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Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels[1]

This standard is issued under the fixed designation A 592/A 592M; 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 high-strength quenched and tempered low-alloy steel forged fittings and parts for pressure vessels. The maximum thickness of forgings under this specification shall be 1½ ~~in. [38 mm] for Grade A, and 3 ¾ in. [95 mm] for Grades E and F (4 in. [102 mm] maximum as heat treated).~~ in. [38 mm] for Grade A, and 4 in. [100 mm] for Grades E and F.

NOTE 1—These grades are similar to corresponding grades in Specification A 517/A 517M~~/A517M.~~.

1.2 Although no provision is made for supplementary requirements in this standard, the supplementary requirements in Specification A 788/A 788M may be considered by the purchaser.

1.3 Welding technique is of fundamental importance and it is presupposed that welding procedures will be in accordance with approved methods for the class of material used.

~~1.3The~~1.4 The values stated in either ~~inch-pound~~SI units or ~~SI (metric)~~ inch-pound units are to be regarded separately as ~~the standard; within the text and tables, the SI units are shown in [brackets].~~ standard. 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.

1.4~~5~~ Unless the order specifies the applicable "M" specification designation, the material shall be furnished to the inch-pound units.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 517/A 517M Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered

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

E 112 Test Methods for Determining ~~the~~ Average Grain Size

3. Ordering Information and General Requirements

~~3.1In addition to the ordering information required by Specification A788, the purchaser shall include with the inquiry and order a detailed drawing, a sketch, or written description of the forging.~~

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

~~3.3If the requirements of this specification are in conflict with the requirements of Specification A788~~

3.1 In addition to the ordering information required by Specification A 788/A 788M, the purchaser shall include with the inquiry and order the following information:

3.1.1 A detailed drawing, a sketch, or written description of the forging.

3.1.2 The charpy impact test temperature if a test temperature lower than 32°F [0°C] is required.

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[1] This specification is under the jurisdiction of ASTM Committee ~~A-1~~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-592/SA-592M in Section II of that Code.

~~[3] Annual Book of ASTM Standards, Vol 01.03.~~

[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.

3.1.3 Additional heat treatment cycles to be applied to the mechanical test specimens following removal from the heat- treated forging or special forged test block.

3.1.4 Required supplementary requirement(s) from Specification A 788/A 788M.

3.2 Material supplied to this specification shall conform to the requirements of Specification A 788/A 788M, which outlines additional ordering information, manufacturing requirements, testing and retesting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements. Failure to comply with the requirements of Specification A 788/A 788M constitutes non-conformance with this specification.

3.3 If the requirements of this specification are in conflict with the requirements of Specification A 788/A 788M, the requirements of this specification shall prevail.

4. Materials and Manufacture

4.1 *Melting Process*—The steel shall be made in accordance with the Melting Process Section of Specification ~~A788~~A 788/A 788M.

4.2 *Grain Size*—The steel shall be fully killed, fine grained (ASTM No. 5 or finer), as determined in accordance with Test Methods E 112, Plate IV.

4.3 *Discard*—Sufficient discard shall be made from each ingot to ensure freedom from piping and excessive segregation.

4.4 The finished product shall be a hot-worked forging as defined by Specification ~~A788~~A 788/A 788M, and shall be forged as close as practicable to the finished shape and size.

5. Heat Treatment

~~5.1After forging and before reheating, the forgings shall be cooled to provide substantially complete transformation of austenite. Heat treatment for properties shall consist of heating the forgings to not less than 1650°F [900°C], quenching in a liquid medium, and tempering at 1150°F [620°C] minimum, with a holding time of 1 h/in. [1 h/25 mm] minimum, but in no case less than ½ h. Forgings with sections over 2½ to 4 in. [65 to 100 mm] inclusive, shall be liquid quenched from a temperature not less than 1750°F [955°C] prior to the above treatment for properties.~~

5.1 After forging and before reheating, the forgings shall be cooled to provide substantially complete transformation of austenite. Heat treatment for properties shall consist of heating the forgings to not less than 1650°F [900°C], quenching in a liquid medium, and tempering at 1150°F [620°C] minimum, with a holding time of 1 h/in. [1 h/25 mm] minimum, but in no case less than ½ h.

6. *Chemical Requirements* Chemical Requirements

6.1 *Heat Analysis*—The heat analysis obtained from sampling in accordance with Specification ~~A788~~A 788/A 788Mshall comply with Table 1.

6.2 *Product Analysis*—The purchaser may use the product analysis provision of Specification ~~A788~~A 788/A 788Mto obtain a product analysis from a forging representing each heat or multiple heat.

7. Mechanical Requirements

7.1 The forgings as represented by tension tests shall conform to the requirements prescribed in Table 2~~. Charpy V-notch impact specimens shall have a lateral expansion opposite the notch of not less than 0.015 in. (15 mils) [0.38 mm]. In addition the values of energy absorption in foot-pounds (or joules) and the fracture appearance in percent shear shall be recorded and reported for information.~~ , and to Table 3 for lateral expansion opposite the notch in Charpy V-notch impact tests. In addition, for the Charpy impact test, the values of energy absorption in foot-pounds [or joules] and the fracture appearance in percent shear shall be recorded and reported for information.

7.2 *Sampling*:

7.2.1 Samples for mechanical test specimens shall be removed after the quenching and tempering heat treatment. The purchaser shall specify any additional thermal treatments that shall be given to the ~~test specimens in addition to the~~ heat ~~treatment specified in 5.1.~~ treated test specimens. (This is intended to simulate subsequent thermal treatments which may ~~subsequently~~ be performed by the fabricator.)

7.2.2 Samples shall be removed so that the test specimens will have their major axes parallel to the direction of major working of the forging.

7.2.3 Test specimens may be machined from a production forging, or prolongation thereof, or from special forged blocks suitably worked and heat treated with the production forgings. Such special blocks shall be obtained from ~~the~~an ingot, slab, or billet from the same heat as the forgings they represent and shall be reduced by forging in a manner similar to that for the products to be represented. The ~~maximum~~forging reduction for a special test block shall not exceed the minimum forging reduction of the forgings represented, and its thickness shall not be less than the maximum thickness of the forgings represented. If a forging is tested, the tests must represent the maximum section thickness in the lot. All test specimens shall be located at the mid-plane of the thickness and, the mid length position of the gauge length ffoor tension test specimens, or the notch of the Charpy V-notch impact test specimens shall be at least *T* from any second surface of the production forging or test ~~block. (~~*block, where T equals the maximum* heat treated *thickness of the* ~~*forging.)*~~ *forging.*