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

AEROSPACE MATERIAL SPECIFICATION

AMS 5335C
Superseding AMS 5335B
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STEEL CASTINGS, SAND
0.65Cr - 0.75Ni - 0.20Mo (0.25 - 0.33C) (SAE 8630 Modified)

1. SCOPE:

1.1 Form: This specification covers a low-alloy steel in the form of sand castings.

1.2 Application: Primarily for parts requiring higher strength than cast carbon steels and which may be heat treated or welded.

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 2360 - Room Temperature Tensile Properties of Castings
AMS 2635 - Radiographic Inspection
AMS 2640 - Magnetic Particle 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 A370 - Mechanical Testing of Steel Products
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

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

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	0.25	0.33
Manganese	0.60	0.95
Silicon	0.50	0.90
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.40	0.90
Nickel	0.40	1.10
Molybdenum	0.15	0.25
Copper	--	0.35

3.2 Condition: Normalized and tempered.

3.3 Castings: A melt shall be the metal poured from a single furnace charge.

3.4 Test Specimens:

3.4.1 Chemical Analysis Specimens: Shall be of any convenient size, shape, and form for vendor's tests. When chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor.

3.4.2 Tensile Specimens: Shall be attached to castings, if practicable, or shall be standard keel blocks conforming to ASTM A370, unless purchaser permits use of cast-to-size specimens. Specimens shall be cast with each melt of metal for castings and, when requested, shall be supplied with the castings. Keel blocks shall be cast in molds made of suitable core sand, shall be poured directly after pouring the castings, and shall be kept in the mold until black. Metal for the specimens shall be part of the melt which is used for the castings.

3.5 Heat Treatment: Castings and representative tensile test specimens shall be normalized by heating to 1700° - 1750°F (926.7° - 954.4°C), holding at heat for not less than 1 hr per inch (25 mm) of maximum cross-section but not less than 1 hr, and cooling in air to room temperature and tempered by heating to a temperature not lower than 1150°F (621°C), holding at heat for not less than 1 hr, and cooling in air.

3.6 Properties: Castings and representative tensile test specimens produced in accordance with 3.4.2 shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.6.1 As Normalized and Tempered:

3.6.1.1 Hardness: 183 - 229 HB or equivalent.

3.6.2 After Hardening and Tempering: Castings and representative tensile test specimens, normalized and tempered as in 3.5, shall meet the following requirements after being hardened by heating to 1600°F ± 25 (871.1°C ± 14), holding at heat for not less than 30 min., and quenching in oil and tempered by heating to 800°F ± 15 (426.7°C ± 8.3), holding at heat for 2 hr ± 0.25, and cooling in air.

3.6.2.1 Tensile Properties: Shall be as follows:

Tensile Strength, min	165,000 psi (1138 MPa)
Yield Strength at 0.2% Offset, min	150,000 psi (1034 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	8%

3.6.2.1.1 Separately-Cast Test Specimens:

3.6.2.1.2 Specimens Cut from Castings: When specified on the drawing or when agreed upon by purchaser and vendor, tensile test specimens conforming to ASTM A370 shall be machined from castings selected at random from each melt. Property requirements shall be as shown on the drawing or as agreed upon by purchaser and vendor and may be defined as specified in AMS 2360.

3.6.2.2 Hardness: Shall be not lower than 331 HB or equivalent.

3.7 Quality:

3.7.1 Castings, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the castings. Castings shall have smooth surfaces and shall be well cleaned.

3.7.2 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 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.

3.7.3 When specified, castings shall be subject to magnetic particle inspection in accordance with AMS 2640 and/or fluorescent penetrant inspection in accordance with AMS 2645.

3.7.4 Radiographic, magnetic particle, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor.

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

3.7.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings repaired by welding provided the weld repair area has properties comparable to those of the parent metal. Repair welds shall be subjected to the same inspection procedures and acceptance standards required of the castings. Weld repair areas shall be suitably marked to facilitate inspection. The repair welding shall be performed prior to any heat treatment and nondestructive testing specified herein.

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: Tests to determine conformance to composition (3.1), hardness of castings as normalized and tempered (3.6.1.1), and quality (3.7) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance of separately-cast test specimens and of castings, when specified, to properties after hardening and tempering (3.6.2) are classified as periodic tests.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests.

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4.2.3.1 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.

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4.3 Sampling: Shall be in accordance with the following:

Ø 4.3.1 Two chemical analysis specimens in accordance with 3.4.1 and/or a casting from each melt.

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

Ø 4.3.3 Three tensile test specimens in accordance with 3.4.2 from each melt, when requested.

4.3.4 One casting from each melt when properties after hardening and tempering of specimens machined from castings are required. Specific size, locations, 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 test specimens are not specified, not less than two tensile test specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting from each master heat.

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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 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 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 and its capacity
Size of furnace charge
Furnace atmosphere
Fluxing or deoxidation procedure
Pouring temperature (variation of ±50° F (±28° C) from the established limit is permissible)
Solidification and cooling procedures
Cleaning operations
Methods of routine inspection

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

4.5 Reports: