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

AEROSPACE MATERIAL SPECIFICATION

AMS 5359A
Superseding AMS 5359

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UNS S35500

STEEL CASTINGS, SAND, CORROSION AND HEAT RESISTANT
15Cr - 4.0Ni - 2.3Mo - 0.08N

1. SCOPE:

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

1.2 Application: Primarily for parts requiring corrosion resistance, high strength, and oxidation resistance up to 850°F (454°C), and especially where parts require welding during fabrication.

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, Pennsylvania 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 2804 - Identification, Castings

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

ASTM A370 - Mechanical Testing of Steel Products
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

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

2.3.1 Federal Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

3.1 (Continued)

	min	max
Carbon	0.08	0.15
Manganese	0.40	1.10
Silicon	--	0.75
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	14.50	15.50
Nickel	3.50	4.50
Molybdenum	2.00	2.60
Nitrogen	0.05	0.11
Carbon + Nitrogen	0.15	0.25

3.2 Condition: Solution heat treated except as specified in 3.5.2.

3.3 Casting: A melt shall be the metal poured from a single furnace charge of 5000 lb (2270 kg) or less.

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 Test Specimens: Shall be attached to the 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: All castings and separately-cast test specimens shall be heat treated as follows:

3.5.1 Solution Heat Treatment: Heat to 2000°F ± 50 (1093.3°C ± 28), hold at heat for not less than 1 hr per inch (25 mm) of section thickness and cool rapidly in air for castings with all cross-sections 1 in. (25 mm) and under in nominal thickness and in water or oil for castings with any cross-section greater than 1 in. (25 mm).

3.5.2 Equalize and Overtemper: When specified by the purchaser, castings, after heat treatment as in 3.5.1, shall be heated to 1400°F ± 50 (760°C ± 28), held at heat for not less than 3 hr, cooled in air to room temperature or below, reheated to 1050°F ± 25 (565.6°C ± 14), held at heat for not less than 3 hr, and cooled in air.

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

3.6.1 As Solution Heat Treated:

3.6.1.1 Hardness: Shall be not higher than 39 HRC or equivalent.

3.6.2 After Austenite Conditioning, Sub-Zero Cooling, and Tempering: Test specimens produced in accordance with 3.4.2 and castings, heat treated in accordance with 3.5.1, shall conform to the requirements of 3.6.2.1 and 3.6.2.2 after being austenite conditioned by heating to 1725° - 1850°F (940.6° - 1010°C), holding at heat for not less than 1 hr per inch (25 mm) of cross-section, and quenching in water or cooling as rapidly as possible to room temperature, sub-zero cooled by cooling to not warmer than -100°F (-73°C), holding at that temperature for not less than 3 hr, and warming in air to room temperature, and tempered by heating to 1000°F ± 25 (537.8°C ± 14), holding at heat for not less than 3 hr, and cooling in air:

3.6.2.1 Hardness: Not lower than 37 HRC.

3.6.2.2 Tensile Properties:

Tensile Strength, min	165,000 psi (1138 MPa)
Yield Strength at 0.2% Offset, min	140,000 psi (965 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	8%

3.7 Quality:

3.7.1 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. Metallic shot or grit shall not be used for final cleaning, unless otherwise permitted.

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 casting and the weld repair areas shall be suitably identified 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 assure that the castings conform 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 or routine control tests.

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 specimens in accordance with 3.4.2 from each melt, when requested.

Ø 4.3.4 One casting 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.
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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 revised test specimens, castings, or both. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.
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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
Ø Gating and risering practices
Pouring temperature (Variation of ± 50° F (± 28° C) from established limits 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.
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4.5 Reports:

4.5.1 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 represented and the results of tests on each melt to determine conformance to the other 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.
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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.