Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5310D
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IRON CASTINGS, PEARLITIC MALLEABLE

1. SCOPE:

1.1 Form: This specification covers a pearlitic malleable iron in the form of castings.

1.2 Application: Primarily for general usage at both ambient and elevated temperatures where wear resistance and/or medium strength is required.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2804 - Identification, Castings

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A220 - Pearlitic Malleable Iron Castings
ASTM A247 - Evaluating the Microstructure of Graphite in Iron Castings
ASTM A370 - Mechanical Testing of Steel Products
ASTM E351 - Chemical Analysis of Cast Iron - All Types
ASTM E446 - Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Condition: Heat treated.

3.2 Casting: Castings may be made by any combination of melting, casting, and heat treating processes ø that will develop the properties of 3.4. A melt shall be the metal poured from a single ladle of 10,000 lb (4540 kg) or less.

Printed in U.S.A.

3.3 Tensile Test Specimens: Not less than three specimens shall be cast with each melt of metal for castings and, when requested, shall be supplied with the castings. In the case of continuous melting, at least three specimens shall be cast for each 8-hr period of casting; one specimen cast, Ø respectively, during pouring of the first casting, approximately the middle casting, and the last casting poured during the 8-hr period. Specimens shall be of standard size as described in ASTM A220 and shall be cast to size in molds made with the regular foundry mix of sand without using chills.

3.4 Properties: Castings and representative tensile test specimens produced in accordance with 3.3 Ø and heat treated with the castings they represent shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.4.1 Separately-Cast Specimens:

3.4.1.1 Tensile Properties: Shall be as follows:

Tensile Strength, min	70,000 psi (483 MPa)
Yield Strength at 0.2% Offset, min	48,000 psi (331 MPa)
Elongation in 4D, min	5%

3.4.2 Castings:

3.4.2.1 Tensile Properties: Specimens cut from castings are not required for acceptance of castings; however, if tensile specimens are machined from castings, such specimens shall have tensile properties not lower than 75% of the requirements for separately-cast specimens.

3.4.2.2 Hardness: Should be 163 - 229 HB or equivalent but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1 are met.

3.4.2.3 Microstructure: Shall consist of temper carbon particles in the form of small rounded nodules Ø uniformly distributed in a matrix of lamellar or spheroidized pearlite, substantially free from primary graphite and massive cementite. Evaluation of microstructure with respect to type, distribution, and size shall be performed in accordance with ASTM A247.

3.4.2.4 Decarburization: When agreed upon by purchaser and vendor, decarburization of any casting Ø surface shall be less than 0.020 in. (0.50 mm), determined as visual depletion of matrix carbide on polished specimens etched in nital etchant and examined at 100X magnification.

3.5 Quality:

3.5.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free Ø from foreign materials and from internal and external imperfections detrimental to usage of the castings.

3.5.1.1 Castings shall have smooth surfaces and shall be well cleaned.

3.5.2 Castings shall be produced under radiographic control, unless otherwise specified. This control shall consist of radiographic examination of castings in accordance with AMS 2635 until proper Ø foundry technique which will produce castings free from harmful internal imperfections, is established for each part number and of production castings as necessary to ensure maintenance of satisfactory quality.

3.5.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with Ø AMS 2645.

3.5.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E446 may be used to define radiographic acceptance standards.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of castings shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the castings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Except as specified in 4.2.1.1, tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed to represent each lot.

4.2.1.1 Tensile properties of specimens cut from castings shall be determined only when specified by purchaser or when separately-cast specimens are not available. Tensile properties of separately-cast specimens need not be determined when tensile properties of specimens cut from castings are determined.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the first-article shipment of a casting to a purchaser, when a change in processing requires reapproval, or when purchaser deems confirmatory testing is required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Three tensile test specimens in accordance with 3.4.2 from each melt.

4.3.2 Two preproduction castings in accordance with 4.4.1 of each part number.

4.3.3 One or more castings from each melt when properties of specimens machined from castings are required. Size, location, and number of specimens machined from castings shall be as specified on the drawing or as agreed upon by purchaser and vendor. When size, location, and number of specimens are not specified, not less than two specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting or castings from each melt.

4.4 Approval:

4.4.1 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.

4.4.2 Vendor shall establish for production of sample castings of each part number parameters for the control factors of processing which will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in parameters for the control factors of processing, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample test specimens, castings, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

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

Type of furnace
Furnace atmosphere
Fluxing or deoxidation procedure
ø Gating and risering practices
Pouring temperature (variation of ±50°F (±30°C) from the established limit is permissible)
Solidification and cooling procedures
Heat treatment procedures
Cleaning operations
Methods of routine inspection

4.4.2.1.1 Any of the above control factors of processing for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Reports:

4.5.1 The vendor of castings shall furnish with each shipment three copies of a report showing the results of tests on separately-cast test specimens or on specimens cut from castings to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, melt number, material specification number and its revision letter, part number, and quantity from each melt.

4.5.2 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.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the castings may be based on the results of testing three additional specimens for each original nonconforming specimen. 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. PREPARATION FOR DELIVERY:

5.1 Identification: Castings shall be identified in accordance with AMS 2804.

5.2 Packaging:

5.2.1 Castings shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the castings to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.