



ASTM A105/A105M-10

Standard Specification for Carbon Steel Forgings for

Piping Applications ¹

1. Scope :-

- 1.1 This specification covers forged carbon steel piping components for ambient – and higher – temperature service in pressure system. Included are flanges, valves, and similar parts ordered either to dimensions specified by the purchaser or to dimensional standards such as the MSS, ASME, and API specification referenced in section 2. Forgings made to this specification are limited to a maximum weight of 10000 lb [4540 kg]. Larger forgings may be ordered to specification A266/A266M. Tube sheets and hollow cylindrical forgings for pressure vessel shells are not included within the scope of this specification. Although this specification covers some piping components machined from rolled bar and seamless tubular products (see 4.2), it does not cover raw material produced in these product forms.
- 1.2 Supplementary requirements are provided for use when additional testing or inspection is desired. These shall apply only when specified individually by the purchaser in the order.
- 1.3 Specification A266/A266M covers other steel forgings and specification A675/A675M and A696 cover other steel bars.
- 1.4 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.
The values stated in either SI units or each-pound units are to be regarded separately as standard. 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.
- 1.5 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.

2. Referenced Documents :-

- 2.1 In addition to those reference documents listed in specification A961/A961M, the following list of standards apply to this specification:



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2.2 ASTM Standards:

- A266/A266M specification for Carbon steel forgings for pressure vessel components
- A370 test methods and definitions for mechanical testing of steel products
- A675/A675M specification for steel bars, carbon, hot-wrought or cold-finished, special quality, for pressure piping components
- A788/A788M specification for steel forgings, general requirements
- A961/A961M specification for common requirements for steel flanges, forged fittings, valves, and parts for piping applications

2.3 MSS Standards :

- SP 44 standard for steel pipe line flanges⁴

2.4 ASME Standards :

- B16.5 Dimensional standards for steel pipe flanges and flanged fittings⁵
 - B16.9 wrought steel butt welding fittings⁵
 - B16.10 face-to-face and end-to-end dimensions of ferrous valves⁵
 - B16.11 forged steel fittings, socket weld, and threaded⁵
 - B16.34 valves-flanged, threaded and welding end⁵
 - B 16.47 large diameter steel flanges⁵
- 2.5 ASME boiler and pressure vessel code:

- API-600 flanged and butt-welding-end steel gate valves⁶
- API-602 compact design carbon steel gate valves for refinery use⁶

3. Ordering Information :-

- 3.1 See specification A961/A961N.
 - 3.1.1 Additional requirements (see 12.2).

4. General Requirements :-

- 4.1 Product furnished to this specification shall conform to the requirements of specification A961/A961M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the requirements of specification A961/A961M constitutes nonconformance with this specification. In case of a conflict between the requirements of this specification and specification A961/A961M, this specification shall prevail.
- 4.2 Except as permitted by section 6 in specification A961/A961M, the finished shall be a forging as defined in the terminology section of specification A788/A788M.



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5. Heat treatment :-

5.1 Heat treatment is not a mandatory requirement of this specification except for the following piping components:

5.1.1 Flanges above Class 300,⁷

5.1.2 Flanges of special design where the design pressure at the design temperature exceeds the pressure-temperature ratings of Class 300, Group 1.1,

5.1.3 Flanges of special design where the design pressure or design temperature are not known,

5.1.4 Piping components of other than flanges which meet both of the following criteria: (1) over NPS 4 and (2) above Class 300, and

5.1.5 Piping components of special Class⁸ other than flanges which meet both of the following criteria: (1) over NPS 4 and (2) when the working pressure at the operating temperature exceeds the tabulated values for special Class 300, group 1.1.

5.2 Heat treatment, when required by 5.1 shall be annealing, normalizing, or normalizing and tempering or quenching and tempering in accordance with specification A961/A961M. 6. Chemical Composition :-

6.1 The steel shall conform to the chemical requirements specified in Table 1.

6.2 Steels to which lead has been added shall not be used.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.35 max
Manganese	0.60-1.05
Phosphorus	0.035 max
Sulfur	0.040 max
Silicon	0.10-0.35
Copper	0.40 max ⁴
Nickel	0.40 max ⁴
Chromium	0.30 max ^{AB}
Molybdenum	0.12 max ^{AB}
Vanadium	0.08 max



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7. Mechanical Properties :-

7.1 The material shall conform to the mechanical property requirements prescribed in Table 2 and Table 3.

7.2 For normalized, normalized and tempered, or quenched and tempered forgings, the central axis of the test specimen shall correspond to the $\frac{1}{4}$ T plane or deeper position, where T is the maximum heat-treated thickness of the represented forging. In addition, for quenched and tempered forgings, the mid length of the test specimen shall be at least T from any second heat-treated surface. When section thickness does not permit this positioning, the test specimen shall be positioned as near possible to the prescribed location.

7.3 Tension Tests:

7.3.1 One tension test shall be made for each heat of as-forged components.

7.3.2 One tension test shall be made from each heat-treating charge. If more than one heat is included in such a charge, each heat shall be tested.

7.3.2.1 When the heat-treating temperatures are the same and the furnaces (either batch or continuous type), are controlled within ± 25 °F [± 14 °C] and equipped with recording pyrometers so that complete records of heat treatment are available, than one tension test from each heat is required instead of one test from each heat in each heat-treatment charge. The test specimen material shall be included with a furnace charge.

7.3.3 Testing shall be performed in accordance with test methods and definitions A370. The largest feasible pound specimen as described in Test methods and definitions A370 shall be used except when hollow cylindrically shaped parts are machined from seamless tubular. The gage length for measuring elongation shall be four times the diameter of the test section. When hollow cylindrically shaped parts are machined from seamless tubular materials, strip tests may be used.

7.3.4 Forgings too small to permit obtaining a sub size specimen of 0.250 in. [6.35 mm] diameter or larger (see test methods and definitions A370) parallel to the dimension of maximum working, and produced in equipment unsuitable for the production of a separately forged test bar such as an automatic or semi-automatic press, may be accepted on the basis of hardness only. One percent of the forgings per lot (see Note 2), or ten forgings, whichever is the lesser number, shall be selected at random, prepared, and tested using the standard brinell test in test methods and definitions A370. The locations of the indentations shall be at the option of the manufacturer but shall be selected to be representative of the forging as a whole. One indentation per forging shall be required but additional indentations may be made to establish the



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representative hardness. The hardness of all forgings so tested shall be 137 to 187 HB inclusive.

7.4 Hardness Tests :

- 7.4.1 Two hardness tests shall be made for each heat of as-forged components. When more than one forging is produced from each heat, a minimum of two forgings shall be tested with one reading from each forging. When only one forging is produced, it shall be tested in two locations.
- 7.4.2 Except when only one forging is produced, a minimum of two forgings shall be hardness tested per batch or continuous run as defined in 7.3.2.1 to ensure that forgings are within the hardness limits given in Table 2. When only one forging is produced, it shall be hardness tested in two locations to ensure it is within the hardness limits given in Table 2.
- 7.4.3 Testing shall be in accordance with test methods and definitions A370. The purchaser may verify that the requirement has been met by testing at any location on the forging, provided such testing does not render the forging useless.

8. Hydrostatic Tests :-

- 8.1 Such tests shall be conducted by the forging manufacturer only when only when supplementary requirement S57 in specification A961/A961M is specified.

9. Retreatment 10. Repair by welding 11. Rejection and reheating 12. Certification :-

12.1 Identification marking – for forgings made to specified dimensions, when agreed upon by the purchaser, and for forgings made to dimensional standards, application of identification marks as required in Specification A961/A961M shall be the certification that the forgings have been furnished in accordance with the requirements of this specification. The specification designation included on test reports shall include year date and revision letter, if any.

12.2 Test Reports – When test reports are required, the manufacturer shall also provide the following, where applicable:

12.2.1 Type heat treatment, section 5,

12.2.2 Tensile property results, section 7 (table 2), report the yield strength and ultimate strength, in ksi [MPa], elongation and reduction in area, in percent; and, if longitudinal strip tension specimens are used, report the width of the gage length,

12.2.3 Chemical analysis results, section 6 (Table 1). Reported results shall be to the same number of significant figures as the limits specified in Table 1 for that element. 12.2.4 Hardness results, section 7 (Table 2), a minimum of two readings, and

12.2.5 Any supplementary testing required by the purchase order.



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13. Product Marking 14. Keywords :-

14.1 pipe fittings, steel; piping applications; pressure containing parts; steel flanges; steel forgings, carbon; steel valves; temperature service applications, elevated; temperature service application, high

Supplementary Requirements :-

S1. Hardness

S2. Heat Treatment

S3. Marking small Forgings

S4. Carbon Equivalent