Society of Automotive Engineers, Inc.
485 LEXINGTON AVENUE, NEW YORK, N.Y. 10017

AEROSPACE MATERIAL SPECIFICATION

AMS4445C
Superseding AMS 4445B
Issued 1-15-57
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MAGNESIUM ALLOY CASTINGS, SAND
3.3Th - 0.75Zr (HK31A-T6)

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 parts operating at 350 - 600 F (177 - 316 C).

3. COMPOSITION: Castings shall conform to the following:

	min	max
Thorium	2.5	4.0
Zirconium, total	0.50	1.0
Zirconium, soluble (1)	0.50	--
Zinc	--	0.30
Copper (1)	--	0.10
Nickel (1)	--	0.01
Other Impurities, total	--	0.20
Magnesium	remainder	

(1) Determination not required for routine acceptance.

3.1 Soluble zirconium is that portion of the zirconium which is soluble in 1:4 hydrochloric acid held below its boiling point.

4. CONDITION: Solution and precipitation heat treated.

5. TECHNICAL REQUIREMENTS:

5.1 Casting: Castings shall be produced in lots from metal conforming to Section 3. Metal remelted from previously analyzed ingot may be poured directly into castings. Furnace or ladle additions of grain refining elements are permissible. Unless otherwise agreed upon by purchaser and vendor, molten metal taken from alloying furnaces, with or without additions of foundry operating scrap (gates, sprues, risers, and rejected castings), shall not be poured into castings unless first converted to ingot, analyzed, and remelted or until the composition of a sample taken after the last addition to the melt has been found to conform to Section 3.

5.1.1 A melt shall be the metal withdrawn from a batch furnace charge of 2000 lb or less as melted for pouring castings, or, when permitted by the purchaser, a melt shall be 4000 lb or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

5.1.2 A lot shall consist of castings poured from a single melt in not more than 8 consecutive hours.

5.2 Cast Test Specimens: Tensile test specimens, and chemical analysis specimens when required, shall be supplied with the castings.

5.2.1 Tensile Test Specimen: Shall be cast with each lot of castings, shall be standard (0.5 in. 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 and shall be subjected to the same grain-refining or alloying treatment given the metal for the castings.

5.2.2 Chemical Analysis Specimens: When required by purchaser, shall be cast from each melt and shall be of size and shape agreed upon by purchaser and vendor.

5.3 Heat Treatment: All castings and tensile test specimens shall be heat treated as follows:

5.3.1 Tensile test specimens from each lot, together with production castings, shall be solution heat treated by heating to 1050 F ± 10 (565.6 C ± 5.6), holding at heat for not less than 2 hr, and air cooling. 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.

5.3.2 Tensile test specimens from each lot, together with production castings, shall, after solution heat treatment as in 5.3.1, be precipitation heat treated by heating to 400 F ± 10 (204.4 C ± 5.6), holding at heat for not less than 16 hr, and air cooling. 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.

5.4 Tensile Properties:

5.4.1 Cast Tensile Test Specimens:

Tensile Strength, psi	27,000 min
Yield Strength at 0.2% Offset or at 0.0080 in. in 2 in. Extension Under Load (E = 6,500,000), psi	13,000 min
Elongation, % in 2 in.	4 min

5.4.2 Specimens Cut from Castings:

5.4.2.1 When tensile properties of actual castings are determined for acceptance, not less than 4, and preferably 10, tensile test specimens shall be cut from thick and thin sections. The average value of all specimens selected shall conform to the following:

Tensile Strength psi	23,000 min
Yield Strength at 0.2% Offset or at 0.0076 in. in 2 in. Extension Under Load (E = 6,500,000), psi	11,700 min
Elongation, % in 2 in. or 4D	2 min

5.4.2.1.1 Any specimen cut from a casting shall conform to the following:

Tensile Strength, psi	19,000 min
Yield Strength at 0.2% Offset or at 0.0072 in. in 2 in. Extension Under Load (E = 6,500,000), psi	10,500 min

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

5.4.2.3 When specified on the order, tensile test specimens taken in locations indicated on the drawing, from a casting chosen at random to represent the lot, shall have the properties indicated on the drawing for each specimen.

5.4.3 Tensile Properties at 600 F (315.6 C): Material shall be capable of meeting the following requirements as applicable to the type of specimen tested. Tensile test specimens shall be heated to 600 F ± 5 (315.6 C ± 2.8), held at 600 F ± 5 (315.6 C ± 2.8) for 10 min. before testing, and tested at 600 F ± 5 (315.6 C ± 2.8) at a rate not greater than 0.05 in. per in. per min. up to the yield strength and at a rate of 0.11 - 0.14 in. per in. per min. above the yield strength.

Test Specimen	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min
Separately Cast	19,000	12,000
Cut from Casting	13,000	9,500

5.4.4 When a dispute occurs between purchaser and vendor over the yield strength values, yield strength determined by the offset method shall apply.

5.5 Hardness of Castings: Except at sprues and risers, castings shall have hardness of Brinell 45 - 70 using 500 kg load and 10 mm ball or 1000 kg load and 9/16 in. ball, or Brinell 50 - 75 using 1000 kg load and 10 mm ball.

6. QUALITY:

6.1 Castings shall be uniform in quality and condition, sound, and free from internal and external imperfections detrimental to fabrication or to performance of parts. Unless otherwise permitted by purchaser, Ø castings cleaned by blasting shall be pickled in a sulfuric or sulfuric-nitric acid solution to remove not less than 0.002 in. of metal before treatment as in Section 9.

6.2 Radiographic and other quality standards shall be as agreed upon by purchaser and vendor.

6.3 Unless otherwise specified, castings shall be produced under radiographic control. This shall consist of radiographic examination of castings 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.

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

6.5 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:

7.1 Unless otherwise specified, the vendor of castings shall furnish with each shipment three copies of a report of the results of tensile tests on test specimens from each lot and a statement that the chemical composition of the castings conforms to the requirements of this specification. This report shall include the purchase order number, lot number, material specification number and its revision letter, part number, and quantity.

7.2 Unless otherwise specified, 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 each shipment or lot of castings 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.

8. IDENTIFICATION: Unless otherwise specified, castings shall be identified in accordance with the latest issue of AMS 2804, including the lot number and heat treatment batch number.

9. PROTECTIVE TREATMENT: Prior to shipment, the product shall be oiled with a light corrosion-inhibiting oil or chrome pickled. Unless otherwise ordered, the product shall be chrome pickled.