



Designation: A 420/A 420M – 05

# Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service<sup>1</sup>

This standard is issued under the fixed designation A 420/A 420M; 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<sup>2</sup> covers wrought carbon steel and alloy steel fittings of seamless and welded construction, covered by the latest revision of ASME B 16.9, ASME B 16.11, MSS-SP-79, and MSS SP-95. Fittings differing from these ASME and MSSVF standards shall be furnished in accordance with Supplementary Requirement S58 of Specification A 960/A 960M. 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 inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other.

## 2. Referenced Documents

2.1 In addition to those Referenced Documents listed in Specification A 960/A 960M, the following list of standards apply to this specification.

2.2 *ASTM Standards:*<sup>3</sup>

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 960/A 960M Specification for Common Requirements for Wrought Steel Piping Fittings

2.3 *ASME Standards:*

B 16.9 Factory-Made Wrought Steel Butt-Welding Fittings<sup>4</sup>

B 16.11 Forged Steel Fittings, Socket-Welding Threaded<sup>4</sup>

Section VIII Division 1, Pressure Vessels<sup>4</sup>

Section IX Welding Qualifications

2.4 *MSS Standards:*

MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions<sup>5</sup>

MSS SP-79 Socket Welding Reducer Inserts<sup>5</sup>

MSS SP-95 Swage(d) Nipples and Bull Plugs<sup>5</sup>

2.5 *ASNT Standards:*

SNT-TC-1A(1984) Recommended Practice for Nondestructive Testing Personnel Qualification and Certification<sup>6</sup>

## 3. Ordering Information

3.1 See Specification A 960/A 960M.

## 4. General Requirements

4.1 Product furnished to this specification shall conform to the requirements of Specification A 960/A 960M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 960/A 960M constitutes non-conformance with this specification. In case of conflict between the requirements of this specification and Specification A 960/A 960M, this specification shall prevail.

## 5. Material

5.1 The material for fittings shall consist of forgings, bars, plates, seamless or fusion welded tubular products with filler metal added. It shall conform to the chemical requirements in Table 1, and be made by one of the following processes: open-hearth, basic-oxygen, or electric-furnace. The steels shall

<sup>1</sup> 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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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SA-420 in Section II of that Code.

<sup>3</sup> 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.

<sup>4</sup> Available from ASME International, Three Park Avenue, New York, NY 10016-5990.

<sup>5</sup> Available from Manufacturers' Standardization Society of the Valve and Fittings Industry, 127 Park St. N.E., Vienna, VA 22180.

<sup>6</sup> Available from American Society for Nondestructive Testing, 1711 Arlingate Plaza, Columbus, OH 43228-0518.

\*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 <sup>A</sup> | Composition, % |           |       |       |           |           |      |      |           |                   |      |
|--------------------|----------------|-----------|-------|-------|-----------|-----------|------|------|-----------|-------------------|------|
|                    | C              | Mn        | P     | S     | Si        | Ni        | Cr   | Mo   | Cu        | Cb                | 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 <sup>B</sup> | 0.08 |
| WPL9               | 0.20           | 0.40–1.06 | 0.030 | 0.030 | ...       | 1.60–2.24 |      |      | 0.75–1.25 |                   |      |
| WPL3 <sup>C</sup>  | 0.20           | 0.31–0.64 | 0.05  | 0.05  | 0.13–0.37 | 3.2–3.8   |      |      | ...       |                   |      |
| WPL8 <sup>D</sup>  | 0.13           | 0.90      | 0.030 | 0.030 | 0.13–0.37 | 8.4–9.6   |      |      | ...       |                   |      |

<sup>A</sup> When fittings are of welded construction, the symbols above shall be supplemented by the letter "W".

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

<sup>C</sup> Fittings made from plate or forgings may have 0.90 % max manganese.

<sup>D</sup> Fittings made from plate may have 0.98 % max manganese.

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 14 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 A 960/A 960M. 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 the fittings are to be post-weld heat treated after being welded by the purchaser and when so specified in the order, the test specimens shall be subjected to the same post-weld heat treatment. The purchaser shall use the post-weld heat treatment shown in Table 2, unless 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.

**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 <sup>A</sup> | 1025–1085         | 550–585 | 1 h/in. [25 mm] 2 h min |

<sup>A</sup> 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. 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**.

9.2 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 1/4 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 need not be reported unless Supplementary Requirement S51 of Specification **A 960/A 960M** 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.

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:*

**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-<br>tudinal   | Trans-<br>verse | Longi-<br>tudinal   | Trans-<br>verse | Longi-<br>tudinal   | Trans-<br>verse | Longi-<br>tudinal     | Trans-<br>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                     | ...             |

<sup>A</sup> 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-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>verse | Longi-<br>tudinal | Trans-<br>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.