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

AEROSPACE MATERIAL SPECIFICATION

AMS 5354C
Superseding 5354B

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STEEL CASTINGS, INVESTMENT, CORROSION AND MODERATE HEAT RESISTANT 13Cr - 2Ni - 3W

1. SCOPE:

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

1.2 Application: Primarily for parts, such as compressor blades and vanes, housings, and valves, for use at temperatures up to 1000°F (538°C). Strength and resistance to tempering at the higher temperatures are greater than those of AMS 5350; ductility is better than that of AMS 5352 but with some sacrifice of attainable hardness.

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 - Flourescent Pentrant Inspection

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:

	min	max
Carbon	0.15	0.20
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	12.00	14.00
Nickel	1.80	2.20
Tungsten	2.50	3.50
Molybdenum	--	0.50
Copper	--	0.50

3.2 Condition: Hardened (air cooled from the austenitizing temperature) and tempered, having hardness not higher than 33 HRC or equivalent, determined in accordance with ASTM A370.

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

3.3.1 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 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 Properties: Castings and separately-cast specimens shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.5.1 Response to Heat Treatment:

3.5.1.1 Attainable Hardness: Castings and separately-cast specimens shall have hardness not lower than 45 HRC or equivalent after being heated to 1750°F ± 25 (954.4°C ± 14), held at heat for 60 min. ± 5 per inch (25 mm) of maximum section thickness, and cooled in still air.

3.5.1.2 Mechanical Properties After Tempering: Castings and separately-cast specimens shall meet the following requirements after being rehardened as in 3.5.1.1 and tempered at 1075°F ± 10 (579.4°C ± 5.6) for 2 - 2-1/4 hr, and cooled in air:

3.5.1.2.1 Tensile Properties:

Tensile Strength, min	145,000 psi (1000 MPa)
Yield Strength at 0.2% Offset, min	115,000 psi (793 MPa)
Elongation in 1 in. (25.4 mm) or 4D, min	10%

3.5.1.2.2 Hardness: 32 - 38 HRC or equivalent.

3.6 Quality:

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

3.6.2 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.

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

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

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

3.6.5.1 When permitted in writing by purchaser, defects in castings may be removed and the casting 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 area 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:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), condition (3.2), and attainable hardness (3.5.1.1) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to mechanical properties after tempering (3.5.1.2) Ø requirements are classified as qualification or periodic control tests.

4.3 Sampling: Shall be in accordance with the following:

Ø4.3.1 Two chemical analysis specimens in accordance with 3.4.1 and/or a casting from each master heat.

Ø4.3.2 Two preproduction castings in accordance with 4.4.1 of each part number.

Ø4.3.3 Three tensile test specimens in accordance with 3.4.2 from each master heat, when requested.

Ø4.3.4 One casting from each master heat.

4.4 Approval:

4.4.1 Sample castings from new or reworked master patterns and the casting procedure shall be approved by Ø purchaser before castings for production use are supplied, unless such approval be waived.

4.4.2 Vendor shall establish separately for tensile test specimens used for master heat qualification and for production of sample castings of each part number the control factors of processing which will produce tensile test specimens meeting master heat qualification requirements and acceptable castings; these Ø shall constitute the approved casting procedures and shall be used for producing subsequent master heat qualification specimens and 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.

4.4.2.1 Control factors for producing test specimens and castings include, but are not limited to, the following:

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- Type of furnace and its capacity
- Size of furnace charge
- Furnace Atmosphere
- Fluxing or deoxidation procedure
- Mold refractory formulation
- Mold back-up material
- Gating Practices
- Mold preheat and pouring temperatures (Variations of $\pm 25^{\circ}F$ ($\pm 14^{\circ}C$) from established limits are permissible)
- Solidification and subsequent 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 Ø a code designation. Each variation in such factors shall be assigned a modified code designation.

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 at least one casting, or of specimens as in 3.4.1 cast in a mold with parts, from each master heat represented, the results of tests to determine conformance to the attainable hard- Ø ness requirements, and a statement that the castings conform to the other technical requirements of this specification. This report shall include the purchase order number, master heat number (and code symbol if used), material specification number and its revision letter, part number, and quantity from each master heat.