



Designation: A860/A860M – 22

Standard Specification for Wrought High-Strength Ferritic Steel Butt-Welding Fittings¹

This standard is issued under the fixed designation A860/A860M; 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 wrought high-strength ferritic steel butt-welding fittings of seamless and electric fusion-welded construction. Dimensions of the fittings are provided in the latest revisions of ASME B16.9 and MSS-SP-75. Butt-welding fittings differing from ASME B16.9 shall be furnished in accordance with Supplementary Requirement S58 of Specification A960/A960M. These fittings are for use in high-pressure gas and oil transmission 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 order specifies the applicable “M” specification designation (SI units), the material shall be furnished to inch-pound units.

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.

Current edition approved Nov. 1, 2022. Published November 2022. Originally approved in 1986. Last previous edition approved in 2018 as A860/A860M – 18. DOI: 10.1520/A0860_A0860M-22.

2. Referenced Documents

2.1 *ASTM Standards*:²

A751 Test Methods and Practices for Chemical Analysis of Steel Products
A960/A960M Specification for Common Requirements for Wrought Steel Piping Fittings

2.2 *ASME Standards*:³

B16.9 Steel Butt-Welding Fittings

2.3 *ASME Boiler and Pressure Vessel Code*:³

Section V
Section VIII Division 1

Section IX

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

2.5 *American Society of Nondestructive Testing*:⁵

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *Barlow’s Formula*—relates the internal pressure that a pipe can withstand to its dimensions and the strength of its materials.

3.1.1.1 *Discussion*—The formula is given in 15.2.

3.2 *Definitions*—For definitions of other terms used in this specification refer to Specification A960/A960M.

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

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

4. Ordering Information

4.1 See Specification **A960/A960M**.

5. General Requirements

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

6. Materials and Manufacture

6.1 The steel for fittings shall be killed steel melted in accordance with a fine grain practice. The steel shall be made by the electric arc furnace, induction melt furnace or basic oxygen furnace melting processes. These melting processes may be followed by additional refining in a ladle metallurgy furnace (LMF). Secondary melting by vacuum-arc remelting (VAR) or electroslag remelting (ESR) may be used.

6.1.1 The melting practice used is intended to produce rounded, well dispersed, fine sulphide inclusions. This practice promotes good notch toughness, assists in the resistance to hydrogen induced cracking, and results in weldability suitable for field welding.

6.2 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**.

6.3 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.

6.4 Starting material 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.

6.5 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.

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

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

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

6.6.3 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 acceptance limits in accordance with Paragraph UW-51 of ASME Boiler and Pressure Vessel Code, Section VIII.

6.7 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.

6.8 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 Requirements S69 or S70 of 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 **13.1** on finish. 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. NDE personnel shall be qualified in accordance with SNT-TC-1A.

6.9 All caps machined from bar stock shall be examined by liquid penetrant or magnetic particle in accordance with Supplementary Requirements S69 or S70 of Specification **A960/A960M**, and with personnel qualifications, acceptance criteria, and marking as in **6.8**.

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 critical 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

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

TABLE 1 Chemical Requirements

	Composition %	
		Heat Analysis
Carbon	0.20 ^A	All values are maximum unless a range is stated
Manganese	1.00–1.45	
Phosphorus	0.030	
Sulfur	0.010	
Silicon	0.15–0.40 ^B	
Nickel	0.50 ^C	
Chromium	0.30 ^C	
Molybdenum	0.25 ^C	
Copper	0.35 ^C	
Titanium	0.05	
Vanadium	0.10	
Niobium ^D	0.04	
Vanadium plus Niobium	0.12	
Aluminum	0.06	

^A The carbon equivalent, as calculated by the following formula, shall not exceed 0.42 %:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

^B If vacuum carbon deoxidation is used, silicon shall not exceed 0.10 % by heat analysis and 0.12 % by product analysis.

^C The sum of Ni + Cr + Mo + Cu shall not exceed 1.0 %.

^D Niobium and columbium are interchangeable names for the same element and both names are acceptable for use in A01.22 specifications.