0.0007 T_s} C_v \sqrt{\Delta P (P_1 + P_2)}$$

$$\Delta P = P_1 - \sqrt{P_1^2 - K_2}$$

$$\text{WHERE : } K = \left( \frac{1 + 0.0007 T_s}{2.1 C_v} \cdot W \right)^2$$

AND  $W$  = Pounds per hour of Steam  
 $\Delta P$  = ( $P_1 - P_2$ ) Pressure Drop in psi  
 $T_s$  = Degree of Superheat(°F)

NOTE = For Saturated Steam  $T_s = 0$

NOTE : For Gas and Steam Max.  $\Delta P = \frac{1}{2} P_1$ , and Min  $P_2 = \frac{1}{2} P_1$  and  $P_1, P_2$  are absolute pressures(PSIA)  $P_1$  = Inlet Pressure  $P_2$  = Outlet Pressure



## Cv Value(BB TYPE)

TYPE	GATE					GLOBE					CHECK						
	CLASS	150#	300#	600#	900#	1500#	150#	300#	600#	900#	1500#	150#	300#	600#	900#	1500#	2500#
2"		306	306	306	262	262	47	47	47	41	41	122	122	122	107	107	68
2 1/2"		492	492	492	396	396	75	75	75	57	57	197	197	197	158	158	106
3"		709	709	709	650	598	108	108	108	99	91	283	283	283	260	239	158
4"		1297	1297	1297	1206	1063	198	198	198	186	162	519	519	519	482	425	267
6"		3107	3107	3107	2851	2474	476	476	476	437	379	1242	1242	1242	1140	989	659
8"		5718	5718	5718	4999	4387	877	877	848	770	671	2287	2287	2215	2000	1755	1180
10"		8934	8934	8496	7844	6824	1370	1370	1295	1203	1046	3573	3573	3398	3137	2729	1875
12"		13351	13351	12804	11460	9970	2047	2047	1957	1753	1524	5340	5340	5122	4571	3976	2757
14"		16282	16282	15357	13917	12002	2503	2503	2357	2132	1841	6513	6513	6143	5560	4801	3338
16"		21567	21567	20176	18172	15650	3301	3301	3099	2793	2400	8627	8627	8070	7285	6260	4378
18"		28721	27889	26260	23932	20588	4401	4281				11488	11155	10509	9573	8235	5787
20"		35767	34837	32203	29487	25885						14307	13934	12859	11794	10354	
22"		43584	42557	39057	35767	31239						17434	17022	15623	14306	12495	
24"		52174	51049	46740	42493	37095						20869	20419	18682	16997	14838	
26"		64271	62995	56806	52193	45556						25708	25198	19513			
28"		74855	73520	65601	60442	53282						29942	29408	26240			
30"		86246	84766	75462	69504	61027						34498	33943	30185			
32"		102780	N/A									41112					
34"		N/A	113424														
36"		129964	125824									51985	50329				
42"		186201	179695									74480		66080			

# HARDNESS CONVERSION

1. The bottom HARDNESS CONVERSION TABLE(hereinafter referred as THE TABLE) is made according to SAE 417b and quoted as information only.
2. The table gives the approximate relationship of hardness of BRINELL and ROCKWELL. It is impossible to give the exact relationship, because of the inevitable influence of size, mass, composition and method of heat treatment.  
Where more precise conversion is required, it should be developed specially to chemical composition, heat treatment and part for each steel.

3. The table is based on extensive tests on carbon and alloy steels, mostly in the heat treated condition, but have been found to be reliable on practically all constructional alloy steel and tool steels in the as-forged, annealed, normalized and quenched and tempered conditions, provided they are homogenous.  
Such special cases as high manganese steel, 18% chromium 8% nickel steel and other austenitic steels, and nickel base alloys, as well as constructional alloy steels and tool steels in the cold worked condition, may not conform to the relationships given with the degree of accuracy as the steels for which the table are intended

Brinell Indentation Diameter, mm	Brinell Hardness Number		Rockwell Hardness Number		Tensile Strength (Approximate)	
	Standard Ball	Tungsten-Carbide Ball	B Scale	C Scale	× 1000 psi	kgf/mm <sup>2</sup> (N/mm <sup>2</sup> )
	10mm Ball 3000kg	1/16" Ball 1000kg Load	Brale 150kg Load			
-	-	-	-	68.0	-	-
-	-	-	-	67.5	-	-
-	-	-	-	67.0	-	-
-	-	(767)	-	66.4	-	-
-	-	(757)	-	65.9	-	-
2.25	-	(745)	-	65.3	-	-
-	-	(733)	-	64.7	-	-
-	-	(722)	-	64.0	-	-
2.30	-	(712)	-	-	-	-
-	-	(710)	-	63.3	-	-
-	-	(698)	-	62.5	-	-
-	-	(684)	-	61.8	-	-
2.35	-	(682)	-	61.7	-	-
-	-	(670)	-	61.0	-	-
-	-	(656)	-	60.1	-	-
2.40	-	(653)	-	60.0	-	-
-	-	(647)	-	59.7	-	-
-	-	(638)	-	59.2	-	-
-	-	630	-	58.8	-	-
2.45	-	627	-	58.7	-	-
2.50	-	-	-	59.1	-	-
2.50	-	601	-	57.3	-	-
2.55	-	-	-	57.3	-	-
2.55	-	578	-	56.0	-	-
2.60	-	-	-	55.6	-	-
2.60	-	555	-	54.7	298	210(2095)
2.65	-	-	-	54.0	292	205(2010)
2.65	-	534	-	53.5	288	202(1981)
2.70	-	-	-	52.5	278	195(1912)
2.70	-	514	-	52.1	274	193(1893)
2.75	495	-	-	51.6	269	189(1854)
2.75	-	-	-	51.1	264	186(1824)
2.75	-	495	-	51.0	264	186(1824)
2.80	477	-	-	50.3	258	181(1775)
2.80	-	-	-	49.6	252	177(1736)
2.80	-	477	-	49.6	252	177(1736)
2.85	461	-	-	48.8	244	172(1687)
2.85	-	-	-	48.5	242	170(1667)
2.85	-	461	-	48.5	242	170(1667)
2.90	444	-	-	47.2	230	162(1589)
2.90	-	-	-	47.1	230	162(1589)
2.90	-	444	-	47.1	230	162(1589)

Brinell Indentation Diameter, mm	Brinell Hardness Number		Rockwell Hardness Number		Tensile Strength (Approximate)	
	Standard Ball	Tungsten-Carbide Ball	B Scale	C Scale	× 1000 psi	kgf/mm <sup>2</sup> (N/mm <sup>2</sup> )
	10mm Ball 3000kg	1/16" Ball 1000kg Load	Brale 150kg Load			
2.95	429	429	-	45.7	219	154(1510)
3.00	415	415	-	44.5	212	149(1461)
3.05	401	401	-	43.1	202	142(1392)
3.10	388	388	-	41.8	193	136(1334)
3.15	375	375	-	40.4	184	129(1265)
3.20	363	363	-	39.1	177	124(1216)
3.25	352	352	(110.0)	37.9	171	120(1177)
3.30	341	341	(109.0)	36.6	164	115(1128)
3.35	331	331	(108.5)	35.5	159	112(1098)
3.40	321	321	(108.0)	34.3	154	108(1059)
3.45	311	311	(107.5)	33.1	149	105(1030)
3.50	302	302	(107.0)	32.1	146	103(1010)
3.55	293	293	(106.0)	30.9	141	99(971)
3.60	285	285	(105.5)	29.9	138	97(951)
3.65	277	277	(104.5)	28.8	134	94(922)
3.70	269	269	(104.0)	27.6	130	91(892)
3.75	262	262	(103.0)	26.6	127	89(873)
3.80	255	255	(102.0)	25.4	123	86(843)
3.85	248	248	(101.0)	24.2	120	84(824)
3.90	241	241	100.0	22.8	116	82(804)
3.95	235	235	99.0	21.7	114	80(785)
4.00	229	229	98.2	20.5	111	78(765)
4.05	223	223	97.3	(18.8)	-	-
4.10	217	217	96.4	(17.5)	105	74(726)
4.15	212	212	95.5	(16.0)	102	72(706)
4.20	207	207	94.6	(15.2)	100	70(686)
4.25	201	201	93.8	(13.8)	98	69(677)
4.30	197	197	92.8	(12.7)	95	67(657)
4.35	192	192	91.9	(11.5)	93	65(637)
4.40	187	187	90.7	(10.0)	90	63(618)
4.45	183	183	90.0	(9.0)	89	63(618)
4.50	179	179	89.0	(8.0)	87	61(598)
4.55	174	174	87.8	(6.4)	85	60(588)
4.60	170	170	86.8	(5.4)	83	58(569)
4.65	167	167	86.0	(4.4)	81	57(559)
4.70	163	163	85.0	(3.3)	79	56(549)
4.80	156	156	82.9	(0.9)	76	53(520)
4.90	149	149	80.8	-	73	51(500)
5.00	143	143	78.7	-	71	50(490)
5.10	137	137	76.4	-	67	47(461)
5.20	131	131	74.0	-	65	46(451)
5.30	126	126	72.0	-	63	44(431)
5.40	121	121	69.8	-	60	42(412)
5.50	116	116	67.6	-	58	40(402)
5.60	111	111	65.7	-	56	39(382)

# CORROSION TABLES

CARBON STEEL AND BRONZE ARE SHOWN FOR COMPARISON PURPOSES

CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL	CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL
acetaldehyde	0	0	E	E	E	E		borac acid	0	G	G	G		E	G
acetic acid aerated	0	0	E	E	E	E		bromine(dry)	0	0	0	0	E	E	E
acetic acid(air free)	0	0	E	E	E	E		bromine(wet)	0	0	0	0	0	E	E
acetic anhydride	0	F	G	G	E	E		butadiene	F	0	G	0			
acetone	E	E	E	E	E	E	E	butane	G	E	G	G	G	E	G
acetylene	E	G	E	E	E	E	F	buttermilk	0	0	E	E		E	
air	E	E	E	E	E			butyric acid	0	0	G	G	E	E	G
alcohols	G	G	E	E	E	E	E	calcium bisulfite	0	G	F	G	E		
aluminium acetate	0	0	F	F	F	F	G	calcium carbonate	0	F	E	E	E	E	G
aluminium chloride 10%	0	0	0	0	E	0	E	calcium chloride	F	G	F	G	G	F	G
aluminium chloride 10%	0	0	0	0	F	0	E	calcium hydroxide	F	0	E	E	E	E	E
aluminium fluoride	0	0	G	G	E	G	E	calcium hypochlorite	0	0	F	F	F	E	
aluminium hydroxide	0	0	E	E	E	G		calcium sulfate	0	E	E	E	E	G	G
aluminium oxalate	0	0			E	G	E	carbolic acid	0	G	G	G	E	E	G
aluminium potassium sulphate	0	0	E	E	E	G	G	carbon bisulfide	G	F	G	G	E		G
aluminium sulfate(alums)	0	F	F	G	E	E	F	carbon tetrachloride(dry)	F	F	G	E	E	E	G
amines	G	0	E	E	E			carbonated water	0	G	E	E	E	E	G
ammonia(aqueous)	E	E	E	E	E	G	E	carbonic acid	0	0	G	G	E	E	E
ammonia(anhydrous liquid)	G	0	G	G	G	G	E	castor oil	G	E	E	E	E		E
ammonium bicarbonate	F	0	G	G	G			china wood oil(tung)	F	F	E	E	E		E
ammonium carbonate	G	0	G	G	G	G		chlorinated solvents	F	F	E	E			G
ammonium chloride	0	0	F	F	E	G	G	chlorine gas(dry)	G	F	G	G	E	E	G
ammonium hydroxide(28%)	0	0	G	G	E	E		chloroacetic acid	0	0	0	0	0	E	G
ammonium hydroxide(conc)	0	0	G	G	E	E		chlorobenzene(dry)	F	F	E	E	F		F
ammonium monophosphate	0	0	G	G	E	E		chloroform(dry)	0	G	E	E	E	E	E
ammonium nitrate	0	0	G	G	E	E		chromic acid	0	0	E	E	E	E	
ammonium phosphate	0	0	G	G	E	E		citrus juices	0	0	E	E	E	E	G
ammonium sulfate	F	G	G	G	E	G	G	coca-cola syrup(pure)	0	0	E	E			
amyl acetate	F	G	G	G	E	G	G	coconut oil	0	0	G	G	G		G
aniline	F	F	G	G	G	G	G	copper chloride	0	F	0	0	E	E	G
aniline dyes	F	0	E	E	E			cooking oil	0	G	E	E	E		
antimony trichloride	0	0	0	0	0	E	G	copper nitrate	0	0	E	E	E	E	0
apple juice	0	0	G	0	0			copper sulfate	0	0	G	G	E	G	E
arsenic acid	0	0	G	G	G			corn oil	F		G	G	G	G	E
asphalt emulsion	G	G	E	E	E			cottonseed oil	F		G	G	G	G	E
asphalt liquid	G	G	E	E	E	E		creosote oil	G	G	G	G	G	E	E
barium carbonate	G	G	E	E	E			creylic acid	F	F	G	G	G	G	G
barium chloride	F	G	G	G	F	E	G	cupric chloride	0	0	0	0	0	0	E
barium hydroxide	F	0	G	G	E	E		diesel fuels	E	E	E	E			E
barium sulfate	F	F	E	E	E		G	dowtherm	G		E	E			
barium sulfide	F	F	G	G	G		F	drying oil			G	G	G	G	
beer	0	E	E	E	G	E	E	epsom salt	F	G	G	G	G		
beet sugar liquors	G	E	E	E	G		E	ethers	G	G	E	E	E	G	E
benzene(benzol)	G	G	E	E	E	G	G	ethyl acetate	G	F	G	G	G	E	G
benzoid acid	0	0	E	E	E	E	G	ethyl alcohol	G	G	G	G	G	G	
borax liquors	F	0	E	E	E	E	G	ethyl chloride(dry)	G	G	E	E	E	G	G

## CODE

E - Excellent    F - Fair    G - Good    0 - Not recommended    Blank - No data

# CORROSION TABLES

CARBON STEEL AND BRONZE ARE SHOWN FOR COMPARISON PURPOSES

CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL	CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL
ethylene glycol	G	G	G	G	E	G		lactic acid	O	G	E	E	E	G	E
ethylene oxide	G	E	G	G	G	G		large oil		E	E	G	G	G	
fatty acids	O		G	E	E	G	E	lead acetate	O		E	E	E	G	E
ferric chloride	O	O	O	O	O	O	E	linseed oil	E	G	E	E	E	E	E
ferric nitrate	O		G	G	E	O	E	lubricating oil	E						
ferric sulfate	O	O	G	G	E		E	magnesium chloride	G	G	F	E	E	G	E
ferrous chloride	O	G	O	O	O	O	G	magnesium hydroxide	G	G	E	E	E	G	E
ferrous sulfate	O	G	E	E	E	G	G	magnesium sulfate	G	G	E	E	E	E	E
fish oils				G				maleic acid		G	G	G	F		F
fluorine							E	malic acid			E	E	E	G	E
formaldehyde	O	F	O	F	F	F	E	mayonnaise			E	E		G	
formic acid	O	G	F	G	G	G	E	mercury	E	O	E	E	E	G	E
fruit juices		G	E	E	E	E	E	methyl alcohol	G	G	G	G	G	E	
fuel oil		G	E	E	E	G	E	methyl chloride	G	E	G	E	E	G	G
furfural	G	F	G	E	E	G	E	methyl ethyl ketone	E	E	E	E	E	E	E
gallic acid	O	F	E	E	E	E	E	milk	O	E	E	E		G	E
gas-manufactured	G	G						mine waters(acid)		F	G	G	E	O	E
gas-natural	G	G	E	E	E			mineral oil			E				
gasoline(lead)	E	E	E	E	E	E		molasses, edible	F		E	E	E	G	E
gasoline(unlead)	E	E	E	E	E	E		molasses, crude	E	E	E	E	E	E	E
gelatin			E	E	E			mustard	O	O	F	E		G	
glucose		E	E	E				mercuric chloride					F		E
glue	E	G	G	G	G	G		naphtha	G	G	E	E	E	E	E
glycerin	F	G	E	E	E	E	E	naphthalene	E	G	G	G	G	G	E
heptane	O	O	O	O	E	G	E	nickel chloride	O		G	G	G	G	
hydrochloric acid(air free)	O	O	O	O	O	F	G	nickel nitrate			G	G	G	G	
hydrogen chloride								nickel sulfate	O		G	G	G	G	
hydrochloric acid	O	O	O	O	O	O	E	nitric acid(10%)	O	O	E	E	E	O	G
hydrofluoric acid	O	O	O	O	O	G	G	nitric acid(30%)	O	O	E	E	E	O	G
hydrogen fluoride	O	O	O	F	F	E		nitric acid(100%)	O	O	E	E	E	O	G
hydrogen			F	E	E		F	nitrobenzene	G		G	G	E	G	
hydroxide	O	O	E	E	E	G		nitrous acid(10%)	O	O	G	G	G	O	
hydrogen peroxide	O		G	G	E	G	E	nitrous oxide	G		G	G	G	O	
hydrogen sulfite(dry)	G	F	E	E	E		G	oleic acid	F	G	G	E	E	G	G
hydrogen sulfide(wet)	F		E	E	E		E	oleum	G		G	G	G	G	G
hypo(sodium thiosulfate)	O	F	E	E	E	G		olive oil			E	E			
hypochlorites - sodium		O	F	E	E	G	E	oxalate	O	O			E	G	E
ink			G	E	E	G	G	oxalic acid	O	G	E	E	E	G	G
iodine(wet)		O	O	O	O	F	E	palmitic acid		G	G	G	G	G	
iodoform	G		O	E		F	E	palm oil			G	G			
isopropyl alcohol			G	G	G	G		paraffin	G	E	E	E	E	E	E
JP-4			E	E	E	E		paraformaldehyde	G	G	G	G	G	G	
JP-5 fuel			E	E	E	E		penicilin	O	O	O	G	O	E	
kerosene	G	E	E	F	E	G	E	pentane	G	E	E	E	G	G	G
ketchup	O	O	F	E	E	G	E	petrolatum			G	G	G		
lacquers(and solvents)	F	E		E		E		phenol	O	E	E	E	E	E	E

## CODE

E - Excellent    F - Fair    G - Good    O - Not recommended    Blank - No data

# CORROSION TABLES

CARBON STEEL AND BRONZE ARE SHOWN FOR COMPARISON PURPOSES

CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL	CORROSIVE MEDIA	CARBON STEEL	BRONZE	AIISI 304	AIISI 316, 347, 321	ALLOY 20	HASTELLOY	MONEL-INCONEL
phosphoric acid(10%)	O		G	G	E	G	E	sodium phosphate	F	F	G	G	G		G
phosphoric acid(25%)	O		G	G	E	G	E	sodium silicate	G	G	G	G	G	G	
phthalic acid			G	G	G			sodium sulfate	G	G	G	E	E	E	E
picric acid	O		E	E	E	G	E	sodium sulfide	G	O	G	G	G		E
pine oil	G		E	E				sodium thiosulfate			E	E	E		
pineapple juice				E				soybean oil	F		E	E	E	E	
potassium bisulfite	O		G	G	G	O		stannic chloride	O	O	O	E	E	F	G
potassium bromide	O		E	E		G		stannous chloride	O	O	O	E	E	F	G
potassium carbonate	G	G	G	G	G	G		starch				G			
potassium chlorate	G		G	G	G			steam(212°F)	E	E	E	E	E	E	
potassium chloride	F	G	F	F	F	G	G	stearic acid		F	E	E	E	G	E
potassium cyanide	G	O	G	G	G	G	G	sugar liquids	O	O	E	E	E	E	E
potassium dichromate	F	O	G	G	G		E	sulfate - black liquor		F	G	G	G	G	E
potassium diphosphate				E				sulfate - green liquor			G	G	G	G	E
potassium ferricyanide	F	O	G	G	G	G	G	sulfate - white liquor			G	G	G	F	E
potassium ferrocyanide	F	G	G	G	G	G	G	sulfur dioxide(dry)	G	F	G	G	G	G	E
potassium hydroxide	F	G	G	G	G	E	E	sulfur trioxide(dry)	G	G	G	G	G	G	E
potassium iodide	F		G	G	G	G		sulfuric acid(20%)	O	G	O	O	E	E	E
potassium nitrate	E		G	G	G	G	G	sulfuric acid(50%)	O	G	O	O	E	E	E
potassium permanganate	G		G	G	G		E	sulfuric acid(100%)	F	E	O	G	E	O	E
potassium sulfate	G	G	G	G	G	G	G	sulfurous acid	O	F	F	O	E	O	G
propane	G	E	G	G	G	G		tall oil				G			
pyrogalllic acid	G		E	E	E	G	E	tannic acid	F	G	E	E	E	G	G
rosin emulsion	F	G	G	G	G	E		tartaric acid	O	E	E	E	E	G	E
salad oil	F	G	G	G	G	G		tetraethyl lead				G	G		
salicylic acid	O	G	G	G	G	G	G	toluene	E	E	E	E	E	E	
sea water	O	F	E	E	E	E	G	tomato juice			F	E	E	G	E
silver nitrate	O	O	G	G	G	O	G	trichloroethylene	G	G	G	G	G	E	E
sodium acetate	F		G	G	G	F	G	tung oil				G			
sodium aluminate			G	G	G	G	G	turpentine	G	G	G	G	G	G	
sodium bicarbonate	F	G	G	G	E	G	G	titanium "E"							
sodium bisulfate(10%)	O	G	E	E	E	G	G	urea			G	G			
sodium bisulfite	O	G	E	E	E	G	G	varnish	O	O	E	E		G	E
sodium borate			G	G	G	G	G	vegetable oil, edible			E	E	E	G	E
sodium bromide(10%)	G		F	G	G	G	G	vegetable oil, non - edible			E	E	E	G	E
sodium carbonate	G							vinegar	O	E	E	E			
sodium chlorate		G	G	G	G		G	vitamins	O	O	O	G	O	E	
sodium chloride	F	G	G	G	G	G	G	water - distilled(aerated)	O	E	E	E	E	E	
sodium chromate	G	F				G		water - fresh		F	E	E	E	E	E
sodium cyanide	G	O	G	G	G	G		water - sea	O	F	E	E	E	E	
sodium fluoride	O		F	G		E	F	whiskey	O		E	E		E	
sodium hydroxide	F	G	G	G	G	E	E	wine	O		E	E			
sodium hypochlorite	O	O	O	G	E	O	E	xylylene(dry)	G		E	E			
sodium nitrate	G	G	G	G	G	G	G	zinc chloride	O	O	O	O	G	G	G
sodium perborate	G		G	G	G	G	G	zinc hydrosulfite	E		E	E	E	G	G
sodium peroxide	F	O	G	G	G	G	G	zinc sulfate	O	G	G	G	G	G	G

## CODE

E - Excellent    F - Fair    G - Good    O - Not recommended    Blank - No data

# MAJOR CLIENTS (OVERSEAS)


























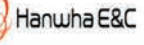


USA/CANADA	EUROPE	INDIA	ASIA	JAPAN
  	   	 	      	          
				

# MAJOR CLIENTS (Middle East)

SAUDI ARABIA	KUWAIT	QATAR	UAE	OMAN
       <p>شركة مرافق الكهرباء والمياه بالجبل وينبع Power and Water Utility Company for Jubail and Yanbu</p>	      	    	<p>هيئة كهرباء ومياه دبي Dubai Electricity &amp; Water Authority</p>   <p>هيئة مياه وكهرباء أبوظبي Abu Dhabi Water &amp; Electricity Authority</p>	
			<p>EGYPT/ALGERIE</p> 	<p>IRAN</p>  



# MAJOR CLIENTS (DOMESTIC)

EPC	PETROCHEM.	POWER
HYUNDAI E&C 	HYUNDAI OIL BANK 	KOREA SOUTH POWER 
GS E&C. 	GS CALTEX 	KOREA SOUTH EAST POWER 
DAELIM INDUSTRY 	SAMSUNG PETRO C 	KOREA EAST WEST POWER 
SAMSUNG E&C 	SK ENERGY 	KOREA MIDLAND POWER 
SK E&C 	YEOCHON PETROCHEM 	KOREA WEST POWER 
DAEWOO ENG. 	HANHWA PETROCHEM 	GE KOREA 
HYUNDAI ENGINEERING 	HONAM PETROCHEM 	KDHC (Korea District Heating Corp.) 
	KUMHO PETROCHEM 	
DOOSAN HEAVY IND. 	LG CHEMICAL 	
HYUNDAI HEAVY IND. 	HANHWA E&C 	
	S-OIL 	
	DAESAN MMA 	

## SUPPLY RECORDS –

### Saudi Kayan Petrochemical Complex PP & PH PJ Jubail, Saudi Arabia

The formation of the **Saudi Kayan Petrochemical Company** (a public stock company) was the outcome of a partnership agreement between Saudi Basic Industries Corp. (SABIC) & AlKayan Petrochemical Company (Kayan). The company's capital amounts to 15 billion Saudi Riyals.



شركة كيان السعودية للبتروكيماويات  
Saudi Kayan Petrochemical Company

SABIC Affiliate

شركة تابعة لسابك



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
SABIC	Saudi Kayan Petrochemical Company	Samsung E&C	Saudi Kayan Petrochemical Complex PP & PH PJ	KJS	8	2008



## SUPPLY RECORDS – Rabigh PJ in Saudi Arabia

In August 2005 Saudi Arabia's **Saudi Aramco** and Japan's **Sumitomo Chemical** agreed to form a 50:50 joint venture to develop a **petrochemical complex in Rabigh** - the centre of one of the world's largest. The venture is called **PetroRabigh**.

The complex is due for completion in the second half of 2008. The complex has required an estimated investment of **\$9.9bn**.



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
Saudi Aramco Sumitomo Chemical	Petro Rabigh 	JGC Mitsubishi	Rabigh PJ PC-1	KVC	994	2006

**السعودية العربية للبتروكيماويات**  
**Saudi Aramco**



## SUPPLY RECORDS – South Pars PJ in Iran



### The South Pars Gas Field Development in Iran Offshore

in Iran contains about 50% of Iran's gas resources and is regarded as the largest offshore gas field in the world.

Iran holds 15.3 percent of the world's gas repositories which is the second largest holder of gas after Russia of 26.7 percent.

The South Pars Gas Field has been divided into 28 phases for exploitation with development cost for each phase of around 1 billion USD.



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
NIOC(National Iranian Oil Company) 	PETRO PARS 	HYUNDAI ENG& CONST.	SOUTH PARS PHASE 4,5	KJS	3,720	2003
		DAELIM, JGC, TEC.IDRO	SOUTH PARS PHASE 6,7,8	KVC	4,239	2004



# SUPPLY RECORDS POWER PLANT-MIDDLE EAST

NO.	CLIENT (USER)	EPC CONTRACTOR	PROJECT NAME	CAPA	QTY	YEAR	LOCATION
E1	AMMAN EAST POWER SUPPLY	DOOSAN HEAVY IND.	AMMAN EAST POWER PJ	370MW	360	2008	JORDAN
E2	JUBAIL WATER AND POWER COMPANY	DOOSAN HEAVY IND.	MARAFIQ HRSG	2700MW	228	2008	SAUDI ARABIA
E3	DEWA=Dubai Electricity and Water Authority	DOOSAN HEAVY IND.	JEBEL ALI-M PJ	2000MW	621	2008	UAE
E4	MEW(Ministry of Electricity & Water)	MITSUBISHI CO. HYUNDAI E&C	SHUAIBA NORTH CO GEN PJ	500MW	560	2008	KUWAIT
E5	GECOL-GENERAL ELECTRIC COMPANY OF LYBIA	HYUNDAI E&C.	ZAWIA CAPP	960MW	1,320	2006	LYBIA
E6	PRAYAS ENERGY GROUP	HYUNDAI E&C.	TANIR BAVI CCGT POWER PROJECT	235MW	52	2000	INDIA
E7	KAHRAMAA(Qatar General Electricity & Water Corporation)	SUEZ ENERGY+MITSUBI - HYUNDAI E&C.	RAS LAFFAN C IWPP PJ	2730MW	153	2009	QATAR
E8	Egyptian Electricity Holding Co	BECHTEL	AYOUN MOUSSA POWER PLANT	640MW	80	1998	EGYPT
E9	Sidi Krir Unit I&II	MITSUBISHI PGESCO-KVC	Sidi Krir Unit I&II Power Plant	650MW		2008	EGYPT
E10	Yerevan Thermal Power Plant CJSC	MITSUBISHI-PGESCO-KVC SEDAE ENERTEC-	Yerevan CAPP	205MW	192	2009	ARMENIA



## SUPPLY RECORDS – PP-III Utility & Offshore PJ in Saudi Arabia

### Al Jubail Polypropylene Plant, Saudi Arabia

The project is located in Yanpet, near Al Jubail in Saudi Arabia, which has been the focus of significant petrochemical investment in the last five years. The Saudi European Petrochemical Company (also known as Ibn Zahr) is 70% owned by **Sabic (Saudi Arabian Basic Industries Company)**. Arab Petroleum Investment Corporation (APICORP) also owns 10% of the company.



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
SABIC	Saudi European Petrochemical Company (= Ibn Zahr)	Daelim Ind.	PP-III Utility & Offshore PJ	KJS	1,113	2007



# SUPPLY RECORDS

## QP LAB PJ in QATAR



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
QP	LAFFAN REFINERY COMPANY	GS E&C	QP LAB PJ	KJS	4,948	2004

**SUPPLY RECORDS in Abu Dhabi, UAE**  
**Umm Al Nar power and water desalination plant PJ**  
 ADWEA (Abu Dhabi Water and Electricity Authority )  
 IP (International Power) Tokyo Electric Power Company (TEPCO) and Mitsui  
 The total project cost, comprising the cost of both acquisition and the planned expansion, is estimated at \$2.1 billion

هيئة مياه وكهرباء أبوظبي  
 Abu Dhabi Water & Electricity Authority

كشافة الإمارات  
 هيئة مياه وكهرباء أبوظبي  
 رمضان الكريم

OWNER	CONTRACTOR	EPC	VENDOR	PROJECT	BRAND	Q'TY	YEAR
ADWEA +IP	-	Mitsui with Toshiba	KVC	Umm Al Nar power and water desalination plant PJ	KVC	355	2005



# SUPPLY RECORDS

## NERP PJ in KUWAIT



The local KUWAIT NATIONAL PETROLEUM CO. (KNPC) is currently gearing-up to build a **new ethane recovery plant(NERP) PJ** at Mina Al Ahmadi Refinery Plant.

The cost to complete the project, by September 2007, has been estimated at **\$397,000,000.**



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
KNPC	HYUNDAI E&C	HYUNDAI E&C	NEW ETHANE RECOVERY PJ	KJS	2,187	2006

# SUPPLY RECORDS –

## Sharq Third Expansion Project Jubail, Saudi Arabia



Saudi Arabia's **Sabic** announced an investment of **\$6.4 billion** for the expansion of its petrochemical capacity in 2004. The plans included increased capacity at its affiliate **Eastern Petrochemical Company (Sharq)**. The company is a 50:50 joint venture between Sabic and a Japanese consortium, led by Japan's government and the Mitsubishi group of companies. Sharq's plans included an investment of **\$2.28 billion in ethylene** and downstream capacity located in Jubail, Saudi Arabia, known as the **Sharq third expansion project**. Completion is slated for 2008

OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
SABIC	Eastern Petrochemical Company (Sharq).-Linde	Hyundai E&C	Sharq third expansion project	KJS Provalve	541	2006

# SUPPLY RECORDS

## 300KTM Bandar Imam LDPE PJ in IRAN



OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
NPC(National Petrochemical Company)	Amir Kabir Petrochemical	Daelim Ind.	300KTM Bandar Imam LDPE PJ	KJS	625	2006

# SUPPLY RECORDS

## QCS, QG, RGX, AKG-II PJ in QATAR



Qatar's North Field is the largest offshore non-associated natural gas field in the world. RasGas was established in 1993 to produce liquefied natural gas (LNG) developed by RasGas (RG), QatarGas (QG) and North Field Alpha (NFA).

OWNER	CONTRACTOR	EPC	PROJECT	BRAND	Q'TY	YEAR
Exxonmobil QP	RAS GAS	CTJV (Chiyoda & Technip)	AKG-II PJ-Al Khaleej Gas PJ Phase-2	YONEKI	3,637	2007
	RAS GAS		RGX-6 PJ-Ras Gas Onshore Expansion PJ Phase-2	YONEKI	7,970	2007
	QATAR GAS		QCS PJ-Qatar Gas Development PJ	YONEKI	1,569	2006
	QATAR GAS		QG-II PJ-Qatar Gas Development PJ	YONEKI	1,212	2006