

ASTM A420/A420M-00

Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service

Grade	Composition, %										
	C	Mn	P	S	Si	Ni	Cu	Cr	Mo	V	Nb
WPL6(1)(2)	0.30	0.60-1.35	0.035	0.040	0.15-0.30	0.40	0.40	0.30	0.12	0.08	0.02
WPL9	0.20	0.40-1.06	0.030	0.030	-	1.60-2.24	0.75-1.25				

GENERAL NOTE :

All values are maximum unless otherwise indicated.

NOTES:

- (1) For each reduction of 0.01% C below 0.30%, an increase of 0.05% Mn above 1.06% will be permitted to a maximum of 1.35%.
 (2) Fittings made from forgings may have 1.35% max Mn.

Tensile Requirements	WPL6	WPL9
Tensile Strength, min, ksi [MPa]	60-85[415-585]	63-88[435-610]
Yield Strength, min, ksi [MPa]	35[240]	46[315]

Wall thickness	Elongation Requirements			
	in		mm	
	Longitudinal		Transverse	
	WPL6	WPL9	WPL6	WPL9

Standard round specimen, or small proportional specimen, min % in 4D

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Rectangular Specimen for wall thickness 0.312in [7.94mm] and over, and for all small sizes tested in full section; min % in 2in [50mm]

≥ 0.312 ≥ 7.94

30 28 16.5 18

Rectangular Specimen for wall thickness less than 0.312in [7.94mm]; min % in 2 in[50mm] (0.5in [12.7mm] wide specimen)

0.281	7.14	28.5	26.5	15.5	17.0
0.250	6.35	27.0	25.0	14.5	16.0
0.219	5.56	25.5	23.5	-	-
0.188	4.76	24.0	22.0	-	-
0.156	3.97	22.5	20.5	-	-
0.125	3.17	21.0	19.0	-	-
0.094	2.38	19.5	17.5	-	-
0.062	1.59	18.0	16.0	-	-

Where the wall thickness lies between two values above, the min elongation value is determined by the following equations:

	WPL6	WPL9
Longitudinal	E=48t+15.00	E=48t+13.00
Transverse	E=32t+6.50	E=32t+8.00

E=elongation in 2in[50mm], %

t= actual thickness of specimen, in [mm]

Material Specification for Stainless Steel Butt-Welding Fittings (ASTM)

ASTM A403/A403M-00a

wrought Austenitic Stainless Steel Piping Fittings

Grade	C	Mn	P	S	Si	Ni	Cr	Mo		
WP 304	0.08	2.00	0.045	0.030	1.00	8.0-11.0	18.0-20.0	-		
WP 304L	0.035	2.00	0.045	0.030	1.00	8.0-13.0	18.0-20.0	-		
WP 316	0.08	2.00	0.045	0.030	1.00	10.0-14.0	16.0-18.0	2.00-3.00		
WP 316L	0.035	2.00	0.045	0.030	1.00	10.0-16.0	16.0-18.0	2.00-3.00		

British Standard Threads (BS 21:1985)

Nominal Bore of pipe	Approximate Outside Diameter of Black Pipe	Number of Threads per Inch	Pitch	Depth of Thread	Diameter at Gauge Plane (Gauge Dia.)	Distance of Gauge Diameter from End (Gauge Length)	Length of Useful Thread
	A		P	h	B	F	E
1/8	0.400	28	0.03571	0.0229	0.383	0.1563	0.2545
1/4	0.538	19	0.05263	0.0337	0.518	0.2367	0.3814
3/8	0.676	19	0.05263	0.0337	0.656	0.2500	0.3947
1/2	0.847	14	0.07143	0.0457	0.825	0.3214	0.5178
3/4	1.063	14	0.07143	0.0582	1.041	0.3750	0.5714
1	1.336	11	0.09091	0.0582	1.309	0.4091	0.6591
1 1/4	1.677	11	0.09091	0.0582	1.650	0.5000	0.7500
1 1/2	1.909	11	0.09091	0.0582	1.882	0.5000	0.7500
2	2.381	11	0.09091	0.0582	2.347	0.6250	0.9204
2 1/2	2.996	11	0.09091	0.0582	2.960	0.6875	1.0511
3	3.499	11	0.09091	0.0582	3.460	0.8125	1.1761
3 1/2	3.991	11	0.09091	0.0582	4.950	0.8750	1.2386
4	4.494	11	0.09091	0.0582	4.450	1.0000	1.4091
5	5.498	11	0.09091	0.0582	5.450	1.125	1.5795
6	6.501	11	0.09091	0.0582	6.450	1.250	1.5795

American Standard Threads (Ansi/Asme B1 20.1-1983)

Nominal pipe Size	Outside Diameter of Pipe	Threads per Inch	Pitch of Threads	Hand-Tight	Engagement	Effective Thread Length External	Depth of Thread
	D	n	P	L1	E1	L2	H
1/8	0.405	27	0.0370	0.1615	0.37360	0.2639	0.02963
1/4	0.540	18	0.05556	0.2278	0.49163	0.4018	0.04444
3/8	0.675	18	0.07143	0.240	0.62701	0.4078	0.05714
1/2	0.840	14	0.07143	0.320	0.77843	0.5337	0.05714
3/4	1.050	14	0.08696	0.339	0.98887	0.5457	0.06957
1	1.315	11 1/2	0.05696	0.400	1.23863	0.6828	0.06957
1 1/4	1.660	11 1/2	0.08696	0.420	1.58338	0.7068	0.06957
1 1/2	1.900	11 1/2	0.08696	0.420	1.82234	0.7235	0.06957
2	2.375	11 1/2	0.12500	0.436	2.29627	0.7565	0.10000
2 1/2	2.875	8	0.12500	0.682	2.76216	1.1375	0.10000
3	3.500	8	0.12500	0.766	3.38850	1.2000	0.10000
3 1/2	4.000	8	0.12500	0.821	3.88881	1.2500	0.10000
4	4.500	8	0.12500	0.844	4.38712	1.3000	0.10000
5	5.563	8	0.12500	0.937	5.44929	1.4063	0.10000
6	6.625	8	0.12500	0.958	6.50597	1.5125	0.10000

Material Specifications for Butt-Welding Fittings (JIS and DIN)

JIS 8231 I Steel Butt-Welding Pipe Fittings for Ordinary Use
JIS G3452 Carbon Steel Pipes for Ordinary Piping
JIS 63457 Arc Welded Carbon Steel Pipes

Steel Grade	Chemical Composition %			Tensile	Yield	Elongation % (1)	
	C	P	S	Strength	Point	Longitudinal	Transverse
	Max			N/mm2 Min		Min	Min
SGP	-	0.040	0.040	290	-	30 (2)	25 (2)
PY400	0.25	0.040	0.040	400	255	-	18

NOTES:

- (1) Values specified are for wall thickness 8mm and over. For each 1 mm decrease in wall thickness below 8mm, a deduction of 1.5% for both longitudinal and transverse from the values shown above is permitted.
(2) Values not applicable to NPS below 32A.

DIN 1626 Welded Circular Unalloyed Steel Tubes Subject to Special Requirements
DIN 1629 Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
DIN 17175 Seamless Tubes of Heat-Resistant Steels

Steel Grade Symbol	Type of deoxidization	Chemical Composition (cast analysis) % max unless otherwise specified)					
		C	Si (1)	Mn	P	S	N (2)
St 37.0	R	0.17	-	-	0.040	0.040	0.049 (3)
St 35.8	-	0.17	0.10-0.35	0.40-0.80	0.040	0.040	-

NOTES:

- (1) The minimum Si content is allowed to fall below 0.10%, when the steel is aluminium-killed or vacuum-deoxidized.
(2) A content in excess of the maximum value stated is permitted if a P content less than the maximum specified by 0.005% P per 0.001 % N is observed. However the N content shall not exceed a value of 0.012% in the case analysis and 0.014% in the product analysis.
(3) The specified value does not apply if the steels are supplied with the RR (instead of R) type of deoxidization.
R=killed, including semi-killed
RR= fully killed

Amounts by which the chemical composition in the product/sample analysis may deviate from the limiting values applicable to the cast analysis.

Element	St 37.0 Allowable Deviation Amount %	St 35.8	
		Limits Quoted in Cast Analysis	Allowable Deviation Amount (2)%
C	0.02	≤ 0.24	± 0.02
Si	-	≤ 0.35	± 0.03
Mn	-	≤ 1.00	± 0.04
P	0.010	≤ 0.040	± 0.010
S	0.010	≤ 0.040	± 0.010
N	0.001 (1)	-	-

NOTES:

- (1) A content in excess of the maximum value stated is permitted if a P content less than the maximum specified by 0.005% P per 0.001 % N is observed. However the N content shall not exceed a value of 0.012% in the case analysis and 0.014% in the product analysis (this does not apply to the RR type of deoxidization).
(2) In a cast the deviation of an element in a sample analysis is permitted to be below the minimum value or only above the maximum value of the range stipulated for the cast analysis, though not both at the same time.

Steel Grade Symbol	Upper Yield Stress ReH for Wall thicknesses, in mm			Tensile Strength RM	Elongation after Fracture A5		Impact Strength Transverse
	ReH ≤ 16	16<ReH ≤ 40	40<ReH ≤ 60		Longitudinal	Transverse	
	Min N/mm2				Min %		
St 37.0	235	225	215	350 (1) -480	25	23	-
St 35.8	235	225	215	360-480	25	23	34

NOTE:

- (1) For cold finished tubes in the NBK condition, minimum values of tensile strength lower than this value by 10N/mm2 is permitted

Material Specifications for Butt-Welding Fittings (ASTM)

ASTM A234/A234M-00a

Piping Fittings of Wrought Carbon Steel and Alloy Steel for
Moderate and High Temperature Service

Grade	Composition, %										
	C	Mn	P	S	Si	Cr	Mo	Ni	Cu	V	Nb
WPB (1)(2)(3)(4)	0.30	0.29-1.06	0.050	0.058	0.10	0.40	0.15	0.40	0.40	0.08	0.02
WPC (1)(2)(3)(4)	0.35	0.29-1.06	0.050	0.058	0.10	0.40	0.15	0.40	0.40	0.08	0.02
WPII CL1	0.05-0.15	0.30-0.60	0.030	0.030	0.50-1.00	1.00-1.50	0.44-0.65	-	-	-	-
WPII CL2	0.05-0.20	0.30-0.80	0.040	0.040	0.50-1.00	1.00-1.50	0.44-0.65	-	-	-	-
WPII CL3											

GENERAL NOTE:

All values are maximum unless otherwise indicated.

NOTES:

- (1) For each reduction of 0.01% below the specified C maximum, an increase of 0.06% Mn above the specified maximum will be permitted, up to a maximum of 1.35%.
- (2) The sum of Cu, Ni, Cr, and Mo shall not exceed 1.00%.
- (3) The sum of Cr and Mo shall not exceed 0.32%.
- (4) The maximum carbon equivalent (C.E.) shall be 0.50, based on heat analysis and the formula $C.E. = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$.

Tensile Requirements	WPB	WPC, WPII CL2	WPII CL1	WPII CL3
Tensile Strength, min, ksi[MPa]	60-85	70-95	60-85	75-100
(0.2% offset or 0.5% extension-under-load)	[415-585]	[485-655]	[415-585]	[520-690]
Yield Strength, min, ksi[MPa]	32	40	30	45
	[240]	[275]	[205]	[310]

	Wall thickness		Elongation Requirements	
	in	mm	Longitudinal	Transverse
Standard round specimen, or small proportional specimen, min % in 4D			22	14
Rectangular Specimen for wall thickness 0.312 in [7.94mm] and over, and for all small sizes tested in full section; min % in 2 in [50mm]	≥0.312	≥7.94	30	20
Rectangular Specimen for wall thickness less than 0.312 in [7.94mm]; min % in 2 in [50mm] (0.5 in [12.7mm] wide specimen)	0.281	7.14	28.5	19
	0.250	6.35	27.0	18
	0.219	5.56	25.5	-
	0.188	4.76	24.0	-
	0.156	3.97	22.5	-
	0.125	3.17	21.0	-
	0.094	2.38	19.5	-
	0.062	1.59	18.0	-

Where the wall thickness lies between two values above, the min elongation value is determined by the following equations :

Longitudinal $E = 48t + 15.00$

Transverse $E = 32t + 10.00$

$E =$ elongation in 2 in [50mm], %

$t =$ actual thickness of specimen, in [mm]