AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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New York City

AMS 4220B

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ALUMINUM ALLOY CASTINGS, SAND
4 Cu 2 Ni 1.5 Mg .2 Cr (A142-T75)
Solution Treated and Overaged

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for air-cooled cylinder heads.

3. COMPOSITION:

Copper	3.7 - 4.5
Nickel	1.8 - 2.3
Magnesium	1.2 - 1.7
Chromium	0.15 - 0.25
Titanium	0.07 - 0.18
Iron	0.80 max
Silicon	0.60 max
Manganese	0.10 max
Zinc	0.10 max
Other Impurities, each	0.05 max
Other Impurities, total	0.15 max
Aluminum	remainder

4. CONDITION: Solution heat treated and overaged.

5. TECHNICAL REQUIREMENTS: (a) Casting.- (1) All metal which is melted for castings shall be ingot conforming in composition to Section 3 above; gates, risers and rejected castings may be used but shall first be converted into such ingot. Furnace or ladle additions of small amounts of grain refining elements or alloys are permissible.

(2) A melt shall be the metal withdrawn from a batch furnace charge of 2000 pounds or less as melted for pouring castings, or when permitted by the purchaser, a melt shall be 3000 pounds or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

(3) During melting, the metal shall be heated to not over 1450 F. The metal being poured into the mold shall not exceed a temperature of 1420 F. Written permission shall be obtained from the purchaser by letter or by notation on the drawing before deviating from the requirements of this paragraph.

(b) Test Specimens.- Unless otherwise specified, tensile test specimens, and chemical analysis specimens when required, shall be cast with each melt of metal for castings and, when requested, shall be supplied with the castings:

(1) Tensile Test Specimens.- Shall be standard (0.5 inch diameter at the reduced parallel section) and shall be cast to size in molds made with the regular foundry mix of green sand, without using chills. Metal for the specimens shall be part of the melt which is used for the castings. If the metal for

castings is given any treatment, such as fluxing or cooling and reheating, the metal for the specimens shall be a portion of the metal so treated, and during such treatment shall be heated to the same maximum temperature and held for approximately the same length of time as the molten metal for castings. The temperature of the metal during pouring of the specimens shall be not lower than the temperature of the metal during pouring of castings.

(2) Chemical Analysis Specimens.- When required by purchaser, shall be of size and shape as agreed between purchaser and vendor.

(c) Heat Treatment.- All castings and tensile test specimens representing them shall be heat treated as follows:

(1) Tensile test specimens from each melt, together with production castings, shall be heated to 960 - 970 F, held at heat for not less than 6 hours and cooled in air. At least one set of tensile test specimens shall be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than 3 hours.

(2) Tensile test specimens from each melt, together with production castings, shall, after solution treatment as in paragraph 5(c)(1), be heated uniformly to approximately 550 F, but to not lower than 500 F, held at heat for not less than 2 hours and cooled in air. At least one set of tensile test specimens shall be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than 3 hours.

(d) Physical Properties.- (1) Unless otherwise specified, tensile test specimens produced in accordance with paragraphs 5(b) and 5(c) shall conform to the following requirements:

Tensile Strength, psi	29,000 min
Elongation, % in 2 in.	1 min

(2) Hardness of castings, except at sprues and risers, shall be Brinell 70-85 using 500 kg load and 10 mm ball or 1000 kg load and 9/16 inch ball, or Brinell 75-90 using 1000 kg load and 10 mm ball.

(3) If castings are cut for examination, not less than two specimens taken from thick sections of castings shall be tested. Average hardness of such specimens shall be as specified in paragraph 5(d)(2) above. Average physical properties shall conform to the following requirements:

Tensile Strength, psi	20,000 min

Conformance to these requirements may be used as basis for acceptance of castings.

(4) Hardness of cylinder heads after assembling to cylinder barrels shall be Brinell 60-75 using 500 kg load and 10 mm ball or 1000 kg load and 9/16 inch ball, or Brinell 65-80 using 1000 kg load and 10 mm ball. This Brinell test shall be made at the spot indicated on the drawing.

6. QUALITY: (a) Castings shall be uniform in quality and condition, sound and free from foreign materials and from internal and external defects detrimental to fabrication or to performance of parts. Castings in which defects are revealed during fabrication will be subject to rejection. Castings shall have smooth surfaces and shall be well cleaned.

(b) Surfaces of the fracture in broken castings shall show essentially uniform color and shall indicate that the castings are substantially free from oxides and other defects.

(c) Cylinder head fins shall show some ductility when being fractured; surfaces of the fracture shall show a fine structure. Cylinder head castings having brittle, coarse grained fins shall be rejected.

(d) Castings shall not be repaired by plugging, welding, or other methods without written permission from the purchaser, but imperfect cylinder head fins may be accepted to the extent of 1/2% of the total fin surface according to the following:

(1) Defective areas shall be smoothly blended without sharp corners.

(2) After blending, the depth of the remaining portion of any fin shall be not less than 50% of the nominal depth of that fin.

(3) Not more than 25% of the allowable imperfect fin surfaces shall be within any one area of 4 sq in. of the head.

(e) Castings shall not be impregnated, chemically treated, or coated to prevent leaking, unless specified or allowed by written permission which states the method to be used. Impregnated castings shall be marked IMP.

7. REPORTS: (a) Unless otherwise specified, the vendor of castings shall furnish with each shipment three copies of a notarized report showing the results of tests to determine conformance of the castings to the requirements of this specification. This report shall show the chemical composition of the castings, physical properties of the tensile test specimens, melt numbers, material specification number, purchase order number, part number and quantity. If the accuracy of control is adequate, each melt need not be analyzed, but the frequency of analysis shall be as agreed between purchaser and vendor.

(b) Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a notarized report showing the purchase order number, material specification number, 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 each shipment or melt of castings to determine conformance to the requirements of this specification, and shall include in the report a certification that the castings conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

8. IDENTIFICATION: Unless otherwise specified, castings shall be identified in accordance with the latest issue of AMS 2804.

9. APPROVAL: (a) Unless otherwise ordered, sample castings from new or reworked patterns shall be approved by purchaser before production castings are supplied.