



Designation: A420/A420M – 22

Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service¹

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 specification² 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.*

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.

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

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:⁴

B16.9 Factory-Made Wrought Steel Butt-Welding Fittings⁴

B16.11 Forged Steel Fittings, Socket-Welding Threaded⁴

2.4 ASME Boiler and Pressure Vessel Code:⁴

Section III

Section VIII Division 1, Pressure Vessels⁴

Section IX

2.5 MSS Standards:

MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions⁵

MSS SP-79 Socket Welding Reducer Inserts⁵

MSS SP-83 Steel Pipe Unions, Socket-Welding and Threaded⁵

MSS SP-95 Swage(d) Nipples and Bull Plugs⁵

MSS SP-97 Integrally Reinforced Forged Branch Outlet Fittings—Socket Welding, Threaded and Butt-welding Ends

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

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	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 agreement, the limit for 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.

2.6 ASNT Standards:

SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification⁶

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 side-wall 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.

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

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

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.

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].

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.

10.1.2 *Retest*—When the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen and the value for more than one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens shall be made. The value for each of these retest specimens shall equal or exceed the required average value. When an erratic result is caused by a defective specimen, or there is uncertainty in test procedure, a retest shall be allowed.

10.2 Procedures:

10.2.1 All material furnished under this specification shall be tested for impact resistance at the temperature for the respective grade in **Table 6**. Exceptions to these requirements are permissible when agreed upon between the purchaser and producer and specified in the order, in that the impact test is acceptable when made at temperatures different from those shown in **Table 6**, provided the test temperature is at least as low as the intended service temperature, and fittings are suitably marked in accordance with Section 19 to identify the reported test temperature.

10.2.2 The notched-bar impact test shall be made in accordance with the procedure for the simple-beam, Charpy-type test of Test Methods and Definitions **A370** if the inch-pound units are specified or Test Methods **A1058** if the M suffix (SI units) standard is specified. Each impact test shall consist of breaking three specimens.

10.3 Specimens:

10.3.1 Notched-bar impact specimens shall be simple-beam, Charpy-type A with a V-notch in accordance with Test Methods and Definitions **A370** if the inch-pound units are specified or Test Methods **A1058** if the M suffix (SI Units) standard is specified. Standard specimens 10 by 10 mm in cross section shall be used unless the material to be tested is of insufficient thickness, in which case the largest obtainable standard subsize impact specimens shall be used. When the size or shape of the finished fittings is insufficient to permit obtaining the smallest standard subsize impact specimens, an impact test by the fitting manufacturer will not be required. The material from which the specimens are taken shall be heat treated with a furnace charge in accordance with **10.4.2** or **10.4.3**. Impact tests shall be made from either the raw material from which the fittings are made or from a finished fitting at the option of the manufacturer.

10.3.2 Test specimens shall be obtained so that the longitudinal axis of the specimen is parallel to the longitudinal axis of the fitting while the axis of the “V” shall be perpendicular to the surface. On wall thickness over 1 in. [25 mm] the specimens shall be obtained with their longitudinal axis located ½ in. [13 mm] from the outer surface.

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 (1/2-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							
in.	[mm]	WPL6		WPL9		WPL3		WPL8	
		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	...
3/32 (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:

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Direction of Test	Equations
Longitudinal	WPL6 $E = 48t + 15.00$
Transverse	WPL9 $t = 32t + 6.50$
	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.

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	18	10
10 by 7.5	10	14	8	11
10 by 5.0	7	9	5	7
10 by 2.5	4	5	3	4

^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 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	25	34	20
10 by 7.5	21	29	17	23
10 by 5.0	17	23	14	19
10 by 2.5	8	11	6	8

transverse to the longitudinal axis of the weld. The axis of the notch shall be perpendicular to the surface.

10.4 Number of Tests: