Designation: A723/A723M – 18a

Standard Specification for Alloy Steel Forgings for High-Strength Pressure Component Application[1]

This standard is issued under the fixed designation A723/A723M; 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 requirements for high-strength quenched and tempered alloy steel forgings for pressure vessels, isostatic presses, shock tubes, and similar components.

1.2 These materials are not intended for welded construction.

1.3 Three grades of nickel-chromium-molybdenum steels and six classes of increasing tensile strength are included. The strength class, section size, and configuration of the forging will largely dictate the applicable type(s) of steel.

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

1.5 Unless the order specifies the applicable "M" specification designation, the material shall be furnished to the inch-pound units.

1.6 *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:*[3]

A275/A275M Practice for Magnetic Particle Examination of Steel Forgings

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A388/A388M Practice for Ultrasonic Examination of Steel Forgings

A788/A788M Specification for Steel Forgings, General Requirements

2.2 *Other Standard:*

ASME Boiler and Pressure Vessel Code[4]

3. Ordering Information and General Requirements

3.1 In addition to the ordering information required by Specification A788/A788M, the purchaser shall include with the inquiry and order a detailed drawing, sketch, or written description of the forging and the method of selecting test location (see 6.2). When appropriate, the areas of significant loading in the forging shall be designated. The purchaser may also include appropriate supplementary requirements from Specification A788/A788M as well as from this specification.

3.2 Material supplied to this specification shall conform to the requirements of Specification A788/A788M, which outlines additional ordering information, manufacturing requirements, testing and retesting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements.

3.3 If the requirements of this specification are in conflict with the requirements of Specification A788/A788M, the requirements of this specification shall prevail.

3.4 When forgings are required to be in compliance with Division 3 of the ASME Boiler and Pressure Vessel Code, Supplementary Requirement S6 should be specified.

[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 A01.06 on Steel Forgings and Billets.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA–723/SA–723M 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] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

4. Materials and Manufacture

4.1 *Melting Practice*—The steel melting procedures of Specification A788/A788M shall apply except that the open-hearth process shall not be used, and that the steel shall be vacuum degassed prior to or during the pouring of the ingot, in order to remove objectionable gases, particularly hydrogen.

4.1.1 Use of secondary remelting or refining operations may be considered for particularly demanding applications.

4.2 *Discard*—Sufficient discard shall be taken from each ingot to secure freedom from piping and excessive segregation.

4.3 *Heat Treatment:*

4.3.1 Forgings shall be rough-machined prior to final heat treatment if it is necessary to reduce the mass to ensure full hardening or to meet the requirements of 6.2. The risk of cracking during heat treatment with high-hardenability steels of the type covered by this specification should be borne in mind when deciding on the degree of surface preparation before heat treatment.

4.3.2 *Heat Treatment for Mechanical Properties*—Heat treatment shall consist of normalizing (which may be part of the preliminary treatment), reaustenitization, liquid quenching, and tempering. The forgings shall be quenched in a suitable liquid medium by spraying or immersion. Quenching shall be followed by tempering at a minimum temperature of 1000 °F [540 °C]. The minimum time at tempering temperature shall be ½ h/in. [½ h/25 mm] of maximum section thickness, unless otherwise agreed between supplier and purchaser.

5. Chemical Composition

5.1 *Heat Analysis*—The heat analysis obtained from sampling in accordance with Specification A788/A788M shall comply with Table 1.

5.1.1 *Temper Embrittlement Control*—The purchaser's attention is drawn to Supplementary Requirement S24 in Specification A788/A788M for application of the J Factor which may be of assistance in the control of temper embrittlement in forgings produced to Specification A723/A723M.

5.2 *Product Analysis*—The manufacturer shall use the product analysis provision of Specification A788/A788M to obtain a product analysis from a forging representing each heat or multiple heat. The purchaser may also make this determination in accordance with Specification A788/A788M.

6. Mechanical Properties

6.1 *General Requirements*—The forging shall conform to the requirements of Table 2 and Table 3. The largest obtainable tension test specimen as specified in Test Methods and Definitions A370 (that is, standard round 0.500-in. [12.5-mm] diameter specimen) shall be used. Charpy V-notch Type A impact specimens, as shown in Test Methods and Definitions A370, shall be used.

TABLE 1 Chemical Requirements

	Composition, %		
	Grade 1	Grade 2	Grade 3
Carbon, max	0.35	0.40	0.40
Manganese, max	1.00	0.90	0.90
Phosphorus, max	0.015	0.015	0.015
Sulfur, max	0.015	0.015	0.015
Silicon, max	0.35	0.35	0.35
Nickel	1.5 to 2.25	2.3 to 3.3	3.3 to 4.5
Chromium	0.80 to 2.00	0.80 to 2.00	0.80 to 2.00
Molybdenum	0.20 to 0.50	0.30 to 0.60	0.40 to 0.80
Vanadium, max	0.20	0.20	0.20

6.2 *Sampling*—The mid-point of the gage length of tension test specimens and the area under the notch of impact specimens shall be located in accordance with one of the following methods as specified by the purchaser, or suggested by the supplier and approved by the purchaser. Wherever practical, all testing shall be from integral prolongations of the forging.

6.2.1 *Method 1*—This method shall always be used when the maximum quenched thickness does not exceed 4 in. [100 mm]. Datum points of the specimens, as described in 6.2, shall be located in the forging or test forging (6.2.4) at mid-thickness and at least ⅔ T (T is the maximum heat-treated thickness) from the quenched end surface or nearest adjacent surfaces.

6.2.2 *Method 2—t* by 2*t*, where *t* is the distance from the area of significant loading (3.1) to the nearest quenched surface. However, the datum points of the specimens as described in 6.2 shall not be nearer to one quenched surface than ¾ in. [20 mm] and to the second quenched surface than 1 ½ in. [40 mm]. When this method of testing is employed, forgings are usually manufactured in accordance with a purchaser-approved drawing showing prequenched dimensions and the location of mechanical test specimens. It is commonly used for disk-type forgings such as tube sheets and covers.

6.2.3 *Method 3*—For maximum quenched thicknesses in excess of 4 in. [100 mm] as heat treated. Where this method of testing is employed, the datum points of the test specimen, as described in 6.2, shall be removed ¼ *T* from the nearest quenched surface and ⅔ *T* from the quenched end surface or nearest adjacent surface.

6.2.4 *Method 4*—Test specimens shall be taken from a representative separate test forging made from the same heat of steel, which shall receive substantially the same reduction and type of hot working, and have a cross section not less than the production forgings which it represents. It shall be heat treated in the same furnace charge and under the same conditions as the production forgings. The test specimen shall be removed using the Method 3 procedure.

6.3 *Thermal Buffers:*

6.3.1 Thermal buffer rings, at least *T* by *T* in cross section or sections of such a ring at least 3 *T* in length, shall be welded to the test end(s) of a forging prior to heat treatment for mechanical properties. The buffer material may be any weldable carbon or low-alloy steel and shall be joined to the forging with a partial penetration-type weld which completely seals the buffered surface. The test coupons shall be removed from the forging in the region buffered by the ring or ring segments. If the latter are used, the test coupons shall be removed from the forging in the area under the center ⅓ of the buffer ring segment length. In either case, the test specimens shall be located at a minimum distance of ½ in. [13 mm] from the buffered surface of the forging and at least ¼ *T* from a quenched surface of the forging. Buffered weld areas must be at least 1 in. [25 mm] from any finished machining surface of the complete forging.