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

AEROSPACE MATERIAL SPECIFICATION

AMS 5364

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Revised

STEEL CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT
19.5Cr - 10.5Ni - 0.60(Cb+Ta)

1. SCOPE:

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

1.2 Application: Primarily for small structural parts of intricate design, such as exhaust couplings and fittings, where welding during fabrication may be required, for use at temperatures up to 1500°F (815°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 (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 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 A262 - Detecting Susceptibility to Intergranular Attack in Stainless Steels
ASTM A370 - Mechanical Testing of Steel Products
ASTM E192 - Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

2.3 Government Publication: Available from Commanding Officer, Naval Publication 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 E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	--	0.08
Manganese	--	2.00
Silicon	--	1.50
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	18.00	21.00
Nickel	9.00	12.00
Columbium + Tantalum	8xC	1.00
Molybdenum	--	0.75
Copper	--	0.75

3.2 Condition: Solution heat treated.

3.3 Casting: Castings shall be poured either from remelted metal from a master heat or directly from a master heat. In either case, metal for casting shall be qualified as in 3.4.

3.3.1 A master heat is refined metal of a single furnace charge or metal blended as in 3.3.2. Gates, sprues, risers, and rejected castings shall be used only in prepartion of master heats; they shall not be remelted directly, without refining, for pouring of castings.

3.3.2 Unless prohibited by purchaser, metal from two or more master heats may be blended provided that the composition of each master heat to be blended is within the limits of 3.1 and that the total weight of metal blended does not exceed 10,000 lb (4540 kg). Ingot and pig may be blended together, shot may be blended, but shot shall not be blended with ingot or pig. When two or more master heats are blended, the resultant blend shall be considered a master heat.

3.4 Master Heat Qualification: Each master heat shall be qualified by evaluation of chemical analysis and tensile test specimens conforming to 3.4.1 and 3.4.2, respectively. A master heat may be considered conditionally qualified if vendor's test results show conformance to all applicable requirements of this specification. However, except when purchaser waives confirmatory testing, final qualification shall be based on purchaser's test results. Conditional qualification of a master heat shall not be construed as a guarantee of acceptance of castings poured therefrom.

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 cast from remelted metal from each master heat except when castings are poured directly from a master heat, in which case the specimens shall also be poured directly from the master heat. Specimens shall be of standard proportions in accordance with ASTM A370 with 0.250 in. (6.35 mm) diameter at the reduced parallel gage section. They shall be cast to size or shall be cast oversize and subsequently machined to 0.250 in. (6.35 mm) diameter. Center gating may be used.

3.5 Heat Treatment: Castings and representative tensile test specimens shall be solution heat treated by heating to 1950°F ± 50 (1066°C ± 30), holding at heat for not less than 1 hr per inch (25 mm) of maximum section thickness but in no case less than 30 min., and cooling in air or water.

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 Separately-Cast Specimens:

3.6.1.1 Hardness: Shall be not higher than 88 HRB or equivalent.

3.6.1.2 Tensile Properties: Shall be as follows:

Tensile Strength, min	70,000 psi (483 MPa)
Yield Strength at 0.2% Offset, min	30,000 psi (207 MPa)
Elongation in 1 in. (25.4 mm) or 4D, min	30%

3.6.2 Castings:

3.6.2.1 Hardness: Shall be not higher than 88 HRB or equivalent.

3.6.2.2 Tensile Properties: 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 master heat. Property requirements for such specimens shall be as shown on the drawing or as agreed upon by purchaser and vendor and may be defined as specified in AMS 2360.

3.6.2.3 Embrittlement: Specimens cut from castings, after sensitizing treatment, shall show no evidence of intercrystalline surface attack when examined microscopically after being exposed to the copper/copper sulfate/sulfuric acid test of ASTM A262, Practice E.

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.

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, 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 subjected to fluorescent penetrant inspection in accordance with AMS 2645.

3.7.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E192 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 provided the weld repair area has properties comparable to those of the parent metal. Repair welds shall be subject to the same inspection procedures and acceptance standards required of the casting. 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 (3.6.1.1 and 3.6.2.1), tensile properties of separately-cast specimens (3.6.1.2), tensile properties of specimens cut from castings (3.6.2.2) when specified, and quality (3.7) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to embrittlement (3.6.2) requirements are classified as periodic tests.

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

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.

4.3 Sampling: Shall be as follows:

4.3.1 A chemical analysis specimen in accordance with 3.4.1 and/or a casting from each master heat.

4.3.2 Three tensile test specimens in accordance with 3.4.2 from each master heat.

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

4.3.4 One of more castings from each master heat when tensile properties of specimens cut from castings are specified and/or when requested for embrittlement testing. 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 or castings from each master heat.

4.4 Approval: