Designation: A 181/A 181M – 06

Standard Specification for Carbon Steel Forgings, for General-Purpose Piping[1]

This standard is issued under the fixed designation A 181/A 181M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification[2] covers nonstandard as-forged fittings, valve components, and parts for general service. Forgings made to this specification are limited to a maximum weight of 10 000 lb [4540 kg]. Larger forgings may be ordered to Specification A 266/A 266M.

1.2 Two classes of material are covered, designated as Classes 60 and 70, respectively, and are classified in accordance with their mechanical properties as specified in 6.1.

1.3 This specification is expressed in both inch-pound units and SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

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. 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.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

A 266/A 266M Specification for Carbon Steel Forgings for Pressure Vessel Components

A 788/A 788M Specification for Steel Forgings, General Requirements

A 961/A 961M Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

3. General Requirements and Ordering Information

3.1 Product furnished to this specification shall conform to the requirements of Specification A 961/A 961M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the requirements of Specification A 961/A 961M constitutes non-conformance with this specification.

3.2 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 ordering information in Specification A 961/A 961M and the following:

3.2.1 Supplementary requirements, and

3.2.2 Additional requirements (See 4.3, 9.1, 10.2, 12.1, and 12.2).

3.3 If the requirements of this specification are in conflict with the requirements of Specification A 961/A 961M, the requirements of this specification shall prevail.

4. Materials and Manufacture

4.1 Except for flanges of all types, hollow, cylindrically shaped parts may be machined from hot-rolled or forged bar, provided that the axial length of the part is approximately parallel to the metal flow lines of the stock. Other parts, excluding flanges of all types, up to and including NPS 4 may be machined from hot-rolled or forged bar. Elbows, return bends, tees, and header tees shall not be machined directly from bar stock.

4.2 Except as permitted in 4.1, the finished product shall be a forging as defined in the Terminology section (exclusively) of Specification A 788/A 788M.

[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] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-181 in Section II of that Code.

[3] 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.**

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4.3 When specified in the order, the manufacturer shall submit for approval of the purchaser a sketch showing the shape of the rough forging before machining.

4.4 Forgings shall be protected against sudden or too rapid cooling from the rolling or forging while passing through the critical range.

4.5 Heat treatment is neither required nor prohibited, but when applied, heat treatment shall consist of tempering, annealing, normalizing, or normalizing and tempering.

5. Chemical Composition

5.1 An analysis of each heat shall be made by the manufacturer to determine the percentages of the elements specified in Table 1. The chemical composition thus determined shall conform to the requirements in Table 1.

6. Mechanical Properties

6.1 The material shall conform to the requirements as to tensile properties prescribed in Table 2.

7. Number of Tests

7.1 One tension test shall be made from each heat.

7.2 If any test specimen is defectively machined, it may be discarded and another specimen substituted.

8. Retests

8.1 When one or more representative test specimens do not conform to specification requirements for the tested characteristic, only a single retest for each nonconforming characteristic may be performed to establish product acceptability. Retests shall be performed on twice the number of representative specimens that were originally nonconforming. When any retest specimen does not conform to specification requirements for the characteristic in question, the lot represented by that specimen shall be rejected, heat-treated or reheat-treated in accordance with 4.5, and tested in accordance with Sections 6 and 7.

9. Reports of Testing

9.1 Upon request of the purchaser in the contract or order, a report of the test results and chemical analyses shall be furnished. The specification designation included on reports of testing shall include year of issue and revision letter, if any.

TABLE 1 Chemical Requirements

Element	Composition, % Classes 60 and 70
Carbon, max	0.35
Manganese, max	1.10[A]
Phosphorus, max	0.05
Silicon	0.10-0.35
Sulfur, max	0.05

[A] Manganese may be increased to 1.35 % max provided the carbon is reduced 0.01 % for each 0.06 % increase in manganese over the limit shown in the table.

TABLE 2 Tensile Requirements

	Class 60	Class 70
Tensile strength, min, ksi [MPa]	60 [415]	70 [485]
Yield strength,[A] min, ksi [MPa]	30 [205]	36 [250]
Elongation in 2 in. [50 mm], min, %	22	18
Reduction of area, min, %	35	24

[A] Determined by either the 0.2 % offset method or the 0.5 % extension-under-load method.

10. Repair by Welding

10.1 Repair welding, by the manufacturer, is permissible for parts made to dimensional standards such as those of ANSI or equivalent standards.

10.2 Prior approval of the purchaser shall be required to weld repair special parts made to the purchaser's requirements.

10.3 The composition of the weld deposits shall be similar to the base metal and in accordance with the procedure qualification for the applicable material. Welding shall be accomplished with a weld procedure designed to produce low hydrogen in the weldment. Short-circuit gas metal arc welding is permissible only with the approval of the purchaser.

11. Marking of Forgings

11.1 Identification marks consisting of the manufacturer's symbol or name, designation of service rating, Specification number, class, and size shall be legibly forged or stamped on each forging, and in such a position as not to injure the usefulness of the forgings.

11.2 *Bar Coding*—In addition to the requirements in 11.1, bar coding is acceptable as a supplementary 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 parts the bar code may be applied to the box or a substantially applied tag.

12. Certificate of Compliance

12.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. The specification designation included on certificates of compliance shall include year of issue and revision letter, if any.

12.2 When specified in the purchase order or contract, a report of the test results shall be furnished.

13. Keywords

13.1 pipe fittings, steel; piping applications; pressure containing parts; steel forgings, carbon; steel valves

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SUPPLEMENTARY REQUIREMENTS

S1. Carbon Equivalent

S1.1 The maximum carbon equivalent based on heat analysis shall be as follows:

Class	Maximum Carbon Equivalent Value	
	Maximum Section Thickness Less Than or Equal to 2 in.	Maximum Section Thickness Greater Than 2 in.
60	0.45	0.46
70	0.47	0.48

S1.2 Determine the carbon equivalent (CE) as follows:

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$

S1.3 A lower maximum carbon equivalent may be agreed upon between the supplier and the purchaser.

S1.4 When this Supplementary Requirement is invoked, all elements in the carbon equivalent formula shall be analyzed and the amounts reported.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 181/A 181M – 01, that may impact the use of this specification. (Approved September 1, 2006)

(*1*) Deleted old 1.3.
(*2*) Deleted the reference to AIAG standard in Referenced Documents because it no longer applies.
(*3*) Revised 11.1.
(*4*) Updated format and made corrections to agree with the use of Specifications A 788/A 788M and A 961/A 961M.

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