

AEROSPACE MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

AMS 5331A

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STEEL CASTINGS, SAND

0.80Cr - 1.8Ni - 0.35Mo (0.38 - 0.46C) (SAE 4340 Modified)

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. APPLICATION: Primarily for parts which require heat treatment to tensile strengths up to 200,000 psi minimum.
3. COMPOSITION: Castings shall conform to the following:

	min	max
Carbon	0.38	0.46
Manganese	0.60	1.00
Silicon	0.50	1.50
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.65	1.00
Nickel	1.65	2.00
Molybdenum	0.30	0.45

4. CONDITION: Annealed, unless otherwise specified.
5. TECHNICAL REQUIREMENTS:
 - 5.1 Casting: A melt shall be the metal poured from a single furnace charge of 7000 lb or less.
 - 5.2 Test Specimens:
 - 5.2.1 Tensile Test Coupons: Shall be attached to castings if practicable, or shall be standard keel blocks as shown in Fig. 1, unless purchaser permits use of cast-to-size specimens. Coupons 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 coupons shall be part of the melt which is used for the castings.
 - 5.2.2 Chemical Analysis Specimens: When required by purchaser, shall be of size and shape agreed upon by purchaser and vendor.
 - 5.3 Annealing: Castings and tensile test specimens shall be annealed by heating to $1550\text{ F} \pm 25$ ($843.3\text{ C} \pm 14$), holding at heat for not less than 1 hr, and cooling as required.

- 5.4 Hardness: Castings shall have hardness not higher than Rockwell C 30 or equivalent.
- 5.5 Carburization or Decarburization: The carbon content shall be within the specification limits throughout the casting, except that within 0.020 in. of the surface or 10% of wall thickness, whichever is smaller, the carbon content may be lower than specified in Section 3. Unless otherwise agreed upon by purchaser and vendor, the heat treatment specified in 5.3 shall be performed in a protective atmosphere to accomplish the carbon control required.
- 5.6 Properties After Hardening and Tempering: Tensile test specimens produced in accordance with 5.2.1 and castings, hardened by heating to $1500\text{ F} \pm 25$ ($815.6\text{ C} \pm 14$), holding at heat for not less than 30 min., and oil quenching, and then tempered twice at not lower than 700 F (372 C) for 2 hr, air cooling after each tempering operation, shall be capable of meeting the following requirements. Specimens cut from castings are not required for routine examination; however, properties obtained from such specimens may be basis for acceptance or rejection of castings. Specific location and size of specimens shall be as agreed upon by purchaser and vendor.

5.6.1 Tensile Properties:

Ø	Tensile Strength, psi	200,000 min
	Yield Strength at 0.2% Offset or at 0.0164 in.	
	in 2 in. Extension Under Load ($E = 29,000,000$), psi	180,000 min
	Elongation, % in 4D	5 min

- 5.6.2 Hardness: Rockwell C 44 - 49 or equivalent.

6. QUALITY:

- 6.1 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. Unless otherwise specified, metallic shot or grit shall not be used for final cleaning.
- 6.2 When castings are broken for fracture test, the fracture shall have uniform color and be substantially free from oxides and other imperfections.
- 6.3 Unless otherwise specified, castings shall be produced under radiographic control. This shall consist of radiographic examination of castings 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.
- 6.4 Radiographic and other quality standards shall be as agreed upon by purchaser and vendor.
- 6.5 Castings shall not be repaired by plugging, welding, or other methods, without written permission from purchaser.

7. REPORTS:

- 7.1 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 heat and a statement that the annealing has been performed in accordance with the requirements of this specification. This report shall include the purchase order number, melt number, material specification number, part number, and quantity from each heat.
- 7.2 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, 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 each lot of castings 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.

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

9. APPROVAL:

- 9.1 To assure uniformity of quality, sample castings from new or reworked patterns shall be approved by purchaser, unless such approval be waived.
- 9.2 Vendor shall use the same foundry practices and the same annealing procedures for production castings as for approved sample castings. If necessary to make any change in processing which could unfavorably affect any characteristics of the castings, vendor shall obtain written permission from purchaser prior to the first shipment of castings incorporating such change.
10. REJECTIONS: Castings not conforming to this specification or to authorized modifications will be subject to rejection.