Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 5316A
Superseding AMS 5316

Issued 5-1-54
Revised 11-1-70

DUCTILE (NODULAR) IRON CASTINGS, SAND
80,000 psi Tensile

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. COMPOSITION:

	min	max
Carbon	3.2	4.0
Manganese	--	0.8
Silicon	1.7	2.5
Phosphorus	--	0.08

2.1 Silicon may be as high as 2.8% if phosphorus is not over 0.05% for castings 1/2 in. thick and under.

2.2 The melt shall be treated with magnesium as necessary to meet the tensile and microstructure requirements but analysis for magnesium is not required.

3. CONDITION: As cast, except that castings may be normalized or normalized and tempered to meet the specified properties.

4. TECHNICAL REQUIREMENTS:

4.1 Casting: A melt shall be the metal poured from a single magnesium-treated ladle of 5000 lb or less.

4.2 Test Specimens:

4.2.1 Tensile Test Coupons: Shall be standard keel blocks as shown in Fig. 1, unless purchaser permits use of "Y" blocks as shown in Fig. 2 or modified keel blocks cast in molds as shown in Fig. 4. Coupons shall be cast with each melt of metal for castings or, if heat treatment is performed and microscopic examination is to be used to check the graphite microstructure of each melt, coupons shall be cast with only a sufficient number of melts to provide a coupon for each heat treat batch. When requested the coupons shall be supplied with the castings. Coupons shall be cast in open molds made of suitable core sand, shall be poured directly after pouring the castings, and shall be left in the mold until black. Metal for the coupons shall be part of the melt which is used for the castings. Molding practice, and the coupon size when use of "Y" blocks is permitted, shall be such that cooling rates of castings and coupons are substantially the same.

4.2.2 Chemical Analysis Specimens: For carbon determinations, a chilled pencil-type specimen shall be cast from each melt or a solid sample shall be cut from the tensile test coupon, the graphite examination specimen, or an actual casting from each melt.

4.2.3 Graphite Examination Specimens (Optional): When heat treatment is performed, graphite examination specimens may be used in lieu of tensile test coupons to represent each melt and, when used, shall be cast from molds as shown in Fig. 5. The specimens shall be cast with each melt of metal for castings and shall represent the last metal poured from the melt. The specimens shall meet the requirements of 4.6.1.

4.3 Heat Treatment: Castings may be normalized or normalized and tempered to meet the requirements of this specification.

4.3.1 When heat treatment is performed, tensile test coupons from each melt shall be heat treated with the castings they represent.

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4.3.1.1 If the graphite examination specimen option is elected, at least one set of tensile test coupons from ø one of the melts being heat treated shall be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than three hours.

4.4 Tensile Properties:

4.4.1 Tensile Test Specimens: Standard tensile test specimens (0.357 in. diameter at the reduced parallel section from 1/2 in. "Y" block or 0.505 in. diameter at the reduced parallel section from other tensile test coupons) cut from the coupons as shown in Figs. 1 and 3 or in Fig. 4 shall conform to the following requirements:

Tensile Strength, psi	80,000 min
Yield Strength at 0.2% Offset or at 0.0090 in. in 2 in. Extension Under Load (E = 24,000,000), psi	60,000 min
Elongation, % in 4D	3 min

4.4.2 Castings: When tensile properties of actual castings are determined for acceptance, tensile properties of specimens cut from sections of castings shall conform to the following requirements:

Tensile Strength, psi	80,000 min
Yield Strength at 0.2% Offset or at 0.0090 in. in 2 in. Extension Under Load (E = 24,000,000), psi	60,000 min
Elongation, % in 4D	2 min

4.4.2.1 Size and location of tensile test specimens machined from castings shall be as shown on the drawing or as agreed upon by purchaser and vendor.

4.5 Hardness: Castings should have hardness of Brinell 202 - 269 but shall not be rejected on the basis of ø hardness if the tensile property requirements are met.

4.6 Microstructure:

4.6.1 The microstructure of the graphite in the graphite examination specimens of 4.2.3 shall be not less ø than 90% Types I and II graphite as illustrated in the issue of ASTM A247, Plate I specified in the latest issue of AMS 2350.

4.6.2 The microstructure of castings and tensile test coupons shall consist of spheroidal graphite in a ø matrix of ferrite and fine pearlite; it shall be essentially free from carbide. The microstructure of the graphite alone shall meet the requirements of 4.6.1.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, acceptance of the product may be based on the testing of three additional specimens for each ø original nonconforming specimen, all of which additional specimens shall conform to specified requirements. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the castings represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. QUALITY:

5.1 Castings shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts. Castings shall have smooth surfaces and shall be well cleaned.

5.2 When castings are broken for fracture test, the fracture shall have uniform color and be substantially free from oxides and other defects.

5.3 Inspection standards and procedures shall be as agreed upon by purchaser and vendor.

5.4 Castings shall not be repaired by plugging, welding, or other methods without written permission from purchaser.

6. REPORTS:

6.1 Unless otherwise specified, the vendor of castings shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each melt and for tensile properties of the test coupons representing each melt, except that when heat treatment is performed and if graphite
ø examination specimens are used in lieu of tensile test coupons to represent each melt, then the tensile properties of the test coupons representing each heat treat batch shall be reported. This report shall include the purchase order number, material specification number and its revision letter, melt number, heat treat batch number, part number, and quantity from each melt.

6.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of castings, part number, and quantity. When castings for making parts are produced or purchased by the parts vendor, that vendor shall inspect castings from each melt represented to determine conformance to the requirements of this specification, and shall include in the report a statement that the castings conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

7. IDENTIFICATION: Unless otherwise specified, castings shall be identified in accordance with the latest issue of AMS 2804.

8. APPROVAL:

8.1 Sample castings from new or reworked patterns and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived.

8.2 Vendor shall establish, in producing sample castings of each part number, the critical items of processing which will produce acceptable castings; this shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in critical items
ø of processing which could affect quality or properties of the castings, vendor shall submit for reapproval a detailed statement of the revised operations and, when requested, sample castings for reapproval. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.

8.2.1 Control factors for producing castings include, but are not limited,to the following:

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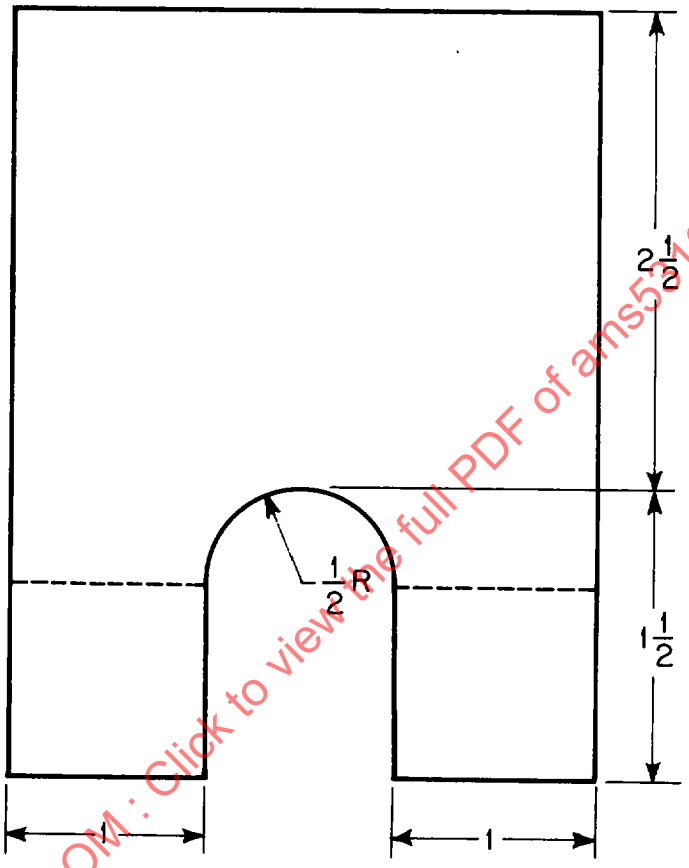
- Type of furnace and its capacity
- Size of furnace charge
- Furnace atmosphere
- Fluxing or deoxidation procedure
- Inoculation procedure
- Variations of more than ± 50 F (± 28 C) in pouring temperature
- Solidification rate and subsequent cooling procedures
- Cleaning operations
- Methods of routine inspection

8.2.1.1 Any of the above critical items of processing considered proprietary by the vendor may be assigned
ø a code designation. Each variation in such factors shall be assigned a modified code designation.

9. REJECTIONS: Castings not conforming to this specification or to authorized modifications will be subject to rejection.

NOTE. SIMILAR SPECIFICATIONS: (a) This specification exceeds the minimum requirements of MIL-I-24137(SHIPS), Class A, dated 23 April 1965.

(b) MIL-I-24137, MIL-I-11466(MR), and ASTM A536 are listed for information only and shall not be construed as acceptable alternates unless all requirements of this AMS are met.



Length of Block shall be 6 in.

Figure 1