

MAGNESIUM ALLOY SHEET AND PLATE  
3.2Th - 0.70Zr (HK31A-0)  
Annealed Recrystallized

UNS M13310

1. SCOPE:

- 1.1 Form: This specification covers a magnesium alloy in the form of sheet and plate.
- 1.2 Application: Primarily for parts requiring good weldability and formability.
- 1.3 Precautions: Product covered by this specification is radioactive. All applicable rules and regulations, including those of the Nuclear Regulatory Agency, pertaining to the handling of radioactive material and all licensing provisions for use of such material should be observed.

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 2202 - Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate  
AMS 2350 - Standards and Test Methods  
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum-Base and Magnesium-Base Alloys, Wrought Products (Except Forgings and Forging Stock) and Flash Welded Rings

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

ASTM E9 - Compression Testing of Metallic Materials at Room Temperature

- 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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## 2.3.1 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

## 3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight,  $\phi$  determined in accordance with AMS 2355:

	min	max
Thorium	2.5	4.0
Zirconium	0.45	1.0
Other Impurities, each	--	0.10
Other Impurities, total	--	0.30
Magnesium		remainder

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Product 0.500 In. (12.50 mm) and Under in Nominal Thickness: Annealed recrystallized and pickled.

3.2.2 Product Over 0.500 In. (12.50 mm) in Nominal Thickness: Annealed recrystallized.

3.3 Properties: The product shall conform to the following requirements; tensile and bend testing shall be performed in accordance with AMS 2355:

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.1.

TABLE I

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
0.016 to 0.250, incl	30,000	18,000	12
Over 0.250 to 0.500, incl	30,000	16,000	12
Over 0.500 to 1.000, incl	30,000	15,000	12
Over 1.000 to 3.000, incl	29,000	14,000	12

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
0.40 to 6.25, incl	205	125	12
Over 6.25 to 12.50, incl	205	110	12
Over 12.50 to 25.00, incl	205	105	12
Over 25.00 to 75.00, incl	200	95	12

3.3.1.1 Tensile property requirements for product under 0.016 in. (0.40 mm) or over 3.000 in. (75.00 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.2 Compressive Properties: Shall be as specified in Table II and 3.3.2.1, determined in accordance with ASTM E9 on specimens taken in the longitudinal direction.

TABLE II

Nominal Thickness Inches	Yield Strength at 0.2% Offset psi, min
0.063 to 0.250, incl	12,000
Over 0.250 to 3.000, incl	10,000

TABLE II (SI)

Nominal Thickness Millimetres	Yield Strength at 0.2% Offset MPa, min
1.60 to 6.25, incl	85
Over 6.25 to 75.00, incl	70

3.3.2.1 Compressive property requirements for product under 0.063 in. (1.60 mm) or over 3.000 in. (75.00 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.3 Bending: Specimens as in 4.3.1 from product 0.016 to 0.125 in. (0.40 to 3.12 mm), incl, in nominal thickness shall withstand, without evidence of cracking when examined at 20X magnification, bending at room temperature through an angle of 90 deg around a diameter equal to the bend factor times the nominal thickness of the product, using either V-block, U-channel, or free bend procedure, with axis of bend perpendicular to the direction of rolling. Only one of these tests will be required in routine

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## 3.3.3 (Continued):

inspection. In case of dispute, results of bend tests using the V-block procedure shall govern:

Nominal Thickness		Bend Factor
Inch	Millimetres	
0.016 to 0.063, incl	0.40 to 1.60, incl	8
Over 0.063 to 0.082, incl	Over 1.60 to 2.05, incl	10
Over 0.082 to 0.125, incl	Over 2.05 to 3.12, incl	12

3.3.3.1 Bending requirements for product under 0.016 in. (0.40 mm) or over 0.125 in. (3.12 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from segregation and foreign materials and from imperfections detrimental to usage of the product.

3.4.1 Limits for imperfections shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2202.

## 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product 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 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.3 Sampling: Shall be in accordance with AMS 2355 and the following:

4.3.1 Specimens for bend testing shall be approximately 1 in. (25 mm) wide and 4 in. (100 mm) long, with the edges smooth and free from rough, sheared surfaces.

## 4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report stating that the product conforms to the chemical composition and other technical requirements of this specification. The report shall include the purchase order number, AMS 4384F, lot number, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4384F, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification and shall include in the report either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each sheet and plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4384 or applicable Military specification designation, inspection lot number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be sufficiently stable to withstand normal handling. The markings shall have no deleterious effect on the product or its performance.

5.1.1 Flat Sheet and Plate Under 6 In. (150 mm) Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm). The inspection lot number may appear in the row marking or may appear at only one location on each piece.

5.1.2 Flat Sheet and Plate 0.375 In. (9.50 mm) and Under Thick, 6 - 60 In. (150 - 1500 mm), Incl, Wide, and 36 - 200 In. (900 - 5000 mm), Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm), the rows being spaced approximately 6 in. (150 mm) on centers across the width and staggered. Every third row shall show the manufacturer's identification and nominal thickness. The other rows shall show the alloy number and temper and AMS 4384 or applicable Military specification designation. The inspection lot number may be included in the rows with the alloy, temper, and specification designation or may appear at only one location on each piece.

5.1.3 Flat Sheet and Plate Over 0.375 In. (9.50 mm) Thick, or Over 60 In. (1500 mm) Wide, or Over 200 In. (5000 mm) Long: Shall be marked as in 5.1.2 or, at vendor's discretion, shall be marked in one or two rows of characters recurring at intervals not greater than 3 ft (900 mm) and running around the periphery of the piece. If one row is used, it shall show all information of 5.1 except that the inspection lot number may be omitted. If two rows are used, one row shall show the alloy and temper and AMS 4384 or applicable Military specification designations; the second row shall show the manufacturer's identification and nominal thickness. The inspection lot number may be included in the line with the manufacturer's identification and nominal thickness or may appear at only one location on each piece.