



Designation: A 960 – 02

An American National Standard

Standard Specification for Common Requirements for Wrought Steel Piping Fittings¹

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1. Scope *

1.1 This specification covers a group of common requirements that shall apply to wrought steel piping fittings covered in any of the following individual product specifications or any other ASTM specification that invokes this specification or portions thereof:

A 234/A 234M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

A 403/A 403M Specification for Wrought Austenitic Stainless Steel Piping Fittings

A 420/A 420M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service

A 758/A 758M Specification for Butt-Welding, Wrought-Carbon Steel, Piping Fittings with Improved Notch Toughness

A 774/A 774M Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

A 815/A 815M Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings

A 858/A 858M Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service

A 860/A 860M Specification for High-Strength Butt-Welding Fittings of Wrought High-Strength Low-Alloy Steel

1.2 In case of conflict between a requirement of the individual product specification and a requirement of this general requirement specification, the requirements of the individual product specification shall prevail over those of this specification.

1.3 By mutual agreement between the purchaser and the supplier, additional requirements may be specified (see 4.1.7). The acceptance of any such additional requirements shall be dependent on negotiations with the supplier and must be included in the order as agreed upon by the purchaser and supplier.

1.4 The values stated in either inch-pound units or SI units [metric] are to be regarded separately as standard. Within the text and the tables, 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. Combining values from the two systems may result in nonconformance with the specification. The inch-pound units shall apply unless the “M” designation [SI] of the product specification is specified in the order.

2. Referenced Documents

2.1 ASTM Standards:

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for²

A 234/A 234M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures³

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels⁴

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products⁴

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings²

A 403/A 403M Specification for Wrought Austenitic Stainless Steel Piping Fittings³

A 420/A 420M Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service³

A 700 Practices for Packaging, Marking and Loading Methods for Steel Products for Domestic Shipment²

A 736/A 736M Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel⁵

A 751 Test Methods, Practices and Terminology for Chemical Analysis of Steel Products⁴

A 758/A 758M Specification for Butt-Welding, Wrought

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 01.05.

³ Annual Book of ASTM Standards, Vol 01.01.

⁴ Annual Book of ASTM Standards, Vol 01.03.

⁵ Annual Book of ASTM Standards, Vol 01.04.

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



Carbon Steel, Piping Fittings with Improved Notch Toughness³

A 774/A 774M Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures³

A 815/A 815M Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings³

A 858/A 858M Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service³

A 860/A 860M Specification for Wrought High-Strength Low-Alloy Steel Butt-Welded Fittings²

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys³

A 967 Specification for Chemical Passivation Treatments for Stainless Steel Parts⁴

E 165 Test Method for Liquid Penetrant Examination⁶

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing⁶

E 709 Guide for Magnetic Particle Examination⁶

E 1916 Guide for the Identification and/or Segregation of Mixed Lots of Metal⁷

2.2 *ASME Boiler and Pressure Vessel Code*:⁸

Section IX Welding Qualifications

2.3 *Military Standard*:⁹

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

2.4 *Manufacturer's Standardization Society Standards*:¹⁰

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

MSS SP-43 Standard Practice for Light Weight Stainless Steel Butt-Welding Fittings

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 Steel Branch Outlet Fittings—Socket Welding, Threaded and Butterfly Ends

2.5 *American Society of Nondestructive Testing*:¹¹

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

2.6 *ASME Standards*:⁸

B16.9 Steel Butt-Welding Fittings

B16.11 Forged Steel Fittings, Socket Welding and Threaded

B16.28 Wrought Steel Butt-Welding Short Radius Elbows and Returns

3. Terminology

3.1 Definitions of Terms Specific to This Specification:

3.1.1 *bar*—a solid section that is long in relationship to its cross sectional dimensions, with a relatively constant cross section throughout its length. (See Specification A 29/A 29M for definitions relating to the production of hot wrought and cold finished bars.)

3.1.2 *certifying organization*—the company or association responsible for the conformance of, the marking of, and the certification of the product to the specification requirements.

3.1.3 *fitting*—a component for non-bolted joints used in piping systems and pressure vessels.

3.1.4 *flange*—a component for bolted joints used in piping systems and pressure vessels.

3.1.5 *forging*—the product of a substantially compressive hot or cold plastic working operation that consolidates the material and produces the required shape.

3.1.6 *Discussion*—The plastic working must be performed by a forging machine, such as a hammer, press, or ring rolling machine and must deform the material to produce an essentially wrought structure throughout the material cross section.

3.2 *Definitions*—For definitions of other terms used in this specification, refer to Terminology A 941.

4. Ordering Information

4.1 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to purchase the needed material. Examples of such information include but are not limited to the following:

4.1.1 Quantity,

4.1.2 Description of fitting and nominal dimensions (standard or special),

4.1.3 Steel composition by grade and class designation,

4.1.4 Construction, seamless or welded (unless seamless or welded construction is specified by the purchaser, either may be furnished at the option of the supplier),

4.1.5 Specification number (including the year/date of issue),

4.1.6 Supplementary requirements, and

4.1.7 Additional requirements.

5. Material

5.1 The material for fittings shall consist of forgings, bars, plates and seamless or welded tubular products.

5.2 The steel shall conform to the chemical requirements of the individual product specification and may be made from any process.

5.3 Ferritic steels shall be fully killed.

5.4 If secondary melting is employed, the heat shall be defined as all ingots remelted from a primary heat.

6. Manufacture

6.1 Forging or shaping operations may be performed by any of the methods included in the individual product specification.

6.2 Hollow cylindrically shaped parts up to and including NPS 4 may be machined from bar or seamless tubular material provided the axial length of the part is approximately parallel to the axial length of the fitting. Elbows, return bends, tees and header tees shall not be machined directly from a solid bar.

⁶ *Annual Book of ASTM Standards*, Vol 03.03.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

⁸ Available from the American Society of Mechanical Engineers, Three Park Avenue, NY 10016-5990.

⁹ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094 Attn: NPODS.

¹⁰ Available from Manufacturers' Standardization Society of the Valve and Fittings Industry, 1815 N. Fort Myer Dr., Arlington, VA 22209.

¹¹ Available from American Society for Nondestructive Testing, 4153 Arlington Plaza, Columbus, OH 43228-0518.



6.3 Fittings, after forming at an elevated temperature, shall be cooled to a temperature below the critical range under suitable conditions to prevent injury by cooling too rapidly.

7. Heat Treatment

7.1 Fittings requiring heat treatment shall be treated as specified in the individual product specification using the following procedures:

7.1.1 *Full Annealing*—Fittings shall be uniformly reheated to a temperature above the transformation range and, after holding for a sufficient time at this temperature, cooled slowly to a temperature below the transformation range.

7.1.2 *Solution Annealing*—Fittings shall be heated to a temperature that causes the carbides to go into solution and then quenched in water or rapidly cooled by other means to prevent reprecipitation.

7.1.3 *Isothermal Annealing*—Isothermal annealing shall consist of austenitizing a ferrous alloy and then cooling to and holding within the range of temperature at which the austenite transforms to a relatively soft ferrite-carbide aggregate.

7.1.4 *Normalizing*—Fittings shall be uniformly reheated to a temperature above the transformation range and subsequently cooled in air at room temperature.

7.1.5 *Tempering and Post-Weld Heat Treatment*—Fittings shall be reheated to the prescribed temperature below the transformation range, held at temperature for the greater of ½ h or 1 h/in. [25.4 mm] of thickness at the thickest section and cooled in still air.

7.1.6 *Stress Relieving*—Fittings shall be uniformly heated to the selected stress relieving temperature. The temperature shall not vary from the selected temperature by more than $\pm 25^{\circ}\text{F}$ [$\pm 14^{\circ}\text{C}$].

7.1.7 *Quench and Temper*—Fittings shall be fully austenitized and immediately quenched in a suitable liquid medium. The quenched fittings shall be reheated to a minimum temperature of 1100°F [590°C] and cooled in still air.

8. Chemical Requirements

8.1 *Chemical Analysis*—Samples for chemical analysis and methods of analysis shall be in accordance with Test Methods, Practices and Terminology A 751 for Chemical Analysis of Steel Products.

8.2 *Heat Analysis*—An analysis of each heat of steel shall be made by the manufacturer to determine the percentages of those elements specified in the individual product specification. If secondary melting processes are employed, the heat analysis shall be obtained from one remelted ingot of each primary melt. The chemical analysis thus determined shall conform to the requirements of the individual product specification. Note that the product analysis (check analysis) tolerances are not to be applied to the heat analysis requirements.

8.3 *Product Analysis*—If a product analysis is performed it shall be in accordance with Test Methods, Practices, and Terminology A 751. The chemical composition thus determined shall conform to limits of the product specification, within the permissible variations of Table 1 or Table 2 of this specification, as appropriate for the grade being supplied.

9. Mechanical Requirements

9.1 *Method of Mechanical Test*—All tests shall be con-

TABLE 1 Product Analysis Tolerances for Low Alloy and Carbon Steels^A

Elements	Limit, or Maximum of Specified Range, %	Permissible Variations Over Maximum Limit or Under Minimum Limit, %
Carbon	0.30 and under over 0.30 to 0.75, incl over 0.75	0.01 0.02 0.03
Manganese	0.90 and under over 0.90 to 2.10, incl	0.03 0.04
Phosphorus	over maximum only	0.005
Sulfur	0.060 and under	0.005
Silicon	0.40 and under over 0.40 to 2.20, incl	0.02 0.05
Nickel	1.00 and under over 1.00 to 2.00, incl over 2.00 to 5.30, incl over 5.30 to 10.00, incl	0.03 0.05 0.07 0.10
Chromium	0.90 and under over 0.90 to 2.10, incl over 2.10 to 3.99, incl	0.03 0.05 0.10
Molybdenum	0.20 and under over 0.20 to 0.40, incl over 0.40 to 1.15, incl	0.01 0.02 0.03
Vanadium	0.10 and under over 0.10 to 0.25, incl over 0.25 to 0.50, incl minimum value specified, under minimum limit only	0.01 0.02 0.03 0.01
Columbium (Niobium)	Up to and incl 0.14 0.15 to 0.50, incl	0.02 0.06
Titanium	Up to and incl 0.85	0.05
Aluminum	0.10 and under over 0.10 to 0.20, incl over 0.20 to 0.30, incl over 0.30 to 0.80, incl over 0.80 to 1.80, incl	0.03 0.04 0.05 0.07 0.10
Lead ^B	0.15 to 0.35, incl	0.03
Copper	to 1.00 incl over 1.00 to 2.00, incl	0.03 0.05

^A Chrome content less than 4.00.

^B Product analysis tolerance for lead applies both over and under to a specified range of 0.15 to 0.35 %.

ducted in accordance with Test Methods and Definitions A 370.

9.2 The test specimen shall represent all material from the same heat and heat treatment load whose maximum thicknesses do not exceed the thickness of the test specimen or blank by more than ¼ in. [6 mm].

9.3 One tension test at room temperature shall be made in accordance with 9.2 from each heat in each heat treatment load.

9.3.1 If heat treatment is performed in either a continuous or batch type furnace controlled within $\pm 25^{\circ}\text{F}$ [$\pm 14^{\circ}\text{C}$] of the required heat treatment temperature and equipped with recording pyrometers so that complete records of heat treatment are available, and if the same heat treating cycles are used on the material represented by the tension test, then one tension test from each heat shall be required, instead of one tension test from each heat in each heat treatment load in accordance with 9.2.

9.4 *Retest*—When a retest is permitted by the product specification, it shall be performed on twice the number of representative specimens that were originally nonconforming. When any retest specimen does not conform to the product specification requirements for the characteristic in question, the lot represented by that specimen shall be rejected or reworked in accordance with Section 14.

