Designation: ~~A420/A420M – 16~~ A420/A420M – 19

Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service[1]

This standard is issued under the fixed designation A420/A420M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification[2] 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, MSS SP-83, MSS SP-95, and MSS SP-97. Fittings differing from these ASME and MSS standards shall be furnished in accordance with Supplementary Requirement S58 of Specification A960/A960M. These fittings are for use in pressure piping and pressure vessel service at low temperatures.

1.2 Optional supplementary requirements are provided for fittings where a greater degree of examination is desired. When desired, one or more of these supplementary requirements shall be specified in the order.

1.3 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 In addition to those Referenced Documents listed in Specification A960/A960M, the following list of standards apply to this specification.

2.2 *ASTM Standards:*[3]

A350/A350M Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A960/A960M Specification for Common Requirements for Wrought Steel Piping Fittings

A1058 Test Methods for Mechanical Testing of Steel Products—Metric

2.3 *ASME Standards:*

B 16.9 Factory-Made Wrought Steel Butt-Welding Fittings[4]

B 16.11 Forged Steel Fittings, Socket-Welding Threaded[4]

Section VIII Division 1, Pressure Vessels[4]

Section IX

2.4 *MSS Standards:*

MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions[5]

MSS SP-79 Socket Welding Reducer Inserts[5]

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications.

Current edition approved ~~May 1, 2016~~Sept. 1, 2019. Published ~~May 2016~~September 2019. Originally approved in 1958. Last previous edition approved in ~~2014~~2016 as ~~A420/A420M – 14.~~A420/A420M – 16. DOI: ~~10.1520/A0420_A0420M-16.~~10.1520/A0420_A0420M-19.

[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-420 in Section II of that Code.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[5] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

***A Summary of Changes section appears at the end of this standard**

MSS SP-83 Steel Pipe Unions, Socket-Welding and Threaded[5]
MSS SP-95 Swage(d) Nipples and Bull Plugs[5]
MSS SP-97 Integrally Reinforced Forged Branch Outlet Fittings—Socket Welding, Threaded and Buttwelding Ends

2.5 *ASNT Standards:*
SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification[6]

3. Ordering Information

3.1 See Specification A960/A960M.

4. General Requirements

4.1 Product furnished to this specification shall conform to the requirements of Specification A960/A960M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A960/A960M constitutes non-conformance with this specification. In case of conflict between the requirements of this specification and Specification A960/A960M, this specification shall prevail.

5. Material

5.1 The starting material for fittings shall be fully killed steel, consisting of forgings, bars, plates, sheet, and seamless or fusion welded tubular products with filler metal added and shall conform to the chemical requirements in Table 1. The steels shall be made using recognized melting practices necessary to produce steels that shall meet the impact requirements of this specification.

6. Manufacture

6.1 Forging or forming operations shall be performed by hammering, pressing, piercing, extruding, upsetting, working, bending, fusion-welding, or machining, or by a combination of two or more of these operations. The forming procedure shall be so applied that it will not produce injurious defects in the fittings.

6.2 All welds, including welds in tubular products from which fittings are made, shall be (*1*) made by welders, welding operators and welding procedures qualified under the provisions of ASME Section IX, (*2*) heat treated in accordance with Section 7 of this specification, and (*3*) nondestructively examined throughout the entire length of each weld in accordance with Section 15 of this specification. The radiography of welds shall be done either prior to or after forming at option of manufacturer. Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

6.3 The welded joints of the fittings shall be finished in accordance with the requirements of Paragraph UW-35 (a) of Section VIII, Division 1 of ASME Boiler and Pressure Vessel Code.

6.4 All butt-weld tees manufactured by cold-forming methods shall be liquid penetrant or magnetic particle examined by one of the methods specified in Supplementary Requirement S52 or S53 of Specification A960/A960M. This examination shall be performed after final heat treatment by NDE personnel qualified under the provisions of SNT-TC-1A. Only the sidewall areas of the tee need be examined. This area is defined by a circle that covers the area from the weld bevel of the branch outlet to the centerline of the body or run. Internal and external surfaces shall be examined when size permits accessibility. After the removal of any cracks, the tees shall be re-examined by the original method. Acceptable tees shall be marked with the symbol PT or MT, as applicable, to indicate compliance.

TABLE 1 Chemical Requirements

NOTE 1—All requirements are maximum unless otherwise indicated.

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

Grade[A]	Composition, %										
	C	Mn	P	S	Si	Ni	Cr	Mo	Cu	~~Cb~~Nb[E]	V
WPL6	0.30	0.50–1.35	0.035	0.040	0.15–0.40	0.40	0.30	0.12	0.40	0.02[B]	0.08
WPL9	0.20	0.40–1.06	0.030	0.030	. . .	1.60–2.24			0.75–1.25		
WPL3[C]	0.20	0.31–0.64	0.05	0.05	0.13–0.37	3.2–3.8			. . .		
WPL8[D]	0.13	0.90	0.030	0.030	0.13–0.37	8.4–9.6			. . .		

[A] When fittings are of welded construction, the symbols above shall be supplemented by the letter "W".
[B] ~~By~~ By agreement, the limit for ~~Columbium~~niobium 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.
[E] Niobium and columbium are interchangeable names for the same element and both names are acceptable for use in A01.22 specifications.

[6] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

6.5 Stubends may be produced with the entire lap added by the welding of a ring, made from plate or bar of the same alloy grade and composition, to the outside of a straight section of pipe, provided the weld is double welded, is a full penetration joint, satisfies the requirements of 6.2 for qualifications and radiography and 7.1 for post weld heat treatment.

7. Heat Treatment

7.1 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.

7.2 The full thickness of the material from which impact test specimens are to be obtained shall be heat treated with a furnace charge as specified in 10.4.2 or 10.4.3.

7.3 After forming, the fittings shall be allowed to cool below the lower critical before applying one of the heat treatments listed in 7.1.

7.4 When specified in the order, the test specimens shall be subjected to a simulated post-weld heat treatment before testing. The simulated post-weld heat treatment used shall be as shown in Table 2, unless the purchaser has otherwise specified in the order.

8. Chemical Composition

8.1 The steel shall conform to requirements of chemical composition for the respective material prescribed in Table 1.

8.2 The steel shall not contain any unspecified elements for the ordered grade to the extent that it then conforms to the requirements of another grade for which that element is a specified element having a required minimum content.

8.3 The chemical composition of weld metal is not required to meet the same limits of the base materials however, the composition of the weld deposit shall be such that it meets the minimum mechanical and impact requirements of this specification. In general, the alloy content shall be similar to that of the base metal but shall not exceed 6 % except in the case of fittings of 9 % nickel steel.

8.4 A product analysis is optional.

9. Tensile Properties

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

9.1.1 Longitudinal or transverse specimens cut from either a fitting or from starting plate or pipe they were manufactured from shall be acceptable for the tension test. For fittings made from forgings, the test specimen shall meet the requirements of Specification A350/A350M for the tension test.

9.1.2 While Table 3 specifies elongation requirements for both longitudinal and transverse specimens, it is not the intent that both requirements apply simultaneously. Instead, it is intended that only the elongation requirement that is appropriate for the specimen used be applicable. Unless specified by the customer, tensile test orientation is at the discretion of the manufacturer.

9.2 At least one tension test shall be made on each heat of material and in the same condition of heat treatment as the finished fittings it represents provided that the wall thickness of the fitting and the representative sample thickness do not vary more than ¼ in. [6 mm]. At least one tension test per heat of weld metal shall be made after heat treatment in the same manner as the base metal. Results of the tension test of the weld metal need not be reported unless Supplementary Requirement S51 of Specification A960/A960M is specified.

9.3 Records of the tension tests shall be certification that the material of the fitting meets the tensile requirements of this specification.

10. Impact Test Properties

10.1 *Properties:*

10.1.1 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.

TABLE 2 Post-Weld Heat Treatment

Grade	Metal Temperature		Minimum Holding Time
	°F	°C	
WPL6	1100–1200	595–650	1 h/in. [25 mm] ¾ h min
WPL3	1100–1150	540–620	¼ h/in. [25 mm] 1 h min
WPL8	1050–1100	565–595	½ 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].

TABLE 3 Tensile Requirements

NOTE 1—Where an ellipsis (. . .) appears in this table, there is no requirement.

Requirement	Grade			
	WPL6	WPL9	WPL3	WPL8
Tensile strength, min ksi [MPa]	60 [415] – 95 [655]	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	Grades							
	WPL6		WPL9		WPL3		WPL8	
	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse
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 (½ in. [12.7- mm] wide specimen)~~	[A]	[A]	[A]	[A]	[A]	[A]	[A]	. . .
Rectangular specimen for wall thickness less than 5/16 in. [7.94 mm]; min % in 2 in. or 50 mm (½-in. [12.7-mm] wide specimen)	[A]	[A]	[A]	[A]	[A]	[A]	[A]	. . .

[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]	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse
5/16 (0.312)	[7.94]	30.0	16.5	28.0	18.0	30.0	20.0	22.0	. . .
9/32 (0.281)	[7.14]	28.5	15.5	26.5	17.0	28.5	19.0	20.75	. . .
1/4 (0.250)	[6.35]	27.0	14.5	25.0	16.0	27.0	18.0	19.5	. . .
7/32 (0.219)	[5.56]	25.5	. . .	23.5	. . .	25.5	. . .	18.25	. . .
3/16 (0.188)	[4.76]	24.0	. . .	22.0	. . .	24.0	. . .	17.0	. . .
5/32 (0.156)	[3.97]	22.5	. . .	20.5	. . .	22.5	. . .	15.75	. . .
1/8 (0.125)	[3.17]	21.0	. . .	19.0	. . .	21.0	. . .	14.5	. . .
3/32 (0.094)	[2.38]	19.5	. . .	17.5	. . .	19.5	. . .	13.25	. . .
1/16 (0.062)	[1.59]	18.0	. . .	16.0	. . .	18.0	. . .	12.0	. . .

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	Equations			
	WPL6	WPL9	WPL3	WPL8
Longitudinal	$E = 48t + 15.00$	48t + 13.00	E = 48t + 15.00	40t + 9.50
Transverse	$t = 32t + 6.50$	32t + 8.00	E = 32t + 10.00	. . .

where:

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

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 10.0	13	17.6	10	13.6
10 by 7.5	10	13.6	8	10.8
10 by 5.0	7	9.5	5	7.0
10 by 2.5	4	5.4	3	4.1

[A] Straight-line interpolation for intermediate values is permitted.