



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5360C
Superseding AMS 5360B

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STEEL CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT
17Cr - 13Ni - 1.9Mo

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 parts for use at temperatures up to 1600° F (871° C). At elevated temperatures, strength of this steel is slightly higher than, and oxidation resistance is similar to, that of the 18-8 types.

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

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

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against infringement of patents."

- 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
Manganese	--	2.00
Silicon	--	0.75
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	16.00 - 18.00	
Nickel	12.00 - 14.00	
Molybdenum	1.50 - 2.25	
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. 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 specimens conforming to 3.4.1. 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.

- 3.5 Heat Treatment: Castings shall be solution heat treated by heating to a temperature within the range 1925° - 1975° F (1051.7° - 1079.4° C), holding at the selected temperature within +25° F (+14° C) for not less than 30 min., and cooling rapidly in air or quenching in oil or water.

- 3.6 Properties of Castings:

- 3.6.1 Hardness: Shall be not higher than 185 HB or equivalent, determined in accordance with ASTM A370.

- 3.6.2 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 in the shipment. 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.

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
Ø 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 fluorescent penetrant inspection in accordance with
Ø AMS 2645.
- 3.7.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by
Ø purchaser and vendor.
- 3.7.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written
Ø 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 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
Ø 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: Tests to determine conformance to all technical requirements of this
Ø specification are classified as acceptance or routine control tests.
- 4.2.1 For direct U.S. Military procurement, qualification test material and supporting test data
Ø shall be submitted to the cognizant qualification agency as directed by the request for procurement, the procuring activity, or the contracting officer.
- 4.3 Sampling: Shall be as follows:
- 4.3.1 Two chemical analysis specimens in accordance with 3.4.1 and/or a casting from each master
Ø heat.
- Ø 4.3.2 Two preproduction castings in accordance with 4.4.1 of each part number.
- 4.3.3 One casting from each master heat when properties of specimens machined from castings are
Ø required.
- 4.4 Approval:

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

4.4.2 Vendor shall establish for production of sample castings of each part number the control factors
Ø 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 castings. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.

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

- Ø 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 $+25^{\circ}\text{F}$ ($+14^{\circ}\text{C}$) from established limits are 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
Ø assigned 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
Ø 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 a statement that the castings have been solution heat treated in accordance with the requirements of this specification. When properties of test specimens cut from castings are specified, the report shall include the results of tests to determine conformance to such requirements. 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.

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 master heat 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.