SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5342C

Issued 7-15-63
Revised 10-1-89

Superseding AMS 5342B

STEEL CASTINGS, INVESTMENT, CORROSION RESISTANT
16Cr - 4.1Ni - 0.28 (Cb+Ta) - 3.2Cu
Homogenization, Solution, and Precipitation Heat Treated
130,000 psi (896 MPa) Tensile Strength

UNS J92200

1. SCOPE:

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

1.2 Application: Primarily for parts requiring good corrosion resistance and strength up to 600°F (316°C). Certain processing procedures and service conditions may cause these castings to become subject to stress-corrosion cracking. ARP 1110 recommends practices to minimize such conditions on wrought products.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications 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 2360 - Room Temperature Tensile Properties of Castings
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

2.1.2 Aerospace Recommended Practices:

ARP1110 - Minimizing Stress Corrosion Cracking in Heat Treatable Wrought Low Alloy and Martensitic Corrosion Resistant Steels

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM A 370 - Mechanical Testing of Steel Products
ASTM E 192 - Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E 353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

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 Specifications:

MIL-H-6875 - Heat Treatment of Steels, Process for

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 Ø by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	--	0.06
Manganese	--	0.70
Silicon	0.50	1.00
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	15.50	16.70
Nickel	3.60	4.60
Columbium + Tantalum	0.15	0.40
Copper	2.80	3.50
Aluminum	--	0.05
Tin	--	0.02
Nitrogen	--	0.05

3.2 Condition: Homogenization, solution, and precipitation 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 is metal blended as in 3.3.2. 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.

3.3.2 Ø 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 15,000 pounds (6804 kg). 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 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.

3.4.2 Tensile Specimens: Shall be cast from remelted metal from each master heat except that when castings are poured directly from a master heat the specimens shall also be poured directly from the master heat. Specimens shall be of standard proportions in accordance with ASTM A 370 with 0.250 inch (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 inch (6.35 mm) diameter. Center gating may be used.

3.5 Ø Heat Treatment: Castings, integrally-cast coupons, and separately-cast tensile specimens shall be heat treated as follows; castings, coupons, and tensile specimens shall be given a homogenization heat treatment prior to solution heat treatment or may be given two solution heat treatments when permitted or specified by purchaser. Either single or double solution treatment shall be followed by the precipitation treatment. Furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6875.

3.5.1 Homogenization: Heat to 2100°F ± 25 (1149°C ± 14), hold at heat for not less than 90 minutes, and cool as required to below 70°F (21°C).

3.5.2 Solution: Heat to 1900°F ± 25 (1038°C ± 14), hold at heat for 60 minutes per inch (25 mm) of maximum cross-section but not less than 30 minutes, and cool as required to below 70°F (21°C).

3.5.3 Precipitation: Heat to a temperature within the range 1085° - 1115°F (585° - 602°C), hold at the selected temperature within ±10°F (±6°C) for not less than 90 minutes, and cool in air to room temperature.

3.6 Properties: Castings, integrally-cast coupons, and separately-cast tensile Ø specimens produced in accordance with 3.4.2 shall conform to the following requirements, determined in accordance with ASTM A 370. Conformance to the requirements of 3.6.1 shall be used as the basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.2 apply.

3.6.1 Separately-Cast Specimens:

3.6.1.1 Tensile Properties:

Tensile Strength, minimum	130,000 psi (896 MPa)
Yield Strength at 0.2% Offset, minimum	120,000 psi (827 MPa)
Elongation in 4D, minimum	8%
Reduction of Area, minimum	15%

3.6.2 Castings and Integrally-Cast Specimens:

3.6.2.1 Tensile Properties:

Tensile Strength, minimum	130,000 psi (896 MPa)
Yield Strength at 0.2% Offset, minimum	120,000 psi (827 MPa)
Elongation in 4D, minimum	6%
Reduction of Area, minimum	15%

3.6.2.1.1 When tensile properties other than those shown in 3.6.2.1 are required, Ø size, location, and number of specimens and required properties shall be as shown on the part drawing or as agreed upon by purchaser and vendor and may be defined as specified in AMS 2360.

3.6.2.2 Hardness: Should be not lower than 30 HRC, or equivalent, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.2.1 are met.

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 E 192 may be used to define radiographic acceptance standards.

3.7.5 Castings shall not be reworked 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 reworked 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 conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Except as specified in 4.2.1.1, tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed to represent each master heat or lot as applicable.

4.2.1.1 Ø Tensile properties of separately-cast specimens need not be determined when tensile properties of specimens cut from castings or from integrally-cast coupons are determined.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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 and Testing: Shall be in accordance with the following; the number Ø of specimens to be sampled shall be the minimum number of specimens tested. A lot shall be all castings of the same part number poured from a single master heat, homogenization, solution, and precipitation heat treated as a batch, and presented for vendor's inspection at one time.

4.3.1 At least one chemical analysis specimen in accordance with 3.4.1 from each master heat or a casting from each lot.

4.3.2 Three separately-cast tensile specimens in accordance with 3.4.2 from each lot except when properties of specimens machined from castings or from integrally-cast coupons are determined.

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

4.3.4 Ø One or more castings or two or more integrally-cast coupons from each lot when properties of specimens machined from castings are required. Size, location, and number of specimens machined from castings or from integrally-cast coupons shall be as specified on the drawing or as agreed upon by purchaser and vendor. When size, location, and number of specimens are not specified or integrally-cast coupons are not available, not less than two tensile specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting or castings from each lot.

4.4 Approval:

4.4.1 Sample castings from new or reworked master 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, separately for tensile specimens used for master heat qualification and for production of sample castings of each part number, parameters for the process control factors which will produce tensile specimens meeting master heat qualification requirements and acceptable castings; these shall constitute the approved casting procedure and shall be used for producing subsequent master heat qualification specimens and 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, test specimens, sample castings, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

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

Type of furnace and its capacity
Type and size of furnace charge
Time molten metal is in furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Number of ladles used in pour
Mold refractory formulation
Mold back-up material
Gating practices
Mold preheat and metal pouring temperatures; variations of ±25°F (±14°C) from established limits are permissible
Solidification and cooling procedures
Homogenization, solution, and precipitation heat treatment procedures
Cleaning operations
Methods of inspection