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NOTICE
OF VALIDATION

AMS 5380E
NOTICE 1
15 JULY 1993

SOCIETY OF AUTOMOTIVE ENGINEERS

AEROSPACE MATERIAL SPECIFICATION

ALLOY CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT 50.5Co – 26Cr – 1.5Ni – 6.0Mo AS CAST

AMS 5380E dated 1 January 1986 with Adoption Notice dated 1 August 1986 has been reviewed and determined to be valid for use in acquisition.

Custodians:
Army – MR
Navy – AS
Air Force – 11

Military Coordinating Activity:
Air Force – 11

AMSC N/A

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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 5380E

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Superseding AMS 5380D

ALLOY CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT
50.5Co - 26Cr - 15Ni - 6.0Mo
As Cast

UNS R30030

1. SCOPE:

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

1.2 Application: Primarily for small parts, such as turbine blades and vanes, requiring high strength up to 1500°F (815°C) and oxidation resistance up to 2000°F (1095°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications 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 2361 - Elevated Temperature Tensile Properties of Castings
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Castings

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

ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E192 - Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E354 - Chemical Analysis of High Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt 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 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 E354 or by spectrographic or other analytical methods approved by purchaser:

Ø

	min	max
Carbon	0.40 -	0.50
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	24.00 -	28.00
Nickel	14.00 -	16.00
Molybdenum	5.50 -	6.50
Iron	--	2.00
Cobalt	remainder	

3.2 Condition: As cast.

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 Unless prohibited by purchaser, metal from two or more master heats may be Ø 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 lb (6800 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 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 Specimens: Shall be cast from remelted metal from each master Ø 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 E8 with 0.250 in. (6.25 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. (6.25 mm) diameter. Center gating may be used. When permitted by purchaser, integrally-cast specimens may be used for evaluating acceptance of castings in lieu of separately-cast specimens. Type and location of integrally-cast specimens and properties for such specimens shall be as agreed upon by purchaser and vendor.

3.5 Properties: Castings and representative tensile specimens produced in accordance with 3.4.2 shall conform to the following requirements:

3.5.1 Separately-Cast Specimens:

3.5.1.1 Tensile Properties at 1500°F (815°C): Shall be as follows, determined in accordance with ASTM E21 on specimens heated to 1500°F ± 10 (815°C ± 5), held at heat for 10 - 20 min. before testing, and tested at 1500°F ± 10 (815°C ± 5) at a rate of 0.03 - 0.07 in./in. per min. (0.03 - 0.07 mm/mm per min.):

Tensile Strength, min	55,000 psi (380 MPa)
Elongation in 4D, min	10%

3.5.2 Castings:

3.5.2.1 Hardness: Shall be as follows, determined in accordance with ASTM E18:

3.5.2.1.1 As Cast: Not higher than 30 HRC, or equivalent.

3.5.2.1.2 After Heat Treatment: Not higher than 43 HRC, or equivalent after being heated to 1475°F ± 10 (800°C ± 5), holding at heat for 50 hr ± 1, and cooling to room temperature.

3.5.2.2 Tensile Properties: When specified on the drawing or when agreed upon by purchaser and vendor, tensile specimens as in 4.3.4 conforming to ASTM E8 shall be machined from a casting or castings selected at random from each master heat. Size, number and location of such specimens and required properties shall be as shown on the drawing or as agreed upon by purchaser and vendor. Property requirements may be defined as specified in AMS 2360 or AMS 2361.

3.6 Quality:

3.6.1 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.

3.6.1.1 Castings shall have smooth surfaces and shall be well cleaned. Metallic shot or grit shall not be used for final cleaning, unless otherwise permitted by purchaser.

3.6.2 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.

3.6.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645.

3.6.4 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.

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

3.6.5.1 Ø When permitted in writing by purchaser, defects in castings shall be removed and the castings repaired by welding in accordance with AMS 2694.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Ø 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 requirements for composition (3.1), elevated-temperature tensile properties of separately-cast specimens (3.5.1.1), as-cast hardness (3.5.2.1.1), quality (3.6) and, when specified, tensile properties of specimens cut from castings (3.5.1.2) are classified as acceptance tests and shall be performed on each master heat or lot as applicable.

4.2.1.1 Tensile properties of specimens cut from castings shall be determined only when specified by purchaser or when separately-cast specimens are not available. Tensile properties of separately-cast specimens need not be determined when such properties are determined on specimens cut from castings.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for hardness after heat treatment (3.5.2.1.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 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 material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

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; a lot shall be all castings of the same part number or configuration poured from the same master heat in a period of eight consecutive hours and presented for vendor's inspection at one time:

4.3.1 Two chemical analysis specimens 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 purchaser permits use of integrally-cast coupons.

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

4.3.4 One or more castings from each lot when properties of specimens machined from castings are required. Size, location, 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 specimens are not specified, 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. Ø

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 procedures 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: Ø

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 (±15°C) from established limits are permissible
Solidification and cooling procedures
Cleaning operations
Methods of inspection

4.4.2.1.1 Any of the above process control factors for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Reports:

4.5.1 The vendor of castings shall furnish with each shipment a report showing 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 and the results of tests on each master heat to determine conformance to the other acceptance test requirements and stating that the castings conform to the other technical requirements of this specification. When properties of specimens cut from castings are