



Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service¹

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1. Scope*

1.1 This specification covers heat-treated wrought carbon steel piping fittings with lowered carbon content of seamless and electric fusion-welded construction covered by the latest revisions in ASME B16.9, ASME B16.11, MSS SP-75, MSS SP-79, MSS SP-83, MSS SP-95, or 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 components where inherent notch toughness and optimum sulfide-cracking resistance are required, such as oil and gas industry piping and distribution systems.

1.2 Optional supplementary requirements are provided for fittings when a greater degree of examination is desired. One or more of the supplementary requirements may be specified in the order.

1.3 This specification does not cover cast-welding fittings or fittings machined from castings.

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. Unless the other specifies the applicable “M” specification designation (SI units), the material shall be furnished to inch-pound units.

2. Referenced Documents

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

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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2.2 ASTM Standards:²

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

2.3 ASME Standards:³

B16.9 Steel Butt-Welding Fittings

B16.11 Forged Steel Fittings, Socket Welding and Threaded

2.4 MSS Standards:⁴

MSS SP-25 The Standard Marking System of Valves, Fittings, Flanges and Unions

MSS SP-75 Specification for High Test Wrought Butt-Welding Fittings

MSS SP-79 Socket Welding Reducer Inserts

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

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

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

2.5 ASME Boiler and Pressure Vessel Code:

Section V⁵

Section VIII Division 1⁵

Section IX

2.6 American Society of Nondestructive Testing:⁶

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

3. Ordering Information

3.1 In addition to the requirements of Specification **A960/A960M**, the following ordering information applies: requirements for certification of the test report.

² 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.

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ 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>.

⁵ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

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

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

4. General Requirements

4.1 Products 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 nonconformance with this specification. In case of conflict between the requirements of this specification and Specification **A960/A960M**, this specification shall prevail.

5. Materials

5.1 The material for fittings shall be fully killed fine-grain material made by a melting process that is intended to produce rounded, well dispersed, fine sulfide inclusions, that promote good notch toughness, assists in the resistance to hydrogen induced cracking, and for weldability suitable for field-welding.

5.2 Starting materials shall consist of plate, sheet, forgings, forging quality bar and seamless or fusion welded tubular products with filler metal added. The chemical composition shall conform to **Table 1**.

5.3 A starting material that specifically requires the addition of any element beyond those listed in **Table 1** is not permitted. This does not preclude the use of deoxidizers.

5.4 Starting materials shall not require a preheat for field welding provided that the restrictions of *ASME Boiler and Pressure Vessel Code*, Section VIII, Paragraph UW-30 are complied with.

6. Manufacture

6.1 Forging or shaping operations may be performed by hammering, pressing, piercing, extruding, upsetting, rolling, bending, fusion welding, machining, or by a combination of these operations.

6.2 All welds including welds in tubular products from which the fittings are made shall be:

6.2.1 Made by welders, welding operators, and welding procedures qualified under the provisions of *ASME Boiler and Pressure Vessel Code*, Section IX,

6.2.2 Heat treated in accordance with Section 7 of this specification, and

6.2.3 Radiographically examined throughout the entire length of each weld in accordance with Articles 1 and 2 of *ASME Boiler and Pressure Vessel Code*, Section V with the acceptance limits in accordance with Paragraph UW-51 in Section VIII of that same code.

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

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 Specification **A960/A960M**. This examination shall be performed in accordance with a written procedure and shall be performed after final heat treatment. Only the side wall area of the tees need be examined. This area is defined by a circle that covers the area from the weld bevel of the branch outlet to the center line of the body or run. Internal and external surfaces shall be examined when size permits accessibility. No cracks shall be permitted. Other imperfections shall be treated in accordance with Section 14 on finish. After the removal of any crack, 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. NDE personnel shall be qualified in accordance with SNT-TC-1A.

6.5 All caps machined from bar stock shall be examined by liquid penetrant or magnetic particle in accordance with Supplementary Requirement S69 or S70 with personnel qualifications, acceptance criteria and marking as in 5.4.

7. Heat Treatment

7.1 All fittings shall be furnished in the heat-treated condition. Fittings formed above the transformation temperature or upon which welding is performed, shall be cooled to below the lower criteria temperature prior to heat treatment. Fittings shall subsequently be heat treated by normalizing, quenching, and tempering or stress-relieving in accordance with Specification **A960/A960M**.

8. Chemical Composition Requirements

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

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

8.3 An analysis of each heat of steel shall be made from a sample taken preferably during the pouring of the heat. The results shall conform to **Table 1**.

8.4 The fittings manufacturer shall make a product analysis per heat from either the starting material or from a fitting in accordance with Specification **A960/A960M**.

8.5 Weld metal used in the construction of the fittings shall conform to the tensile and impact requirements of 9.4 and 11.1 after heat treatment in accordance with Section 7. A chemical analysis shall be performed on deposited weld metal for each heat of filler metal or, for submerged arc welding, each heat of

TABLE 1 Chemical Requirements

	Composition %	
	Heat Analysis	
Carbon	0.20	All values are maximum unless a range is shown
Manganese	0.90–1.35	
Phosphorus	0.030	
Sulfur	0.010	
Silicon	0.15–0.40 ^A	
Nickel	0.50 ^B	
Chromium	0.30 ^B	
Molybdenum	0.20 ^B	
Copper	0.35 ^B	

^A When vacuum carbon deoxidation is used, the silicon shall be 0.10 % maximum, and on product analysis shall not exceed 0.12 %.

^B The combined total of nickel, chromium, molybdenum, and copper shall not exceed 1.0 %.

filler metal and batch of flux. The weld metal shall be deposited in accordance with the qualified weld procedure.

8.6 Only the carbon content of the deposited weld-metal composition need comply with the requirements of **Table 1**. The total nickel content of the deposited weld metal shall not exceed 1.0 %.

9. Tensile Requirements

9.1 The tensile properties of the fitting material shall conform to the requirements listed in **Table 2**.

9.2 Tension test specimens shall be taken from a fitting after final heat treatment or from a test piece of the same heat and nominal thickness that was heat-treated in a charge with the fittings it represents.

9.3 One tensile test is required for each heat of fittings of the same section thickness and heat treated in either a continuous- or batch-type furnace, controlled within a range of 50 °F [28 °C] and equipped with recording pyrometers.

9.4 In addition, fittings containing welds shall have one center-weld tension test made with the axis transverse to the weld seam for each heat of filler metal, or each heat of filler metal and batch of flux for submerged arc welds, for fittings of the same section thickness and heat treated in either a continuous or batch-type furnace controlled within a range of 50 °F [28 °C] and equipped with recording pyrometers. Only the ultimate tensile strength need meet the minimum requirements of **Table 2**.

TABLE 2 Mechanical Requirements

Yield strength, min, 0.2 % offset, ksi [MPa]	36 [250]
Tensile strength, min, ksi [MPa]	70 [485]-95 [655]
<i>Elongation:</i>	
Standard round specimen, or small-size proportional specimen, min, % in 4D	22
Rectangular specimen, for section thickness $\frac{5}{16}$ in. [7.94 mm] and over, and for small sizes tested in full section; min, % in 2 in. [50 mm].	30
Rectangular specimen for section thickness less than $\frac{5}{16}$ in. [7.94 mm]; min, % in 2 in. [50 mm].	A
Width of specimen $1\frac{1}{2}$ in. [40 mm].	
Reduction of area (round specimen only); min, %.	40
<i>Toughness:</i>	
C_v energy absorption ^B ; measured at -50 °F [-46 °C]:	
Specimen size, mm	Average/min, ft-lbs [J]
10 × 10	20/16 [27/22]
10 × 7.5	17/13 [23/18]
10 × 5	13/11 [18/15]

^A For each $\frac{1}{32}$ in. [0.79 mm] decrease in section thickness below $\frac{5}{16}$ in. [7.94 mm] a deduction 1.5 % from the 30 % shown above is permitted. Where the section thickness lies between two values defined above, the minimum elongation value is determined by the following equation:

$$E = 48t + 15.00 \quad (1)$$

where:

E = elongation in 2 in. [50 mm], and
 t = actual thickness of specimen, in.

^B These requirements are intended to minimize fracture initiation. The requirements are not intended to give assurance against fracture propagation.

10. Hardness Requirements

10.1 Fittings shall have a maximum hardness of 22 HRC (235 HBW).

11. Notch Toughness Properties

11.1 The notch toughness properties of the fittings shall conform to the requirements listed in **Table 2**. The testing shall be performed as specified in Specification **A960/A960M**. Full-size Charpy, V-notch, Type A specimens shall be used whenever possible. Small size specimens shall be used only when the material thickness does not permit full size specimens. The impact specimens shall not be flattened after heat treatment. All base metal specimens shall be removed with the axis of the specimens longitudinal to the direction of primary metal flow. Weld metal specimens shall have the axis transverse to the weld seam.

11.2 One set of impact tests (three specimens) shall be made to represent the base metal and one set of impact tests (three specimens) shall be made to represent the weld metal on the same frequency as the tension tests.

11.3 The test temperature shall be -50 °F [-46 °C].

12. Dimensions

12.1 Dimensional requirements for NPS 14 and smaller fittings are provided by ASME B16.9, B16.11, MSS SP-79, MSS SP-83, MSS SP-95, or MSS SP-97.

12.2 Dimensional requirements for fittings larger than NPS 14 up through NPS 48 are provided in MSS SP-75, except as modified by **12.3**

12.3 Fittings of a size or shape differing from the standards in **12.1** and **12.2** but meeting all the other requirements of this specification, may be furnished in accordance with Supplementary Requirement S58 of Specification **A960/A960M**.

13. Surface Finish, Appearance, and Corrosion Protection

13.1 The requirements of Specification **A960/A960M** apply.

14. Repair by Welding (Base Metal)

14.1 Repair welding, by the manufacturer, is permissible in accordance with Specification **A960/A960M** and the following:

14.1.1 The deposited weld metal shall conform to the requirements of **8.5** and **8.6**. Electrodes for the shielded metal-arc process shall be of the low-hydrogen type.

14.1.2 Sections thicker than 1 in. [25 mm] shall also be radiographed after repair welding in accordance with **6.2**.

14.1.3 All fittings repaired by welding shall be thermally treated after repair by either complete reheat treatment or post-weld heat treatment at least 50 °F [28 °C] below the tempering temperature if tempering has been performed.

14.1.4 Indications discovered by nondestructive examination shall, after heat treatment, be again examined by the same NDE method as used in the original determination.

14.1.5 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

15. Hydrostatic Test

15.1 Hydrostatic testing is not required by this specification.

15.2 Every fitting shall be capable of withstanding without failure, leakage, or impairment of serviceability, a hydrostatic test pressure of 1½ times its pressure rating or 1½ times the piping design pressure.

16. Rejection and Rehearing

16.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection shall be reported to the producer or supplier promptly in writing. In case of dissatisfaction with the results of the tests, the producer or supplier may make claim for a rehearing.

17. Certification

17.1 Test reports are required for all fittings covered by this specification. Each test report shall meet the requirements for certification in Specification **A960/A960M** as well as include the following information specific to this specification:

17.1.1 Chemical analysis results, Section 8 (**Table 1**), reported results for base metal only shall be to the same number of significant figures as the limits specified in **Table 1** for that element,

17.1.2 Tensile property results, Section 9 (**Table 2**), report the yield strength and tensile strength in ksi [MPa], and elongation and reduction of area in percent for the base metal only,

17.1.3 Transverse-weld tensile results (if applicable) **9.4**,

17.1.4 Impact test results, (Section 11 and **Table 2**), base metal and weld metal, report specimen size and test temperature,

17.1.5 Type heat treatment, (Section 7),

17.1.6 Radiographic examination results, and

17.1.7 Any supplemental testing required by the purchase order.

18. Product Marking

18.1 In addition to marking requirements of Specification **A960/A960M**, the following additional marking requirements shall apply:

18.1.1 Quenched and tempered fittings shall be marked with the symbol QT, and cold-formed trees shall be marked as prescribed in **6.4**.

18.1.2 Fittings that have been repaired by welding shall be marked with the letter W following the designation number.

18.1.3 If the impact test temperature is other than $-50\text{ }^{\circ}\text{F}$ [$-46\text{ }^{\circ}\text{C}$], the impact test temperature shall be marked on the fitting.

18.2 *Bar Coding*—In addition to the requirements in **18.1**, bar coding is acceptable as a supplemental identification method. The purchaser may specify in the order a specific bar coding system to be used. The bar coding system, if applied at the discretion of the supplier, should be consistent with one of the published industry standards for bar coding. If used on small fittings, the bar code may be applied to the box or a substantially applied tag.

19. Keywords

19.1 corrosive service applications; pipe fittings—steel; piping applications; pressure containing parts; temperature service applications—low

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A858/A858M–13, that may impact the use of this specification. (Approved October 1, 2014)

(I) Revised Section **13** to clarify requirements for surface finish, appearance, and corrosion protection.

Committee A01 has identified the location of selected changes to this specification since the last issue, A858/A858M–10a, that may impact the use of this specification. (Approved October 1, 2013)

(I) Revised Sections **17** and **18** on certification and marking.

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