Designation: A 858/A 858M – 00

Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service[1]

This standard is issued under the fixed designation A 858/A 858M; 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 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 ANSI B 16.9, ANSI B 16.11, ANSI B 16.28, MSS-SP-75, and MSS-SP-79. Fittings differing from these ASME and MSS standards shall be furnished in accordance with Supplementary Requirement S58 of Specification A 960. 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 inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. Combining values from the two systems may result in nonconformance with this specification. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. 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 A 960, the following list of standards apply to this specification.

2.2 *ASTM Standards:*

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe[2]

A 960 Specification for Common Requirements for Wrought Steel Pipe Fittings[2]

2.3 *ASME Boiler and Pressure Vessel Code:*

Section V Nondestructive Examination[3]

Section VIII Division 1, Pressure Vessels[3]

3. Ordering Information

3.1 In addition to the requirements of Specification A 960, the following ordering information applies: requirements for certification of the test report.

4. General Requirements

4.1 Products furnished to this specification shall conform to the requirements of Specification A 960, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 960 constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 960, 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.

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[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] *Annual Book of ASTM Standards*, Vol 01.01.

[3] Available from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

TABLE 1 Chemical Requirements

	Composition %	
	Heat Analysis	
Carbon	0.20	
Manganese	0.90–1.35	All values are
Phosphorus	0.030	maximum unless a
Sulfur	0.010	range is shown
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 %.

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 A 960. 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 A 960.

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 A 960.

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 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 [485]
Elongation:	
Standard round specimen, or small-size proportional specimen, min, % in 4D	22
Rectangular specimen, for section thickness 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 5⁄16in. [7.94 mm]; min, % in 2 in. [50 mm]. Width of specimen 1½ in. [40 mm].	[A]
Reduction of area (round specimen only); min, %.	40
Toughness:	
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 1⁄32 in. [0.79 mm] decrease in section thickness below 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:

$$E = 48t + 15.00$$

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 HB).

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 in accordance with Methods and Definitions A 370. 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 ANSI B 16.9, B 16.11, B 16.28, or MSS-SP-79.

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 A 960.

13. Finish and Appearance

13.1 See Specification A 960 for specific requirements.

14. Repair by Welding (Base Metal)

14.1 Repair welding, by the manufacturer, is permissible in accordance with Specification A 960 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 When requested by the purchaser, the manufacturer shall provide a certificate of compliance to this specification (including year date). In addition, if requested to provide test reports, the manufacturer shall also provide the following, where applicable:

17.1.1 Chemical analysis results, (Section 8 and Table 1), base metal only, and

17.1.2 Tensile property results, (Section 9 and Table 2), including the yield strength and tensile strength in ksi, and elongation and reduction of area in percent for the base metal. Transverse-weld tensile strength shall be reported in ksi.

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

17.1.4 Type heat treatment, (Section 7),

17.1.5 Radiographic examination results, and

17.1.6 Any supplemental testing required by the purchase order.

18. Product Marking

18.1 Identification marking shall consist of the manufacturer's symbol or name (Note 1), specification number (year date not needed), size, and nominal wall thickness or schedule, and heat code identity. In addition, quenched and tempered fittings shall be marked with the symbol QT, and cold-formed tees shall be marked as prescribed in 6.4.

NOTE 1—For purposes of identification marking, the manufacturer is considered the organization that certifies the piping component complies with this specification.

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

18.3 Marking shall be by low-stress die stamps or interrupted dot stamps and shall be in accordance with MSS-SP-25.

18.4 If the impact test temperature is other than −50°F [−46°C], the impact test temperature shall be marked on the fitting.

18.5 *Bar Coding*—In addition to the requirements in 18.1, 18.2, 18.3, and 18.4, 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