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## Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels<sup>1</sup>

This standard is issued under the fixed designation A592/A592M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification<sup>2</sup> 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 4 in. [100 mm] for Grades E and F.

NOTE 1—These grades are similar to corresponding grades in Specification A517/A517M.

1.2 Although no provision is made for supplementary requirements in this standard, the supplementary requirements in Specification A788/A788M 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.

1.4 The values stated in either SI units or inch-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 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:*<sup>3</sup>

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A517/A517M Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered

A788/A788M Specification for Steel Forgings, General Requirements

E112 Test Methods for Determining Average Grain Size

### 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 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.

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 A788/A788M.

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. Failure to comply with the requirements of Specification A788/A788M constitutes non-conformance with this specification.

<sup>1</sup> 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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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SA-592/SA-592M in Section II of that Code.

<sup>3</sup> 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.

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.

#### 4. Materials and Manufacture

4.1 *Melting Process*—The steel shall be made in accordance with the Melting Process Section of Specification A788/A788M.

4.2 *Grain Size*—The steel shall be fully killed, fine grained (ASTM No. 5 or finer), as determined in accordance with Test Methods E112, 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/A788M, and shall be forged as close as practicable to the finished shape and size.

#### 5. Heat Treatment

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

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

6.2 *Product Analysis*—The purchaser may use the product analysis provision of Specification A788/A788M to 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, and to Table 3 for

**TABLE 1 Chemical Requirements**

Element	Composition, %		
	Grade A <sup>A</sup>	Grade E <sup>A</sup>	Grade F <sup>A</sup>
Carbon	0.15–0.21	0.12–0.20	0.10–0.20
Manganese	0.80–1.10	0.40–0.70	0.60–1.00
Phosphorus, max	0.025	0.025	0.025
Sulfur, max	0.025	0.025	0.025
Silicon	0.40–0.80	0.20–0.35	0.15–0.35
Nickel	...	...	0.70–1.00
Chromium	0.50–0.80	1.40–2.00	0.40–0.65
Molybdenum	0.18–0.28	0.40–0.60	0.40–0.60
Vanadium	...	<sup>B</sup>	0.03–0.08
Titanium	...	0.04–0.10	...
Zirconium	0.05–0.15	...	...
Copper	...	0.20–0.40	0.15–0.50
Boron	0.0025 max	0.0015–0.005	0.002–0.006

<sup>A</sup> Similar to Specification A517/A517M Grades A, E, and F, respectively.

<sup>B</sup> May be substituted for part or all of titanium content on a one for one basis.