Designation: A395/A395M – 99 (Reapproved 2022)

Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures[1]

This standard is issued under the fixed designation A395/A395M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers ductile iron castings for pressure-retaining parts for use at elevated temperatures. Castings of all grades are suitable for use up to 450 °F. For temperatures above 450 °F and up to 650 °F, only Grade 60-40-18 castings are suitable (Note 1).

1.2 Valves, flanges, pipe fittings, pumps, and other piping components are generally manufactured in advance and supplied from stock by the manufacturer, jobber, or dealer.

1.3 For supplemental casting requirements, Specification A834 may be utilized.

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 nonconformance with the standard.

NOTE 1—For service other than as specified in this section, reference should be made to Specification A536 for Ductile Iron Castings.[2]

1.5 *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:*[2]

A247 Test Method for Evaluating the Microstructure of Graphite in Iron Castings

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A536 Specification for Ductile Iron Castings

A732/A732M Specification for Castings, Investment, Carbon and Low-Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures

A834 Specification for Common Requirements for Iron Castings for General Industrial Use

E8/E8M Test Methods for Tension Testing of Metallic Materials

E10 Test Method for Brinell Hardness of Metallic Materials

E186 Reference Radiographs for Heavy-Walled (2 to 4½ in. (50.8 to 114 mm)) Steel Castings

E280 Reference Radiographs for Heavy-Walled (4½ to 12 in. (114 to 305 mm)) Steel Castings

E446 Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness

E689 Reference Radiographs for Ductile Iron Castings

E1806 Practice for Sampling Steel and Iron for Determination of Chemical Composition

F1476 Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications

F1548 Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications

2.2 *Manufacturers Standardization Society of the Valve and Fittings Industry Standard:*[3]

SP 25 Standard Marking Systems for Valves, Flanges, Pipe Fittings, and Unions

3. Classification

3.1 Castings ordered to this specification are classified by grades based on mechanical property requirements, as listed in Table 1. See note following Table 1.

4. Ordering Information

4.1 Orders for material under this specification shall include the following applicable information:

[1] This specification is under the jurisdiction of ASTM Committee A04 on Iron Castings and is the direct responsibility of Subcommittee A04.02 on Malleable and Ductile Iron Castings.

Current edition approved Oct. 1, 2022. Published October 2022. Originally approved in 1955. Last previous edition approved in 2018 as A395/A395M – 99 (2018). DOI: 10.1520/A0395_A0395M-99R22.

[2] 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] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.org.

TABLE 1 Mechanical Property Requirements

Property	Grade 60-40-18	Grade 65-45-15
Tensile Strength Minimum, psi [MPa]	60 000 [415]	65 000 [450]
Yield Strength Minimum, psi [MPa]	40 000 [275]	45 000 [310]
Elongation in 2 in. Minimum, %	18	15
Hardness HB, 3000 kgf Load	143–187	156–201

4.1.1 Drawing, catalog number, or part identifications,

4.1.1.1 For Grade 65-45-15, drawing indicating critical area(s) of casting (see 7.2.2 and 7.3.2).

4.1.2 Quantity (weight or number of pieces),

4.1.3 ASTM designation and year of issue,

4.1.4 Grade (See Table 1); if a grade is not specified, the manufacturer shall supply Grade 60-40-18.

4.1.5 Heat-treating requirements (see 5.2.1),

4.1.6 Pressure test requirements (see 7.4.3),

4.1.7 Test samples from castings (see 11.1.1 and 12.1.1),

4.1.8 Test coupons size (see 11.2),

4.1.9 Metallographic option (see 12.1.1),

4.1.10 Place of inspection (see 16.1),

4.1.11 Certification requirements (see 17.1),

4.1.12 Identification marking (see 18.2), and

4.1.13 Supplementary requirements (see 1.4, 7.4.2, S1, and S2).

5. Materials and Manufacture

5.1 The melting method and the nodularizing practice shall be optional with the foundry.

5.2 Except as provided in 5.2.1, all castings Grade 60-40-18 shall be given a ferritizing heat treatment that produces essentially a ferritic structure that contains no massive carbides.

5.2.1 When specified in the purchase order, Grade 60-40-18 castings may be provided in an as-cast condition provided they comply with the requirements of 7.1 and 7.2.1.

5.2.2 Castings supplied in accordance with 5.2.1 may be stress relieved by agreement between the manufacturer and purchaser.

5.3 Castings Grade 65-45-15 may be provided in as-cast condition or heat treated, provided they comply with the requirements of 7.1, 7.2.2, and 7.3.2.

6. Chemical Requirements

6.1 The casting shall conform to the following requirements for chemical composition (Note 2):

Total carbon, min, %	3.00
Silicon, max, %	2.50
Phosphorus, max, %	0.08

6.1.1 The chemical analysis for total carbon shall be made on chilled cast pencil-type specimens or from thin wafers approximately 1/32 in. [0.8 mm] thick cut from test coupons. Drillings are not reliable because of the probable loss of graphite.

6.1.2 For each reduction of 0.01 % below the maximum specified phosphorus content, an increase of 0.08 % silicon above the specified maximum will be permitted up to a maximum of 2.75 %.

NOTE 2—Silicon contents above 2.75 % or phosphorus contents above 0.08 % have a tendency to lower the impact resistance of the material. If the carbon content is below 3.00 %, excess cementite may form during cooling and, if this is not removed during heat treatment, the impact resistance of the material may be lowered.

7. Requirements

7.1 *Tensile Properties:*

7.1.1 The ductile iron as represented by the test specimens shall conform to the mechanical property requirements in Table 1.

7.2 *Hardness:*

7.2.1 For Grade 60-40-18, the hardness of the castings and test specimens shall be within the limits in Table 1.

7.2.2 For Grade 65-45-15, the hardness of test specimen and the critical area(s) of the casting, as identified on the casting drawing, shall be within the limits in Table 1. If the Grade 65-45-15 casting drawing does not have critical area(s) of the casting identified, all areas of the casting shall be within the hardness limits in Table 1.

7.3 *Microstructure:*

7.3.1 For Grade 60-40-18, the microstructure of the separately cast test coupon or the casting shall be essentially ferritic and contain no massive carbides, and have a minimum of 90 % Type I and Type II graphite as in Fig. 1 or Plate I of Test Method A247.

7.3.2 For Grade 65-45-15, the microstructure of the critical areas of the casting, as identified on the casting drawing, shall be 45 % pearlitic, maximum, contain no massive carbides, and have a minimum 90 % Type I and Type II graphite as in Fig. 1 or Plate I of Test Method A247.

7.4 *Pressure Test Requirements:*

7.4.1 Each pressure-retaining Grade 60-40-18 casting shall be tested after machining to the test pressure specified by the applicable standard of ANSI, ASME Boiler and Pressure Vessel Code, or other pertinent code, and shall show no leaks.

7.4.2 Castings Grade 65-45-15 manufactured under this specification shall be capable of passing hydrostatic test(s) compatible with the rating of the finished cast component. Such tests shall be conducted by the casting manufacturer only when Supplementary Requirement S2 is specified.

7.4.3 Castings Grade 60-40-18, ordered under this specification not covered by ANSI standards and ASME Pressure Vessel Code, and castings for special service applications, shall be tested to such pressures as may be agreed upon by the manufacturer and the purchaser.

7.4.4 For castings Grade 60-40-18, it is realized that the foundry may be unable to perform the hydrostatic test prior to shipment, or that the purchaser may wish to defer testing until additional work or machining has been performed on the casting. Castings ordered in the rough state for final machining by the purchaser may be tested hydrostatically prior to shipment by the manufacturer at pressures to be agreed upon with the purchaser. However, the foundry is responsible for the satisfactory performance of the castings under the final hydrostatic test.