~~Designation:A727/A727M–02 (Reapproved 2007)~~ Designation: A727/A727M – 09

Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness[1]

This standard is issued under the fixed designation A727/A727M; 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[2] covers forged carbon steel piping components intended primarily for service in pressure piping systems from −20 to +650 °F [−30 to +345 °C] where inherent notch toughness is desired, but where notch toughness testing is not required. Included are forged or ring-rolled flanges, forged fittings, and valves made to specified dimensions, or to dimensional standards such as the ASME and API specifications referenced in Section 2.

1.2 This specification is limited to forgings with maximum finished section thicknesses no larger than 2 in. [51 mm].

1.3 It shall be the responsibility of the purchaser to determine whether material meeting the requirements of this specification is satisfactory for the service application.

1.4 Supplementary requirements are provided for use when additional testing or inspection is desired. These shall apply only when specified by the purchaser in the order.

NOTE 1—There are no provisions for impact testing in this specification. When impact testing is required, refer to Specification A350/A350M.

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

1.6 The values stated in either ~~inch-pound~~SI units or ~~SI~~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 ~~are~~may not be exact equivalents; therefore, each system ~~must~~shall be used independently of the other. Combining values from the two systems may result in non-conformance with the ~~specification.~~ 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.

2.2 *ASTM Standards:*[3]

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

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~~

~~E59Practice for Sampling Steel and Iron for Determination of Chemical Composition~~ Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

2.3 *ASME Boiler and Pressure Vessel Codes:*

~~Section II, Material Specifications, Part C~~

~~SFA 5.5Low-Alloy Steel Covered Arc-Welding Electrodes~~ [4]

Section II Material Specifications, Part C Material Specifications, Part C

[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 ~~March~~Oct. 1, ~~2007.~~2009. Published ~~April 2007.~~November 2009. Originally approved in 1976. Last previous edition approved in ~~2002~~2007 as A727/A727M – 02(2007). DOI: ~~10.1520/A0727_A0727M-02R07.~~10.1520/A0727_A0727M-09.

[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-727 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.

[4] ~~Withdrawn.~~

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

Section IX Welding and Brazing Qualifications
SFA 5.5 Low-Alloy Steel Covered Arc-Welding Electrodes
B 16.5 Steel Pipe Flanges and Flanged Fittings
B 16.10 Face-to-Face and End-to-End Dimensions of Ferrous Valves
~~B 16.11Forged Steel Fittings, Socket-Welding and Threaded~~
~~B 16.30Unfired Pressure Vessel Flange Dimensions~~
B 16.11 Forged Steel Fittings, Socket-Welding and Threaded
2.4 *API Standards:*[5]
600 Steel Gate Valves with Flanged or Butt-Welding Ends
602 Compact Design Carbon Steel Gate Valves for Refinery Use
605 Large Diameter Carbon Steel Flanges
2.5 *MSS Standard:*[6]
MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions

3. General Requirements and Ordering Information

3.1 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.

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 following:

3.2.1 Additional requirements (see 15.1 and 15.2).

4. Materials and Manufacture

4.1 The steel shall be made by one or more of the following processes: open-hearth, basic-oxygen, or electric-furnace, and shall be fully killed, fine-grain practice.

4.2 Forgings shall be manufactured from ingots, blooms, billets, slabs, or bars. These items shall be forged, rolled, or strandcast.

4.3 A sufficient discard shall be made from the ingot to secure freedom from injurious piping and undue segregation.

4.4 The finished product shall be a forging as defined by the Terminology section of Specification A788/A788M.

5. Heat Treatment

5.1 Following plastic working, the forging manufacturer shall heat treat the forgings by normalizing, or normalizing and tempering, or quenching and tempering.

5.1.1 *Normalizing*—The procedure for normalizing shall consist of uniformly heating the forgings to a temperature between 1550 and 1700 °F [845 and 925 °C], holding a sufficient time to attain uniform temperature throughout, and cooling in still air. The forging shall be at a temperature below 1000 °F [540 °C] before heating for normalizing.

5.1.2 *Quenching*—The procedure for quenching shall consist of uniformly heating the forging to a temperature between 1550 and 1700 °F [845 and 925 °C], holding a sufficient time to attain uniform temperature throughout, and quenching into a suitable liquid medium. The forging shall be at a temperature below 1000 °F [540 °C] before heating for quenching.

5.1.3 *Tempering*—The procedure for tempering shall consist of reheating the forging subsequent to normalizing or quenching to a temperature of at least 1100 °F [595 °C], but not above the lower transformation temperature, for 30 min/in. [30 min/25 mm] of maximum section thickness, with minimum holding time at tempering temperature not less than 30 min.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

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

7. *Mechanical Requirements* Mechanical Requirements

7.1 *Tension Tests*:

7.1.1 *Requirements*—The material shall conform to requirements for tensile properties prescribed in Table 2.

7.1.1.1 The test specimen shall be obtained from a rough or finished production forging, or prolongation thereof, or it may be obtained from separately forged test blanks from the same heat of steel as the production forging. The test blank shall be reduced

[5] ~~Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.~~
[5] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://api-ec.api.org.
[6] ~~Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://api-ec.api.org.~~
[6] 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.

TABLE 1 Chemical Requirements

Elements	Composition, %
Carbon	
Heat Analysis	0.25 max
~~Product Analysis~~	~~0.28 max~~
Manganese	
Heat Analysis	0.90 to 1.35
~~Product Analysis~~	~~0.84 to 1.41~~
Phosphorus	
Heat Analysis	0.035 max
~~Product Analysis~~	~~0.043 max~~
Sulfur	
Heat Analysis	0.025 max
~~Product Analysis~~	~~0.033 max~~
Silicon	
Heat Analysis	0.15 to 0.30
~~Product Analysis~~	~~0.13 to 0.32~~
Nickel	
Heat Analysis	0.40[A]
~~Product Analysis~~	~~0.43~~
Chromium	
Heat Analysis	0.30[A,B]
~~Product Analysis~~	~~0.34~~
Molybdenum	
Heat Analysis	0.12[A,B]
~~Product Analysis~~	~~0.13~~
Copper	
Heat Analysis	0.40[A]
~~Product Analysis~~	~~0.43~~
Columbium (Nb)	
Heat Analysis	0.02
~~Product Analysis~~	~~0.03~~
Vanadium	
Heat Analysis	0.05
~~Product Analysis~~	~~0.055~~

[A] The sum of copper, nickel, chromium and molybdenum shall not exceed 1.00 % on heat and product analysis.

[B] The sum of chromium and molybdenum shall not exceed 0.32 % on heat and product analysis.

TABLE 2 Tensile Requirements

Tensile strength, ksi [MPa]	60.0 to 85.0 [415 to 585]
Yield strength, min, ksi [MPa][A]	36.0 [250]
Elongation in 2 in. or 50 mm, min, %	22
Reduction of area, min, %	30

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

by forging in a manner similar to that for the products represented, shall receive approximately the same hot working and reduction, be of the same nominal thickness, and receive the same heat treatment as the finished products represented. The test material shall be treated in the same furnace at the same time as the forging it represents, subject to the requirements of 7.1.2.1.

7.1.2 *Number of Tests*—One tension test at room temperature shall be made for each nominal wall thickness ± ¼ in. [± 6 mm] from each heat in each heat treatment charge.

7.1.2.1 If heat treatment is performed in either a continuous or a batch-type furnace controlled within ± 25 °F [± 14 °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 forgings represented by the tension test, then one tension test per nominal wall thickness ± ¼ in. [± 6 mm] from each heat shall be required, instead of one tension test per nominal wall thickness from each heat in each heat-treatment charge.

7.1.3 *Test Locations and Orientations*—The test specimen shall be removed from the midwall of the heaviest section of the forging or test blank.

7.1.3.1 The test specimen shall have its longitudinal axis located parallel to the direction of major working of the forging or test blank, except for flanges and rings the test specimen shall be in the tangential direction.

7.1.4 *Test Method*—Testing shall be performed in accordance with Test Methods and Definitions A370 using the largest feasible of the round specimens. The gage length for measuring elongation shall be four times the diameter of the test section.

7.2 *Hardness Test*:

7.2.1 *Requirements*—If the production forgings are liquid-quenched and tempered, hardness of the forgings shall not exceed 187 HB after heat treatment. The purchaser may verify that the requirement has been met by testing at any location on the forgings provided such testing does not render the forgings useless.