

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5351E

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Superseding AMS 5351D

STEEL CASTINGS, SAND, CORROSION AND MODERATE HEAT RESISTANT 13Cr Normalized and Tempered

UNS J91150

1. SCOPE:

1.1 Form: This specification covers a corrosion and moderate heat resistant steel in the form of sand castings.

1.2 Application: Primarily for parts, such as compressor housings, requiring oxidation resistance up to 1000°F (540°C) but useful at the higher temperatures only when stresses are low.

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

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

- AMS 2350 - Standards and Test Methods
- AMS 2635 - Radiographic Inspection
- AMS 2640 - Magnetic Particle Inspection
- AMS 2645 - Fluorescent Penetrant Inspection
- AMS 2694 - Repair Welding of Aerospace Castings
- AMS 2804 - Identification, Castings

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

ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E446 - Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness

- 2.3 U.S. 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 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E353 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	--	0.15
Manganese	--	1.00
Silicon	--	1.50
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	11.50 -	14.00
Nickel	--	1.00
Molybdenum	--	0.50
Aluminum	--	0.05
Copper	--	0.50
Tin	--	0.05

- 3.2 Condition: Normalized and tempered.

- 3.3 Casting: A melt shall be the metal poured from a single furnace charge of 15,000 lb (6800 kg) or less. A lot shall be all castings of the same part number poured from a single melt in not more than eight consecutive hours and normalized and tempered together as a batch.

- 3.4 Test Specimens: 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.

- 3.5 Heat Treatment: Castings shall be normalized by heating to $1850^{\circ}\text{F} + 25$ ($1010^{\circ}\text{C} + 15$), holding at heat for not less than 1 hr per in. (25 mm) of maximum section thickness but in no case less than 30 min., and cooling in air and tempered by heating to a temperature not lower than 1100°F (595°C), holding at heat for the proper time to produce the specified hardness, and cooling in air.
- 3.6 Properties: Castings shall conform to the following requirements:
- 3.6.1 Hardness: 217 - 248 HB, or equivalent, determined in accordance with ASTM E10.
- 3.6.2 Response to Heat Treatment: Specimens from castings 0.375 in. (9.50 mm) and under in section thickness and 0.375 in. + 0.010 (9.50 mm + 0.25) thick specimens cut from thicker sections of a casting shall have hardness of 35 - 45 HRC, or equivalent, determined in accordance with ASTM E18, after being heated to $1750^{\circ}\text{F} + 10$ ($955^{\circ}\text{C} + 5$), held at heat for 15 - 45 min., and cooled in still air.
- 3.7 Quality:
- 3.7.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the castings.
- 3.7.1.1 Castings shall have smooth surfaces and shall be well cleaned. Metallic shot or grit shall not be used for final cleaning.
- 3.7.2 Castings shall be produced under radiographic control. 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 subjected to magnetic particle inspection in accordance with AMS 2640, to fluorescent penetrant inspection in accordance with AMS 2645, or to both.
- 3.7.4 Radiographic, magnetic particle, 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.
- 3.7.5 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 in accordance with AMS 2694.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of castings shall supply all samples for vendor's tests 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 sample and to perform any confirmatory testing deemed necessary to ensure that the castings conforms to the requirements of this specification.
- 4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, on each lot, when a change in material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.
- 4.2.1 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, contracting officer, or request for procurement.
- 4.3 Sampling: Shall be in accordance with the following:
- 4.3.1 Two chemical analysis specimens in accordance with 3.4 from each melt or a casting from each lot.
- 4.3.2 Two preproduction castings in accordance with 4.4.1 of each part number.
- 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 by purchaser.
- 4.4.2 Vendor shall establish for production of sample castings of each part number parameters for the process control factors 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 process control factors, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample castings. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.