

ASTM A420 / ASME SA420

SPECIFICATION FOR PIPING FITTINGS OF WROUGHT CARBON STEEL AND ALLOY STEEL FOR LOWTEMPERATURE SERVICE

This specification covers wrought carbon steel and alloy steel fittings of seamless and welded construction, covered by the latest revision of ASME B16.9, ASME B16.11, MSS-SP-79, and MSS SP-95.

These fittings are for use in pressure piping and pressure vessel service at low temperatures.

A. General Requirements :-

1. Product furnished to this specification shall conform to the requirements of Specification A 960.
2. In case of conflict between the requirements of this specification and Specification A 960, this specification shall prevail.

B. Heat Treatment :-

1. All fittings shall be furnished in the normalized, normalized and tempered, annealed, or quenched and tempered condition. All welding shall be completed prior to the austenitizing heat treatment.
2. The full thickness of the material from which impact test specimens are to be obtained shall be heat treated with a furnace charge.
3. After forming, the fittings shall be allowed to cool below the lower critical before applying one of the heat treatments listed in point B.1.
4. When the fittings are to be post-weld heat treated after being welded by the purchaser. The purchaser shall use the post-weld heat treatment shown in Table 1, unless otherwise specified in the order.

Table 1

Grade	Metal Temperature		Minimum Holding Time
	°F	°C	
WPL6	1100–1200	595–650	1 h/in. [25 mm] 3/4 h min
WPL3	1100–1150	540–620	1/4 h/in. [25 mm] 1 h min
WPL8	1050–1100	565–595	1/2 h/in. [25 mm] 1 h min
WPL9 ^A	1025–1085	550–585	1 h/in. [25 mm] 2 h min

^A 2 in. [51 mm] thickness and over. The cooling rate shall not be less than 300°F [150°C] per hour down to a temperature of 600°F [315° C].

C. Chemical Composition :-

The steel shall conform to requirements of chemical composition for the respective material prescribed in Table 2.

Table 2

Grade ^A	Composition, %										
	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	Cb	V
WPL6	0.3	0.50–1.35	0.035	0.04	0.15–0.40	0.4	0.3	0.12	0.4	0.02 ^B	0.08
WPL9	0.2	0.40–1.06	0.03	0.03	...	1.60–2.24	...	...	0.75–1.25	...	...
WPL3 ^C	0.2	0.31–0.64	0.05	0.05	0.13–0.37	3.2–3.8	...	...	...	...	...
WPL8 ^D	0.13	0.9	0.03	0.03	0.13–0.37	8.4–9.6	...	...	...	...	...

NOTE 1–All requirements are maximum unless otherwise indicated.

NOTE 2–Where an ellipsis (. . .) appears in this table, there is no requirement.

^A When fittings are of welded construction, the symbols above shall be supplemented by the letter “W.”

^B By agreement, the limit for Columbium may be increased up to 0.05% on heat analysis and 0.06% on product analysis.

^C Fittings made from plate or forgings may have 0.90% max manganese.

^D Fittings made from plate may have 0.98% max manganese.

D. Tensile Properties :-

The tensile properties of the fittings material shall conform to the requirements for the applicable grade of material as listed in Table 3.

Table 3

Requirement	WPL6		WPL9		WPL3		WPL8	
	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
Tensile strength, min ksi [MPa]	60 [415] – 85 [585]		63 [435] – 88 [610]		65 [450] – 90 [620]		100 [690] – 125 [865]	
Yield strength, min ksi [MPa]	35 [240]		46 [315]		35 [240]		75 [515]	
Elongation Requirements	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
Standard round specimen, or small proportional specimen, min % in 4 D	22	12	20	...	22	14	16	...
Rectangular specimen for wall thickness 5/16 in. [7.94 mm] and over, and for all small sizes tested in full section; min % in 2 in. or 50 mm	30	16.5	28	18	30	20	22	...

Rectangular specimen for wall thickness less than 5/16 in [7.94 mm]; min% in 2 in. or 50 mm (1/2 in. [12.7 mm] wide specimen)	A	A	A	A	A	A	A	...
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^A For each 1/32 in. [0.79 mm] decrease in wall thickness below 5/16 in. [7.94 mm], a deduction of 1.5% (grades WPL6, WPL9, and WPL3) or 1.25% (WPL8) for longitudinal and 1.0% (grades WPL6, WPL9, and WPL3) for transverse from the values shown above is permitted. The following table gives the minimum value for various wall thicknesses:

Wall Thickness		Grades							
		WPL6		WPL9		WPL3		WPL8	
in.	[mm]	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
5/16 (0.312)	[7.94]	30	16.5	28	18	30	20	22	...
9/32 (0.281)	[7.14]	28.5	15.5	26.5	17	28.5	19	20.75	...
1/4 (0.250)	[6.35]	27	14.5	25	16	27	18	19.5	...
7/32 (0.219)	[5.56]	25.5	...	23.5	...	25.5	...	18.25	...
3/16 (0.188)	[4.76]	24	...	22	...	24	...	17	...
5/32 (0.156)	[3.97]	22.5	...	20.5	...	22.5	...	15.75	...
1/8 (0.125)	[3.17]	21	...	19	...	21	...	14.5	...
3/32 (0.094)	[2.38]	19.5	...	17.5	...	19.5	...	13.25	...
1/16 (0.062)	[1.59]	18	...	16	...	18	...	12	...

NOTE – The preceding table gives the computed minimum elongation value for each 1/32 in. [0.79 mm] decrease in wall thickness. Where the wall thickness lies between two values above, the minimum elongation value is determined by the following equations:

Direction of Test

Longitudinal
Transverse

WPL6
E = 48t + 15.00
E = 32t + 6.50

WPL9
48t + 13.00
32t + 8.00

Equations

WPL3
E = 48t + 15.00
E = 32t + 10.00

WPL8
40t + 9.50
...

where:

E = elongation in 2 in. or 50 mm, %, and
t = actual thickness of specimen, in.

E. Impact Test Properties :-

1. The notched bar impact properties of the base metal and weld metal shall conform to the requirements of Table 4 or Table 5 for the applicable grade of material.
2. All material furnished under this specification shall be tested for impact resistance at the temperature for the respective grade in Table 6.
3. Notched-bar impact specimens shall be simple- beam, Charpy-type A with a V-notch in accordance with Test Methods and Definitions A 370.

Table 4: CHARPY IMPACT REQUIREMENTS FOR WPL6, WPL9, AND WPL3^A

Size of Specimen, mm	Charpy V-Notch Impact Value Required for Acceptance (Average of Three Specimens)		Minimum Charpy V-Notch Impact Value Without Requiring Retest (One Specimen Only of a Set)	
	ft · lbf	J	ft · lbf	J
10 by 10	13	17.6	10	13.6
10 by 7.5	10	13.6	8	10.8
10 by 5	7	9.5	5	7
10 by 2.5	4	5.4	3	4.1

^A Straight-line interpolation for intermediate values is permitted.

Table 5: CHARPY IMPACT REQUIREMENTS FOR WPL8

Size of Specimen, mm	Charpy V-Notch Impact Value Required for Acceptance (Average of Three Specimens)		Minimum Charpy V-Notch Impact Value Without Requiring Retest (One Specimen Only of a Set)	
	ft · lbf	J	ft · lbf	J
10 by 10	25	33.9	20	27.1
10 by 7.5	21	28.5	17	23.1
10 by 5	17	23.1	14	19
10 by 2.5	8	10.8	6	8.1

Table 6: IMPACT TEST TEMPERATURE

Grade	Impact Test Temperature, °F [°C]
WPL6	-50 [-45]

WPL9	-100 [-75]
WPL3	-150 [-100]
WPL8	-320 [-195]

F. Radiographic Examination :-

1. All fusion-welded butt joints shall be radiographically examined throughout the entire length in accordance with Paragraph UW-51 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.
2. Instead of radiographic examination, welds made by the manufacturer may be ultrasonically examined in accordance with Appendix 12 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.

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