



Designation: A536 – 84 (Reapproved 2019)^{ε1}

Standard Specification for Ductile Iron Castings¹

This standard is issued under the fixed designation A536; 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.

^{ε1} NOTE—Footnote 3 was editorially corrected in May 2019.

1. Scope

1.1 This specification covers castings made of ductile iron, also known as spheroidal or nodular iron, which is described as cast iron with the graphite substantially spheroidal in shape and essentially free of other forms of graphite, as defined in Terminology A644.

1.2 No precise quantitative relationship can be stated between the properties of the iron in various locations of the same casting or between the properties of castings and those of a test specimen cast from the same iron (see Appendix X1).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A644 Terminology Relating to 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

E8/E8M Test Methods for Tension Testing of Metallic Materials

¹ This specification is under the jurisdiction of the 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.

2.2 *Military Standard:*³

MIL-STD-129 Marking for Shipment and Storage

3. Ordering Information

3.1 Orders for material to this specification shall include the following information:

3.1.1 ASTM designation,

3.1.2 Grade of ductile iron required (see Table 1, and Sections 4 and 9),

3.1.3 Special properties, if required (see Section 7),

3.1.4 If a different number of samples is required (see Section 10),

3.1.5 Certification, if required (see Section 14), and

3.1.6 Special preparation for delivery, if required (see Section 15).

4. Tensile Requirements

4.1 The iron represented by the test specimens shall conform to the requirements as to tensile properties presented in Tables 1 and 2. The irons listed in Table 1 cover those in general use, while those listed in Table 2 are used for special applications (such as pipes, fittings, etc.).

4.2 The yield strength shall be determined at 0.2 % offset by the offset method (see Test Methods E8/E8M). Other methods may be used by mutual consent of the manufacturer and purchaser.

5. Heat Treatment

5.1 The 60-40-18 grade will normally require a full ferritizing anneal. The 120-90-02 and the 100-70-03 grades generally require a quench and temper or a normalize and temper, or an isothermal heat treatment. The other two grades can be met either as-cast or by heat treatment. Ductile iron, which is heat treated by quenching to martensite and tempering, may have substantially lower fatigue strength than as-cast material of the same hardness.

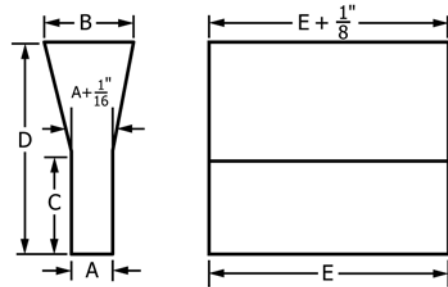
³ Available from General Services Administration – Vendor Support Center, <https://vsc.gsa.gov/administration/files/MIL-STD-129R.pdf>.

TABLE 1 Tensile Requirements

| | Grade 60-40-18 | Grade 65-45-12 | Grade 80-55-06 | Grade 100-70-03 | Grade 120-90-02 |
|--------------------------------------|-------------------|-------------------|-------------------|--------------------|--------------------|
| Tensile strength, min, psi | 60 000 | 65 000 | 80 000 | 100 000 | 120 000 |
| Tensile strength, min, MPa | 414 | 448 | 552 | 689 | 827 |
| Yield strength, min, psi | 40 000 | 45 000 | 55 000 | 70 000 | 90 000 |
| Yield strength, min, MPa | 276 | 310 | 379 | 483 | 621 |
| Elongation in 2 in. or 50 mm, min, % | 18 | 12 | 6.0 | 3.0 | 2.0 |

TABLE 2 Tensile Requirements for Special Applications

| | Grade 60-42-10 | Grade 70-50-05 | Grade 80-60-03 |
|--------------------------------------|-------------------|-------------------|-------------------|
| Tensile strength, min, psi | 60 000 | 70 000 | 80 000 |
| Tensile strength, min, MPa | 415 | 485 | 555 |
| Yield strength, min, psi | 42 000 | 50 000 | 60 000 |
| Yield strength, min, MPa | 290 | 345 | 415 |
| Elongation in 2 in. or 50 mm, min, % | 10 | 5 | 3 |

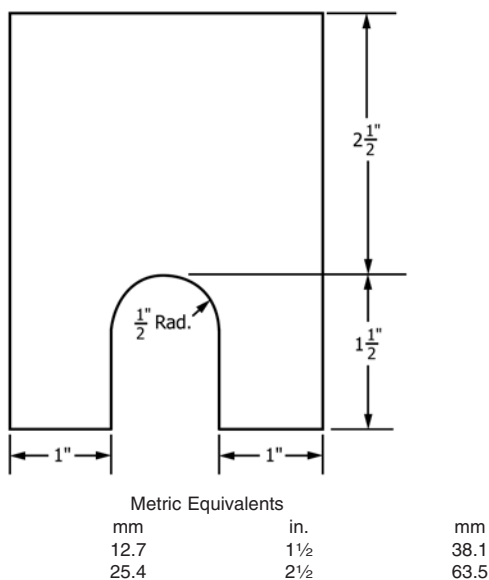


6. Test Coupons

6.1 The separately cast test coupons from which the tension test specimens are machined shall be cast to the size and shape shown in Fig. 1 or Fig. 2. A modified keel block cast from the mold shown in Fig. 3 may be substituted for the 1-in. Y-block or the 1-in. keel block. The test coupons shall be cast in open molds made of suitable core sand having a minimum wall thickness of 1½ in. (38 mm) for the ½-in. (12.5-mm) and 1-in. (25-mm) sizes and 3 in. (75 mm) for the 3-in. size. The coupons shall be left in the mold until they have cooled to a black color (approximately 900 °F (482 °C) or less). The size of coupon cast to represent the casting shall be at the option of the purchaser. In case no option is expressed, the manufacturer shall make the choice.

| Dimensions | Y-Block Size | | | | | |
|------------|---|--------|---|--------|--|--------|
| | For Castings of Thickness Less Than ½ in. (13 mm) | | For Castings of Thickness ½ in. (13 mm) to 1½ in. (38 mm) | | For Castings of Thickness of 1½ in. (38 mm) and Over | |
| | in. | mm | in. | mm | in. | mm |
| A | ½ | 13 | 1 | 25 | 3 | 75 |
| B | 1⅝ | 40 | 2⅝ | 54 | 5 | 125 |
| C | 2 | 50 | 3 | 75 | 4 | 100 |
| D | 4 | 100 | 6 | 150 | 8 | 200 |
| E | 7 | 175 | 7 | 175 | 7 | 175 |
| | approx | approx | approx | approx | approx | approx |

FIG. 2 Y-Blocks for Test Coupons



NOTE 1—The length of the keel block shall be 6 in. (152 mm).

FIG. 1 Keel Block for Test Coupons

6.2 When investment castings are made to this specification, the manufacturer may use test specimens cast to size incorporated in the mold with the castings, or separately cast to size using the same type of mold and the same thermal conditions that are used to produce the castings. These test specimens shall be made to the dimensions shown in Fig. 1 of Specification A732/A732M or Figs. 5 and 6 of Test Methods and Definitions A370.

6.3 The manufacturer may use separately cast test coupons or test specimens cut from castings when castings made to this specification are nodularized or inoculated in the mold. Separately cast test coupons shall have a chemistry that is representative of castings produced from the ladle poured and a cooling rate equivalent to that obtained with the test molds shown in Figs. 1 and 2, Figs. 4-6, or Appendix X2. The size (cooling rate) of the coupon chosen to represent the casting should be decided by the purchaser. If test coupon size is not specified, the manufacturer shall make the choice. When test bars will be cut from castings, test bar location shall be agreed on by the purchaser and manufacturer and indicated on the casting drawing. The manufacturer shall maintain sufficient controls and control documentation to assure the purchaser that properties determined from test coupons or test bars are representative of castings shipped.

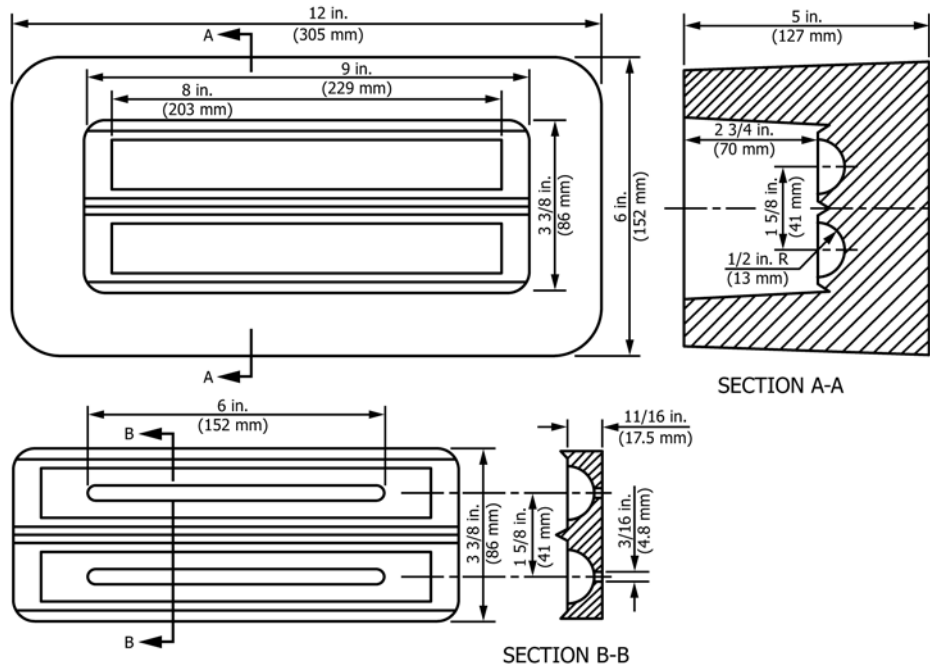
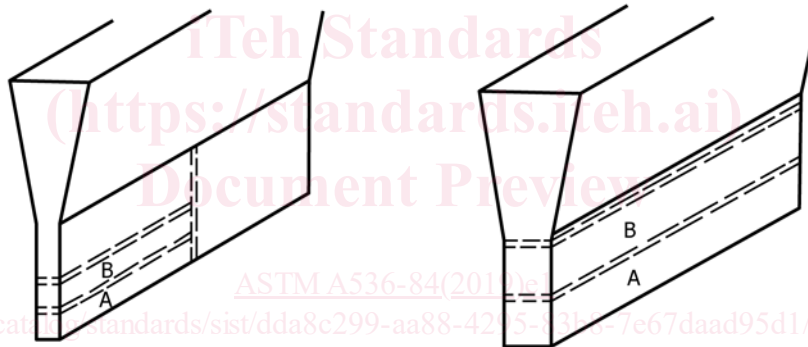
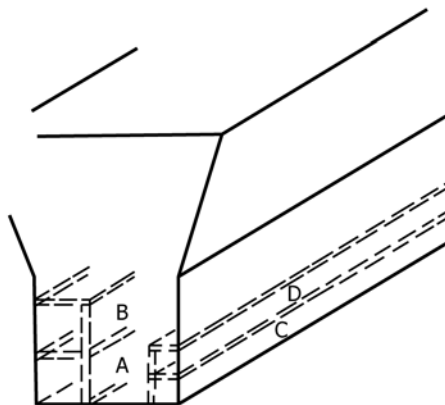


FIG. 3 Mold for Modified Keel Block



(a) 1/2-in. (12.7 mm) Y-Block—Two blanks for 0.252-in. (6.40 mm) diameter test specimens.

(b) 1-in. (25.4 mm) Y-Block—Two blanks for 0.50-in. (12.7 mm) diameter tension test specimens.



(c) 3-in. (76.2 mm) Y-Block—Two blanks for 0.50-in. (12.7 mm) diameter tension test specimens.

FIG. 4 Sectioning Procedure for Y-Blocks

6.4 The test coupons shall be poured from the same ladle or heat as the castings they represent.

6.5 Test coupons shall be subjected to the same thermal treatment as the castings they represent.