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Standard Specification for Cupola Malleable Iron¹

This standard is issued under the fixed designation A197/A197M; 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 malleable irons for castings made by the cupola process.

1.2 Without knowledge of casting geometry and process details, quantitative relationships cannot be stated between the properties of the iron in the various locations of a casting and those of a test bar cast from the same iron.

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

2. Referenced Documents

2.1 *ASTM Standards:*²

[A247 Test Method for Evaluating the Microstructure of Graphite in Iron Castings](#)

[A644 Terminology Relating to Iron Castings](#)

[E8 Test Methods for Tension Testing of Metallic Materials](#)

3. Terminology

3.1 *Definitions*—Definitions for many terms common to iron castings are found in Terminology [A644](#).

4. Classification

4.1 Iron produced for castings ordered under this specification is classified in a single grade and is qualified by tests on separately cast test bars. Separately cast test bars shall be poured from the same lot of iron as the castings they represent and shall be heat treated with those castings.

5. Ordering Information

5.1 The purchase order for castings ordered under this specification shall state the specification designation and the year in which the specification was issued.

5.2 Any options or special additions to the basic requirements of this specification shall be clearly and fully stipulated.

6. Chemical Composition

6.1 The chemical composition of the iron shall be such as to produce the mechanical properties required by this specification.

7. Mechanical Requirements

7.1 Factors influencing the properties of castings and their relationship to those of test specimens and separate test castings are discussed in [Appendix X1](#).

7.2 *Tensile Test:*

7.2.1 *Tensile Test Specimens:*

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.

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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.

7.2.1.1 The tensile test specimens shall be cast to the form and dimensions shown in Fig. 1 and Fig. 2 using the same kind of molding material used for the production castings.

7.2.1.2 All test specimens shall be suitably identified with the designation of the pour period.

7.2.1.3 All test specimens shall be heat treated in the same production furnace and for the same cycles as the castings they represent.

7.2.2 Tensile Test Method:

7.2.2.1 Perform the tensile test on unmachined specimens.

7.2.2.2 Gage Length—The gage length of the standard tensile specimen shall be 2.00 ± 0.01 in. [50.0 ± 0.03 mm].

7.2.2.3 Cross-Sectional Area—The diameter used to compute the cross-sectional area shall be the average between the largest and smallest diameters in that section of the 2-in. [50 mm] gage length having the smallest diameter and shall be measured to the nearest 0.001 in. [0.02 mm]. No cast bar having a mean diameter less than 0.590 in. [15 mm] shall be accepted for test.

7.2.2.4 Speed of Testing—After reaching a stress equivalent to approximately half of the anticipated yield stress, the speed of the moving head of the testing machine shall not exceed 0.50 in./min [12.5 mm/min] through the breaking load.

7.2.2.5 Yield Strength—While the values for yield point and yield strength are not identical, they are sufficiently close for most applications to be used interchangeably. They shall be determined by an approved technique described in Test Methods E8 or by an equivalent method. If determined as yield strength, that stress producing an extension under load of 0.01 in. [0.25 mm] over the 2-in. [50 mm] gage length (for example, 0.5 % extension) or an offset of 0.2 % shall be taken as the yield stress, which shall be converted to yield strength by dividing by the original cross-sectional area of the gage length found in accordance with 7.2.2.3. It shall be reported to the nearest 100 psi [1 MPa]. In referee work, yield strength shall be determined at an offset of 0.2 % from the stress strain curve.

7.2.2.6 Tensile Strength—The tensile strength shall be the maximum load carried by the specimen during the test divided by the original cross-sectional area of the gage length, as found in accordance with 7.2.2.3. It shall be reported to the nearest 100 psi [1 MPa].

7.2.2.7 Elongation—The elongation is the increase in gage length after fracture of a tensile specimen, measured to the nearest 0.01 in. [0.25 mm] expressed as a percentage of the original gage length. It shall be reported to the nearest 0.5 %.

7.2.3 Number of Tests and Retests:

7.2.3.1 At least three tensile test specimens shall be cast from a representative ladle of iron from each 4-h pour period during which the purchaser's castings were poured.

7.2.3.2 Only one test specimen need be tested to qualify each pour period and heat treatment batch provided the requirements of this specification are met by that test specimen.

7.2.3.3 If after testing, a specimen shows evidence of a defect, another tensile test may be made on a companion specimen. Also, a retest shall be permitted whenever fracture occurs outside the central 50 % of the gage length.

7.2.3.4 If the result of a valid test fails to conform to the requirements of this specification, two retests shall be made. If either of the retest fails to meet the specification, all the castings from the pour period and the heat treat batch represented by these test specimens shall be rejected.

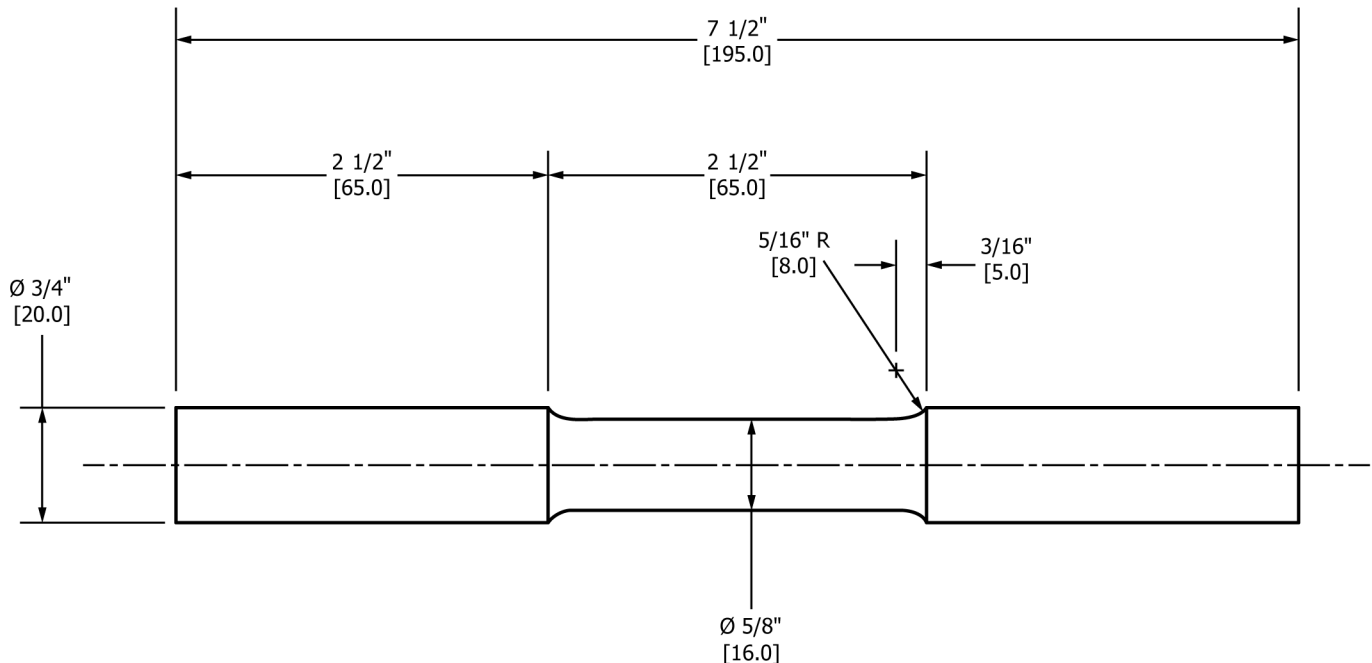


FIG. 1 Tension Test Specimen