



Designation: A536 – 26a

## Standard Specification for Ductile Iron Castings<sup>1</sup>

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.*

### 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 SI values given in Tables 1 and 2 are mathematical conversions to SI units that are provided for information only for minimum mechanical properties 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:<sup>2</sup>

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A644 Terminology Relating to Iron Castings

E8/E8M Test Methods for Tension Testing of Metallic Materials

#### 2.2 Military Standard:<sup>3</sup>

MIL-STD-129 Marking for Shipment and Storage

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [www.astm.org/contact](http://www.astm.org/contact). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

### 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, Table 2, and Sections 4 and 9), including any deviations to the properties listed in Table 1 (see X1.3.1 and Table X1.1),

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 and retention time for maintenance of records (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.

4.3 Tensile strength, yield strength, and elongation may degrade with section thicknesses in excess of 1.2 in. Any deviations to the minimum properties in Table 1 for general castings must be agreed upon between the manufacturer and purchaser and specified in the order for materials purchased to this specification (see Section 3). Guidance for how properties may degrade with increasing section thickness in separately cast test blocks for grades listed in Table 1 is provided in X1.3.1 and Table X1.1.

### 5. Heat Treatment

5.1 The 60-40-18 and 60-42-10 grades may require a full ferritizing anneal heat treatment. The 100-70-03 and 120-90-02 grades generally require a normalize and temper, quench and temper, or an isothermal heat treatment. The other grades in Tables 1 and 2 can be met either as-cast or by heat treatment. Ductile iron, which is heat treated by quenching to martensite

TABLE 1 Tensile Requirements

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

<sup>A</sup> Metric values for minimum mechanical properties are conversions from inch-pound units for information only.

TABLE 2 Tensile Requirements for Special Applications

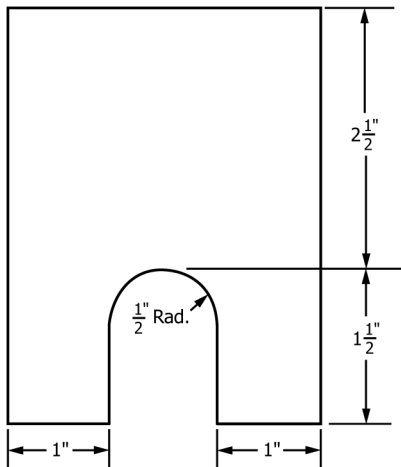
|                                         | Grade<br>60-42-10 | Grade<br>70-50-05 | Grade<br>80-60-03 |
|-----------------------------------------|-------------------|-------------------|-------------------|
| Tensile strength, min, psi              | 60 000            | 70 000            | 80 000  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

<sup>A</sup> Metric values for minimum mechanical properties are conversions from inch-pound units for information only.

and tempering, may have substantially lower fatigue strength than as-cast material of the same hardness.

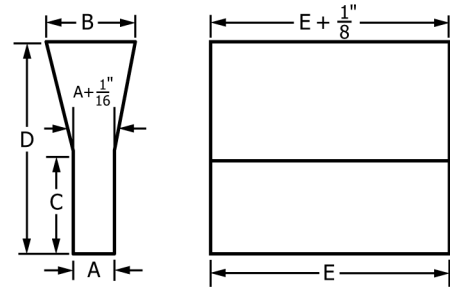
## 6. Test Blocks

6.1 The separately cast test blocks 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 blocks shall be cast in open molds made of suitable core sand having a minimum wall thickness of 1½ in. for the ½ in. and 1 in. sizes and 3 in. for the 3 in. size. The test blocks shall be left in the mold until they have cooled to a black color (approximately 900 °F (482 °C) or less). The size of test block 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.



NOTE 1—The length of the keel block shall be 6 in.

FIG. 1 Keel Block for Test Bars



| Dimensions | Y-Block Size                                       |                                                    |                                                       |
|------------|----------------------------------------------------|----------------------------------------------------|-------------------------------------------------------|
|            | For Castings<br>of Thickness<br>Less Than<br>½ in. | For Castings<br>of Thickness<br>½ in. to<br>1½ in. | For Castings<br>of Thickness<br>of 1½ in.<br>and Over |
|            | in.                                                | in.                                                | in.                                                   |
| A          | ½                                                  | 1                                                  | 3                                                     |
| B          | 1⅝                                                 | 2⅝                                                 | 5                                                     |
| C          | 2                                                  | 3                                                  | 4                                                     |
| D          | 4                                                  | 6                                                  | 8                                                     |
| E          | 7                                                  | 7                                                  | 7                                                     |
|            | approx                                             | approx                                             | approx                                                |

FIG. 2 Y-Blocks for Test Bars

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 Figs. 5 and 6 of Test Methods and Definitions A370.

6.3 The manufacturer may use separately cast test bars or test bars cut from castings when castings made to this specification are nodularized or inoculated in the mold. Separately cast test bars 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 and 5, or Appendix X2. The size (cooling rate) of the test block/bar chosen to represent the casting should be decided by the purchaser. If test bar 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.

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