



Designation: A842 – 11a (Reapproved 2022)^{ε1}

Standard Specification for Compacted Graphite Iron Castings¹

This standard is issued under the fixed designation A842; 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.

^{ε1} NOTE—Footnote 3 and 2.3 were updated editorially in October 2022.

1. Scope

1.1 This specification covers castings made of compacted graphite iron, which is described as cast iron with the graphite in compacted (vermiform) shapes and essentially free of flake graphite in the bulk of the casting.

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

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 *Exception*—The inch-pound units in [Figs. 1-3](#) are standard. SI units are added for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

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.

2.2 *Federal Standard:*³

[Federal Standard No. 123 Marking for Shipment \(Civil Agencies\)](#)

2.3 *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 and year of issue,

3.1.2 Grade of compacted graphite iron required as identified in [Table 1](#),

3.1.3 Special properties, if required (see [4.1](#) and [10.1](#)),

3.1.4 If samples other than those identified in [Section 9](#) are required,

3.1.5 Certification if so designated by the purchaser, and

3.1.6 Special preparation for delivery, if required.

4. Chemical Composition

4.1 It is the intent of this specification to subordinate chemical composition to mechanical properties; however, any chemical requirement may be specified by agreement between the manufacturer and the purchaser.

5. Requirements

5.1 Compacted graphite cast iron shall be examined metallographically for the acceptable graphite formation. Nondestructive testing such as ultrasonic velocity or resonance frequency may also be used to determine the graphite nodularity. However, in cases of dispute, the metallographic examination shall prevail.

5.2 The metallographic examination shall be performed on a sample sectioned from the casting, on a separately cast test coupon as shown in [Fig. 1](#), or on a test lug from a casting. The location on the casting from which the metallographic specimen is sectioned shall be agreed by the manufacturer and the purchaser. In the case of a test coupon or test lug, the specimen shall represent the last metal from the treated batch. The

³ Available from General Services Administration – Vendor Support Center, <https://vsc.gsa.gov>.

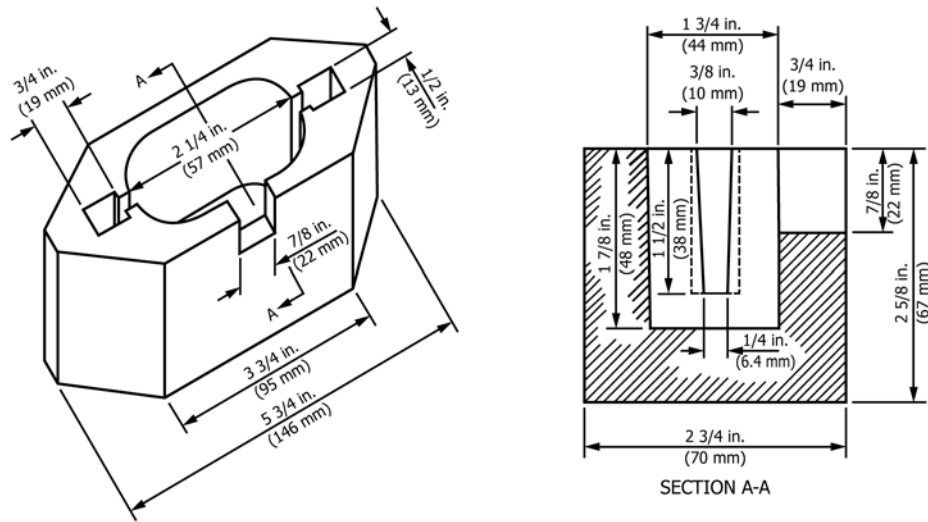
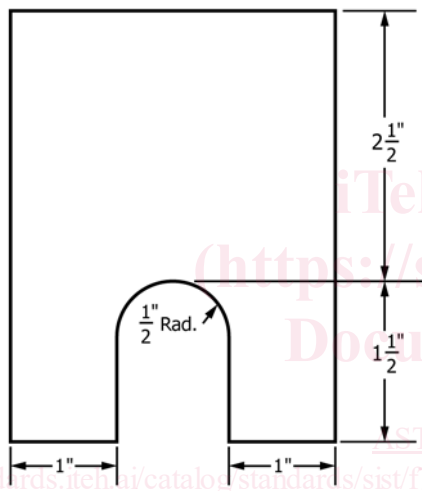


FIG. 1 Test Coupon for Microscopical Examination of Compacted Graphite Iron



Metric Equivalents			
in.	mm	in.	mm
1/2	12.7	1 1/2	38.1
1	25.4	2 1/2	63.5

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

FIG. 2 Keel Block

casting lug dimension and location shall be agreed by manufacturer and purchaser.

5.3 When castings are produced to this specification by treating the iron in the mold for graphite form control, the manufacturer may use separately cast test coupons or cut test specimens from castings to qualify conformance of the microstructure requirements. When separately cast test coupons are used, the test coupons shall have a chemical composition representative of that in the castings, produced from that iron poured, and having a cooling rate equivalent to that obtained through use of test molds as shown in Figs. 1-4. The size of the cast coupon representing the castings shall be the option of the purchaser. In case no option is expressed, the manufacturer shall make the choice. When test specimens are to be taken

from a casting, the location shall be agreed on by the purchaser and the manufacturer and documented on the casting drawing. It is the manufacturer's required responsibility to maintain adequate controls and documentation to assure the customer that test specimen microstructures are representative of microstructure in the castings shipped.

5.4 The acceptable graphite formation in the microstructure of the test coupon or casting lug shall contain 80 % minimum Type IV graphite (see Plate 1, Graphite Form Types of Test Method A247). The remainder of the graphite should be Type I, II, or III, with no free flake graphite (Type VII) in the bulk of the casting. The presence of up to 20 % of Types I, II, and III graphite gives rise to the definition of a maximum of 20 % nodularity in compacted graphite cast iron. The nodularity percentage can be arrived at by using the manual particle count, semiautomatic, or automatic image analysis methods. Whichever method is used, the procedure should be agreed on between the manufacturer and the purchaser.

5.5 Unless otherwise specified, the matrix microstructure of castings covered by this specification shall be substantially free of primary cementite.

5.6 Flake graphite is not permitted except within the surface rim zone of the casting. The amount of flake graphite at the surface shall be agreed by the manufacturer and the purchaser.

NOTE 1—Flake graphite in the casting surface reduces fatigue life, which should be taken into account during casting design. Machining removes this flake graphite and shot blasting generally minimizes its effect.

6. Tensile Requirements

6.1 The iron as represented by the test specimens shall conform to the requirements for tensile properties, as identified in Table 1.

6.2 Tensile properties shall be determined using the test bar described in 7.1 or one of the test coupons described in 7.2, except as provided in 10.4.

6.3 The yield strength presented in Table 1 shall be determined at 0.2 % offset by the offset method as described in Test

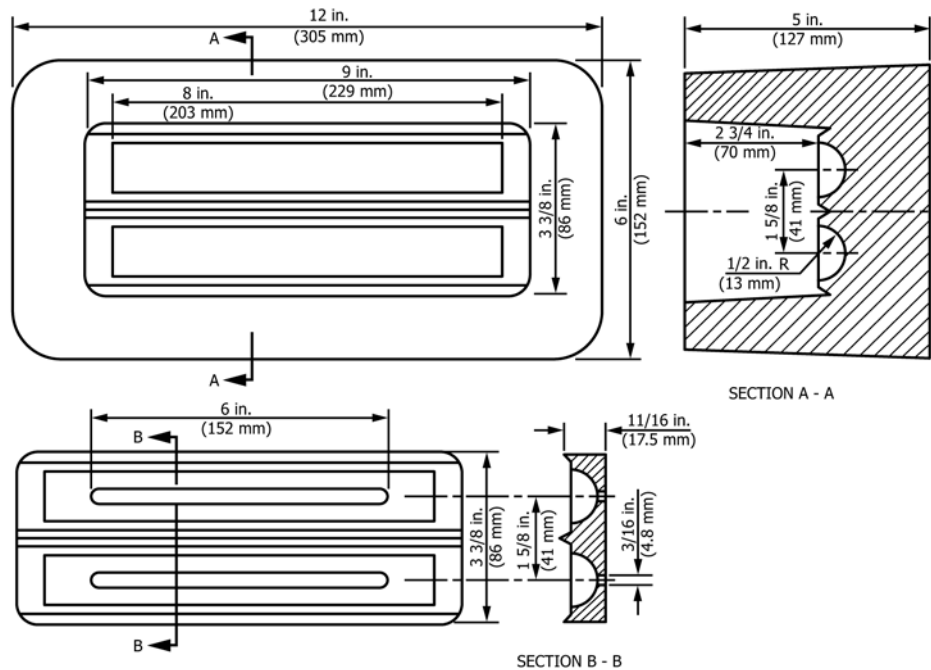


FIG. 3 Mold for Modified Keel Block

TABLE 1 Tensile Requirements

	Grade ^A 250	Grade 300	Grade 350	Grade 400	Grade ^B 450
Tensile strength, min, MPa	250	300	350	400	450
Yield strength, min, MPa	175	210	245	280	315
Elongation in 50 mm, min, %	3.0	1.5	1.0	1.0	1.0

^A The 250 grade is a ferritic grade. Heat treatment to attain required mechanical properties and microstructure shall be the option of the manufacturer.

^B The 450 grade is a pearlitic grade usually produced without heat treatment with addition of certain alloys to promote pearlite as a major part of the matrix.

TABLE 2 Diameter and Length of Cast Test Bar

Test Bar	Nominal	As-Cast Diameter, mm		Length, mm	
		Minimum	Maximum	Minimum	Maximum
B	30	29	31	150	230

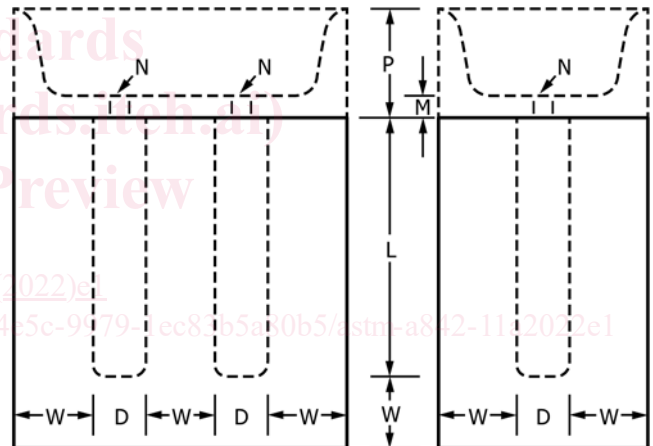


FIG. 4 Design and Dimensions for Mold for Separately Cast Cylindrical Test Bars

Methods E8/E8M. Other methods may be used by mutual agreement between manufacturer and purchaser.

7. Cast Test Bars

7.1 Test bars shall be separate castings poured from the same iron as the castings they represent. Test bars shall be cast to the size and shape as described in Table 2 and shown in Fig. 4.

7.2 Test coupons shall be separate castings poured from the same iron as the castings they represent. Test coupons shall be cast to the size and shape of the Y-block shown in Fig. 5, the keel block shown in Fig. 2, or the modified keel block shown in Fig. 3.

7.3 Test bars and test coupons shall be cast in dried, baked, or chemically bonded molds consisting of an aggregate of silica sand with the appropriate binders. All molds shall have a

thickness of sand adjacent to the test piece equal to or greater than the thickness of the piece.

7.4 Test bars and test coupons shall be subjected to the same thermal treatment as the castings they represent.

8. Tension Test Specimen

8.1 The standard round tension test specimen with 50 mm gage length described in Test Methods E8/E8M shall be used.

9. Workmanship, Finish, and Appearance

9.1 The surface of the casting shall be inspected visually for surface discontinuities such as cracks, hot tears, adhering sand or scale, cold shuts, and gas holes. Surface discontinuities shall meet visual acceptance standards mutually agreed on between the purchaser and the supplier.