



Designation: A961/A961M – 23

Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications¹

This standard is issued under the fixed designation A961/A961M; 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 a group of common requirements that shall apply to steel flanges, forged fittings, valves, and parts for piping applications under any of the following individual product specifications:

Title of Specification	ASTM Designation
Forgings, Carbon Steel, for Piping Components	A105/A105M
Forgings, Carbon Steel, for General-Purpose Piping	A181/A181M
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service	A182/A182M
Forgings, Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components	A350/A350M
Forged or Rolled 8 and 9 % Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service	A522/A522M
Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service	A694/A694M
Flanges, Forged, Carbon and Alloy Steel for Low Temperature Service	A707/A707M
Forgings, Carbon Steel, for Piping Components with Inherent Notch Toughness	A727/A727M
Forgings, Titanium-Stabilized Carbon Steel, for Glass-Lined Piping and Pressure Vessel Service	A836/A836M

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 Section 4.1.2). 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 between the purchaser and supplier.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text and

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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the tables, 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. The inch-pound units shall apply, unless the “M” designation (SI) of the product specification is specified in the order.

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.*

2. Referenced Documents

2.1 ASTM Standards:²

- A105/A105M Specification for Carbon Steel Forgings for Piping Applications
- A181/A181M Specification for Carbon Steel Forgings, for General-Purpose Piping
- A182/A182M Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- A275/A275M Practice for Magnetic Particle Examination of Steel Forgings
- A350/A350M Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A522/A522M Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service
- A694/A694M Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
- A700 Guide for Packaging, Marking, and Loading Methods

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.

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

- for Steel Products for Shipment
- A707/A707M** Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
- A727/A727M** Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness
- A751** Test Methods and Practices for Chemical Analysis of Steel Products
- A836/A836M** Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service
- A941** Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
- A967/A967M** Specification for Chemical Passivation Treatments for Stainless Steel Parts
- A991/A991M** Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
- A1058** Test Methods for Mechanical Testing of Steel Products—Metric
- B880** Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys
- E165/E165M** Practice for Liquid Penetrant Testing for General Industry
- E381** Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
- E709** Guide for Magnetic Particle Testing
- E1916** Guide for Identification of Mixed Lots of Metals
- 2.2 *ASME Standard*.³
- ASME** Boiler and Pressure Vessel Code—Section IX
- 2.3 *Manufacturer’s Standardization Society Standard*.⁴
- SP 25** Standard Marking System of Valves, Fittings, Flanges and Unions

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this specification, refer to Terminology **A941**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bar, n*—a solid rolled or forged section that is long in relationship to its cross sectional dimensions, with a relatively constant cross section throughout its length and a wrought microstructure.

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

3.2.3 *fitting, n*—a component for non-bolted joints in piping systems.

3.2.4 *flange, n*—a component for bolted joints used in piping systems.

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>.

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

3.2.5.1 *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 a wrought structure throughout the material cross section.

3.2.6 *longitudinal axis, n*—an axis along the lengthwise direction of the part, bar, pipe or tubing parallel to the direction of the greatest extension of the steel during rolling, extruding or forging.

3.2.7 *seamless tubing, n*—a tubular product made without a welded seam.

3.2.7.1 *Discussion*—It is manufactured usually by hot working the material, and if necessary, by subsequently cold finishing the hot worked tubular product to produce the desired shape, dimensions and properties.

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 Size and pressure class or dimensions, (tolerances and surface finishes should be included),

4.1.3 Specification number with grade or class, or both, as applicable, and year/date,

4.1.4 Choice of testing track from the options listed in Test Methods **A1058** when material is ordered to an M suffix (SI units) product standard. If the choice of test track is not specified in the order, then the default ASTM track shall be used as noted in Test Methods **A1058**,

4.1.5 Supplementary requirements, and

4.1.6 Additional requirements.

5. Melting Process

5.1 Unless otherwise specified in the individual Product Specification, the steel shall be fully killed.

5.2 If a specific type of melting is required by the purchaser, it shall be stated on the purchase order.

5.3 The primary melting may incorporate separate degassing or refining and may be followed by secondary melting, such as electroslag remelting or vacuum remelting. If secondary melting is employed, the heat shall be defined as all of the ingot remelted from a single primary heat.

5.4 Steel may be cast in ingots or may be strand cast. When steel of different grades is sequentially strand cast, identification of the resultant transition material is required. The steel producer shall remove the transition material by an established procedure that positively separates the grades.

5.5 A sufficient discard shall be made from the source material to secure freedom from injurious porosity and shrinkage, and undue segregation.

6. Manufacture

6.1 The finished part shall be manufactured from a forging that is as close as practicable to the finished size or shape. Alternative starting materials may be used, but with the following exceptions and requirements.

6.1.1 *Bar*—Flanges, elbows, return bends, tees, and header tees shall not be machined directly from bar. Other parts up to, and including, NPS 4 can be machined from bar provided the longitudinal axis of the part is parallel to the longitudinal axis of the bar.

6.1.2 *Wrought Seamless Pipe and Tubing*—Flanges shall not be machined directly from seamless pipe or tubing. Other hollow parts can be machined from seamless pipe and tubing provided the longitudinal axis of the part is parallel to the longitudinal axis of the pipe or tubing.

7. Heat Treatment

7.1 Material requiring heat treatment shall be treated as specified in the individual product specification using the following procedures that are defined in more detail in Terminology A941.

7.1.1 *Annealing*—Material 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 (or Solution Treat or Treatment)*—Material shall be heated to a temperature that causes the chromium carbides to go into solution, and then, quenched in water or rapidly cooled by other means to prevent re-precipitation.

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*—Material 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*—Material shall be reheated to the prescribed temperature below the transformation range, held at temperature for the greater of 30 min or 1 h/in. [25.4 mm] of thickness at the thickest section and cooled in still air.

7.1.6 *Stress Relieving*—Material shall be uniformly heated to the selected stress relieving temperature, held long enough to reduce stresses and then cooled at a rate that will result in the properties required for the material grade and minimize the development of new residual stresses. The temperature shall not vary from the selected temperature by more than ± 25 °F [± 14 °C].

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

7.1.8 *Same Heat Treat Cycle*—Heat treat loads at the same temperature, equivalent soak times as appropriate for the maximum section size on the respective load and equivalent cooling methods.

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 A751.

8.2 *Heat Analysis*—An analysis of each heat of steel shall be made by the steel 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, or the product of one remelted ingot, from 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 A751. Samples for analysis shall be taken from midway between center and surface of solid parts, midway between inner and outer surfaces of hollow parts, midway between center and surface of full-size prolongations or from broken mechanical test specimens. The chemical composition thus determined shall conform to the limits of the product specification, within the permissible variations of Table 1 of this specification.

8.3.1 Limits on formula calculations involving elemental contents shall apply only to the heat analysis, unless agreed upon between supplier and purchaser. Where limits on formula calculations involving elemental contents apply to product analysis by such agreement, permissible variations in the formula calculation results beyond the limits for the heat analysis shall also be agreed upon between supplier and purchaser. Examples of such formula calculations include, but are not limited to, the following: carbon equivalent $CE = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15$; J factor = $(Mn + Si) \times (P + Sn) \times 10^4$; or requirements for specific elemental balance or sufficiency, typically related to Ti, Nb, or Al and interstitials C and N, such as Nb = 5 × C minimum.

9. Mechanical Requirements

9.1 *Method of Mechanical Tests*—All tests shall be conducted in accordance with Test Methods and Definitions A370 if the inch-pound units are specified or Test Methods A1058 if the M suffix (SI units) is specified.

9.2 For the purpose of determining conformance to the product specification requirements, specimens shall be obtained from the production forgings, or from separately forged test blanks prepared from the stock used to make the finished product. In either case, mechanical test specimens shall not be removed until after all heat treatment is complete. If repair welding is performed, test specimens shall not be removed until after post-weld heat treatment is complete, unless permitted by the product specification. The locations from which test specimens are removed shall be in accordance with the Product Specification.

9.3 If separately forged test blanks are used, they shall be of the same heat of steel, be subjected to substantially the same reduction and working as the production forging they