



Satellite & Space



UAV



Defense



Vibration Test Equipment



Aerospace



Electrochem Battery Applications



WHY USE MAGNESIUM

- **Lightweight:** With a density of only 1.74 g/cm³, magnesium is the lightest structural metal, weighing in at 33% lighter than aluminum (2.7 g/cm³) and 60% lighter than titanium (4.51 g/cm³).
- **Machinability:** Free machining even while dry, machining magnesium requires less power, causes reduced tool wear, and allows for greatly improved machining speeds over other metals.
- **Formability:** Superior plasticity at only 300°C, allowing for less spring-back and greater draw depths.
- **Heat Resistance :** Modern alloys can operate in demanding, high temperature environments.
- **Dent Resistance:** Superior to aluminium sheet when used in automotive panels, cell phones, laptops, and camera cases.
- **Corrosion Resistance:** In normal atmospheres, the corrosion rate of uncoated magnesium is lower than iron or steel. In severe environments, superior coating and finishing systems prevent galvanic corrosion of components.
- **Safety:** Nontoxic and has very limited flammability in bulk form due to its excellent heat dissipation.
- **Environment Friendly:** Abundant, the third greatest ion concentration found in seawater, and endlessly recyclable at 5% of the initial refinement energy without degradation of its properties.



ALUMINIUM VS MAGNESIUM



AL 6061

- Magnesium 0.8 – 1.2%
- Silicon 0.4 – 0.8%
- Copper 0.15 – 0.40%
- Aluminium Balance

AZ31B

- Aluminium 2.5 – 3.5%
- Zinc 0.7 – 1.3%
- Manganese 0.2 – 1.0%
- Magnesium Balance

Elektron 43

- Yttrium 3.7 – 4.3%
- Rare Earths 2.5 – 3.5%
- Zirconium 0.2% min
- Magnesium Balance

Physical Properties

Density	0.098 lbs/in ³ (2.70 g/cm ³)	0.064 lbs/in ³ (1.78 g/cm ³)	0.068 lbs/in ³ (1.83 g/cm ³)
Coefficient of Thermal Expansion	12.5x10 ⁻⁶ °F (68.37x10 ⁻⁶ K)	4.9 x 10 ⁻⁶ °F (26.8 x 10 ⁻⁶ K)	4.7 x 10 ⁻⁶ °F (25.6 x 10 ⁻⁶ K)
Specific Heat	0.22 Btu/lb/°F (915.2 J/kg/K)	0.25 Btu/lb/°F (1040 J/kg/K)	0.24 Btu/lb/°F (993 J/kg/K)
Thermal Conductivity	83 Btu/hr/ft ² /°F (143.4 W/m ² /K)	44.5 Btu/hr/ft ² /°F (76.9 W/m ² /K)	33.3 Btu/hr/ft ² /°F (57.6 W/m ² /K)
Melting Range	1080-1205°F (582 - 652°C)	1050°F -1170°F (566° - 632°C)	1004-1184° F (540 - 640° C)
Modulus of Elasticity	68.9 GPa	44 GPa	44 GPa
Poissons Ratio	0.33	0.35	0.295
Fracture Elongation	10%	8%	12%
Tensile Yield Strength	36ksi	22ksi	33ksi

AZ31B MAGNESIUM SHEET, PLATE & COIL

AZ31B BENEFITS

Lightweight:

33% lighter than aluminum
75% lighter than steel

Easy machining

40% faster than Al 6061
96% faster than Al 7075

Longer tool life

5 to 10 times longer tool life
when compared to aluminum

Excellent damping properties

AZ31B APPLICATIONS

- Aerospace/rotorcraft
- Space/satellites
- Defense
- Automotive/motor sport
- Computer/cell phone/camera housing
- Electrical housing
- Medical equipment
- Orthopedic braces
- Robotics



MACHINING

Magnesium machines faster than any other known metal. Machining magnesium is limited only to the speed of the cutting tool. Studies have shown that magnesium machines 40% faster than 6000 series aluminum and up to 96% faster than 7000 series aluminium, employing the use of large feed rates and greater depths of cut. Machining magnesium uses 55% less power than what is required to machine aluminium and behaves like wood with well broken chips that do not accumulate on the tooling.

Extremely fine and smooth surfaces can be achieved and 5 to 10 times longer tool life can be expected.

SURFACE TREATMENT

Surface protection of AZ31B depends on the operating conditions it needs to with stand during service. In dry conditions, with limited exposure to moisture, AZ31B can be left bare or lightly oiled. A protective coating solution should be given to applications in more demanding environments. AZ31B can be protected by a variety of coatings, including chromating, anodizing, plating, e-coat, paint, and plasma electrolytic oxidation (PEO). It is recommended to prepare the magnesium by cleaning and pre-treating (conversion coating) the surface using traditional non-ferrous methods prior e-coat or paint. Non-chromate pretreatments are commercially available and improve the adhesion of the paint system. For further guidance on surface protection. For further guidance on surface protection, contact Vulcan Metals Specialty Products.



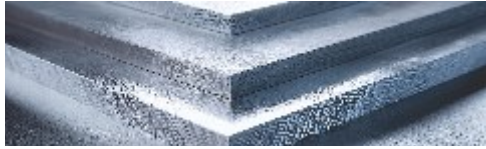
WELDABILITY

AZ31B has excellent weldability with gas shielded arc using AZ61A (preferred) or AZ92A filler rod. Post weld stress relief is recommended to prevent stress corrosion cracking. AZ31B sheet and plate can also be friction stir welded.

AZ31B MAGNESIUM SHEET, PLATE & COIL

CHEMICAL COMPOSITION

Aluminum	2.5 - 3.5%
Zinc	0.7 - 1.3%
Manganese	0.20 - 1.0%
Magnesium	Balance



PHYSICAL PROPERTIES

Specific gravity	0.064 lb/in ³ (1.78g/cm ³)
Coefficient of thermal expansion	4.9 x 10 ⁶ F (26.8 x 10 ⁻⁶ K)
Specific heat capacity	0.25 Btu/lb ³ /°F (1040 J/kg/K)
Thermal conductivity	44.5 Btu/hr/ft/°F (76.9 W/m/K)
Modulus of elasticity	6500 ksi (44 GPa)
Poissons ratio	0.35
Melting range	1050°F - 1170°F (566°-632°C)

MECHANICAL PROPERTIES

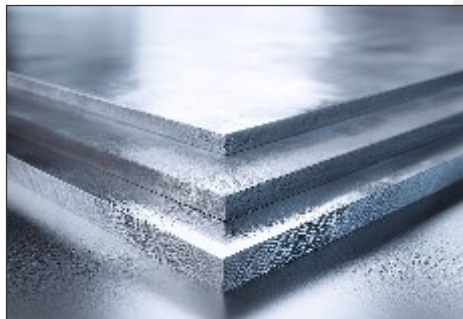
Gauge, inches (mm)	Temper	Tensile Strength, ksi (MPa)	Yield Strength, ksi (MPa)	Elongation
0.040 - .050" (1 - 1.51)	-0	32 (221)	18 (124)	12%
0.060 - 0.49" (1.52 - 12.6)	-0	32 (221)	15 (103)	12%
0.5 - 1.99" (12.7 - 50.8)	-0	32 (221)	15 (103)	10%
2" - 3" (50.8 - 76.2)	-0	32 (221)	15 (103)	9%
0.040 - 0.249" (1 - 6.32)	-H24	39 (269)	29 (200)	6%
0.25 - 0.374" (6.32 - 9.5)	-H24	38 (262)	26 (179)	8%
0.375 - 0.5" (9.5 - 12.7)	-H24	37 (255)	24 (165)	8%
0.5 - 1" (12.7 - 25.4)	-H24	36 (248)	22 (152)	8%
1 - 2" (25.4 - 50.8)	-H24	34 (234)	20 (138)	8%
2 - 3" (50.8 - 76.2)	-H24	34 (234)	18 (124)	8%

HEAVY GAUGE ROLLED PLATE



Sizes:	0.25" (6.35 mm) - 10" (254 mm) thick
Maximum Width:	72" (1828 mm)
Maximum Length:	240" (6100 mm)

THIN GAUGE SHEET/PLATE



Sizes:	0.249" (6.35 mm) - 0.040" (1 mm)
Maximum Width:	60" (1524 mm)
Maximum Length:	240" (6100 mm)

Coil is also available in these gauges.

ULTRA THIN GAUGE SHEET



Sizes:	0.010" (0.25 mm) - 0.038" (0.81 mm)
Maximum Width:	10" (254 mm)

Coil is also available in these gauges.

AZ31B meets these specifications: AMS 4377, AMS 4375, AMS 4382 and ASTM B90
Domestically Made / DFARS Compliant / RDHS Compliant / Frank Dodd Act Compliant

ELEKTRON 43 PLATES

ELEKTRON 43 BENEFITS

Flame Resistant

Non-burning
Lightweight

33% lighter than aluminum

75% lighter than steel

High Strength Creep Resistant

Free machining

40% faster than Al 6061
96% faster than Al 7075

ELEKTRON 43 APPLICATIONS

- Aerospace / aircraft
- Defense
- Motorsport / automotive
- Space / satellites
- Electrical housing
- High-performance equipment
- Lightweighting



SURFACE TREATMENT

The surface protection of Elektron 43 is dependent on the service conditions where the material will be operating. In dry conditions, with limited exposure to moisture, Elektron 43 can be left bare or lightly oiled. A protective coating solution should be given to application in more demanding environments. Elektron 43 can be protected by a variety of coatings that include chromating, anodizing, plating, e-coat, paint, and plasma electrolytic oxidation (PEO). It is recommended to prepare the magnesium surface by cleaning and pre-treatment (conversion coating) using traditional non-ferrous methods prior to paint. There are commercially available non-chromate pre-treatments that result in good adhesion of the paint system. For further guidance on surface protection, contact Vulcan Metals Specialty Products.



Elektron 43 meets these specifications: AMS 4378; ASTM B107
Domestically Made | DFARS Compliant | RDHS Compliant

MINIMUM TENSILE PROPERTIES

INCH/POUND UNITS

Nominal Thickness inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
1.00 to 1.50 incl.	44	33	12
Over 1.50 to 6.0 incl.	47	30	6

MINIMUM TENSILE PROPERTIES

SI UNITS

Nominal Thickness, inches	Tensile Strength, ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D, %
25.4 to 38.1 incl.	303	228	12
Over 38.1 to 152.4 incl.	324	207	6

CHEMICAL COMPOSITION

Yttrium	3.7 - 4.3%
Rare Earths	2.3 - 3.5%
Zirconium	0.2% min
Magnesium	Balance

PHYSICAL PROPERTIES

Specific gravity	1.83
Coefficient of thermal expansion	$2.56 \times 10^{-6} \text{K}^{-1}$
Specific heat capacity	$993 \text{ J kg}^{-1} \text{K}^{-1}$
Thermal conductivity	$57.6 \text{ W m}^{-1} \text{K}^{-1}$
Modulus of elasticity	44 GPa
Poissons ratio	0.295
Melting range	540°C - 640°C

MACHINING

Magnesium machines faster than most metals, only limited to the speed of the cutting tool. Studies have shown that magnesium machines 40% faster than 6000 series aluminium and up to 96% faster than 7000 series aluminium, employing the use of large feed rates and greater depths of cut. Machining magnesium uses 55% less power than what is required to machine aluminium.

Magnesium machines like wood with well broken chips that do not accumulate on tooling. Extremely fine and smooth surfaces can be achieved and 5 to 10 times longer tool life can be expected.



FLAME RESISTANT

Elektron 43 is a flame-resistant alloy. It meets the flammability requirements set out in the FAA's Aircraft Materials Fire Test Handbook DOT/FAA/AR-00/12 for commercial aircraft. The unique alloy content of Elektron 43 provides it with an aluminum-like flammability resistance when in bulk form.

This flame resistance is the result of a robust, protective surface oxide that forms, making E43 the alloy of choice for applications requiring both lightweight and high strength in demanding environments.

MAGNESIUM PLATE FOR VIBRATION TEST FIXTURES

TOOLING PLATE BENEFITS

Lightweight

- 33% lighter than aluminum
- 75% lighter than steel
- High damping properties

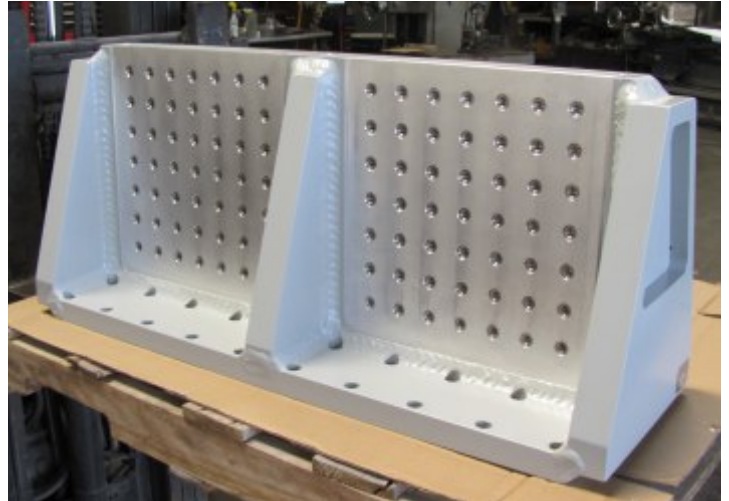
Easy machining

- 40% faster than Al 6061
- 96% faster than Al 7075

Longer tool life

- 5 to 10 times longer tool life when compared to aluminum

Flat, stable and stress free. Good damping Properties



DAMPING CAPACITY OF MAGNESIUM



Damping capacity is a measure of a material's ability to dissipate elastic strain energy during mechanical vibration or wave propagation. When ranked according to damping capacity, materials may be roughly categorized as either high or low damping. Low damping materials may be utilized in musical instruments where sustained vibration and acoustic wave propagation is desired.

Conversely, high damping materials are excellent for suppressing vibration which is critical for control of noise, stability of sensitive systems and instruments, and for reducing machine fatigue wear. Fatigue wear is often caused by the momentum of swinging or moving components and is worsened by heavy components.

PROPERTIES OF MAGNESIUM ALLOYS AZ31B- TOOLING PLATE

AZ31B-TP has a density of 0.064 lbs/inch³ (1.78g/cm³) which is 30% lower than aluminium alloys.

The low density and high damping capacity make AZ31B-TP the material of choice for vibration test fixtures. Fixtures fabricated from AZ31B-TP exhibit higher resonant frequencies relative to equivalent aluminium structures. This allows testing to be carried out at higher frequencies and shorter test times, reducing testing costs. The low density of the tooling plate leads to fixtures with lower weight. The reduced mass of a magnesium fixture increases the overall envelope of operation of any given vibration test bed. This allows multiple parts to be run in the same test, greatly reducing the overall cost.

AZ31B-TP is weldable and dimensionally stable, allowing for the fabrication of complex fixtures.



VIBRATION TESTING

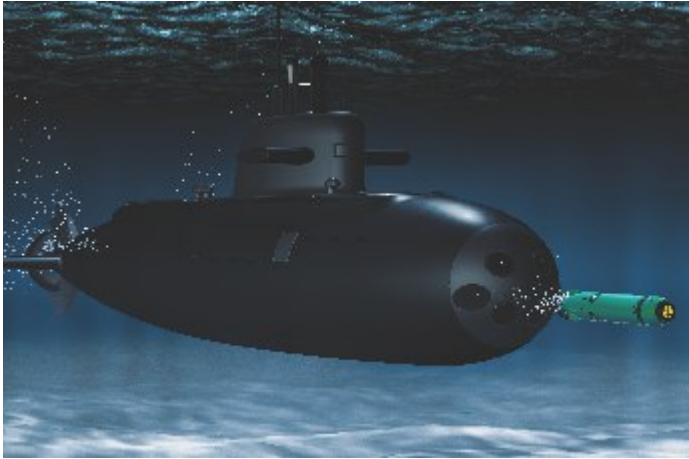


Two key components of vibration testing are the machine table and the fixture that supports the part. Both need to be stiff, strong, lightweight, and have good damping characteristics to reduce resonance. Its combined physical and mechanical properties make Magnesium AZ31B-Tool Plate an ideal choice for vibration testing components.

SPECIFIC DAMPING CAPACITY

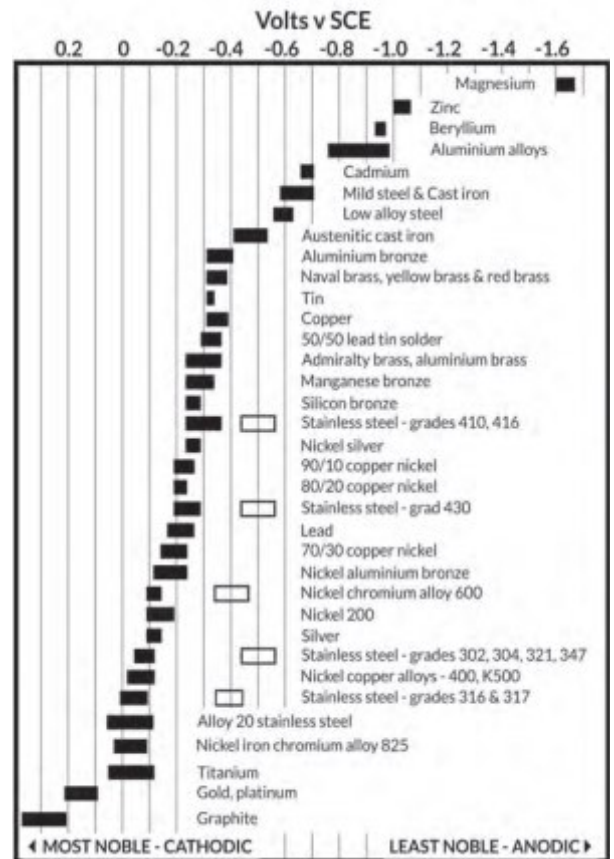
Aa6061 - T6, Zn, Ti	1.50%
Cast Irons, Ni alloys	2.50%
Pure Al, Cu	3.50%
Steel	4%
Mg Alloy - AZ31B - F	10%

ELECTROCHEMICAL BATTERY STRIP



Magnesium seawater batteries are one example of magnesium's potential in energy applications. These electrochemical batteries use voltaic cells that contain a magnesium anode and a non-magnesium cathode and use seawater as their shared electrolyte. Seawater batteries are ideal for use in maritime and emergency response environments as a lightweight, low cost, environmentally friendly, low maintenance, long storage life alternative to other batteries, such as reactive, high maintenance lithium batteries, in part because they are not activated until they are deployed in seawater.

Lightweight, low cost, safe, highly anodic, and environmentally friendly magnesium is an attractive choice for battery anode applications. Magnesium is naturally anodic compared to other transition metals. The greater distance between the potentials of the anode and cathode determine the possible voltage. Magnesium's potential can be seen in the chart on the right. Alloying elements, such as those used in AZ31B and AZ61A, further improve magnesium's mechanical and electrochemical properties



MAGNESIUM IN SEA WATER APPLICATIONS



Electric motor torpedoes



Submarines



Sonobuoys



Emergency lighting on lifeboats and life vests



Field rechargers



Emergency power



Weather measuring equipment

BENEFITS OF MAGNESIUM IN BATTERIES

- Naturally Environmentally Friendly
- Low Cost & Abundant
- High Energy Density
- Safe Alternative to Lithium-Based Batteries



UAV (Drones & Unmanned Systems)



In UAV design, every gram matters. Allows for the design of lighter structures than aluminum while retaining the stiffness and structural integrity required by the application—improving endurance.

WHY MAGNESIUM FOR UAV PLATFORMS

- High strength-to-weight ratio
- Reduced total mass = longer flight time
- Improved payload capacity without increasing size
- Excellent machinability for precision lightweight parts
- Better vibration suppression vs heavier metals for sensitive payloads

VULCAN MAGNESIUM ALLOYS FOR UAV

- AZ31B a versatile wrought alloy with excellent formability and machinability for airframe structures, housings, and brackets
- Elektron® 43 a high-performance alloy offering increased and improved performance in harsh, corrosive, and elevated temperature environments, ideal for mission-critical UAV systems



TYPICAL UAV APPLICATIONS

- Airframe panels
- Structural brackets
- Payload housings
- Electronics enclosures

- Gimbal mounts
- Sensor structures
- Battery trays
- Lightweight fixtures

- Flight control housings
- Navigation system structures
- Thermal management components
- EMI shielding enclosures

GEOLOGICAL SURVEY CALIBRATION BLOCKS



As a trusted supplier of advanced magnesium solutions, Vulcan Specialty Metal Products partners with world-class alloy developers to deliver precision materials for the most demanding industries. Through our close collaboration with Magnesium Elektron, Vulcan provides highly functional magnesium alloys engineered for accuracy, repeatability, and long-term performance in critical measurement applications.

Vulcan supplies AZ31B Magnesium Calibration Blocks that have a proven legacy in the Oil & Gas industry, supporting density logging applications since the technology's inception in the 1950s. This decades-long field history highlights the reliability of magnesium-based calibration systems in harsh downhole environments where material stability and dimensional integrity are essential.

When used alongside matched aluminium reference blocks, Vulcan-supplied magnesium calibration blocks enable precise calibration of borehole logging tools that determine formation density through gamma-ray scattering. These calibration systems are fundamental to ensuring measurement accuracy in gamma ray and nuclear logging operations, directly supporting reservoir evaluation and drilling decision-making.

To meet diverse customer and tool-specific requirements, Vulcan offers calibration blocks in multiple supply conditions—from cast slab raw material to fully machined and coated components manufactured to exact customer drawings and specifications. Our role extends beyond material supply, providing technical alignment, quality assurance, and dependable delivery for critical logging and measurement programs worldwide.

Material & Forms

- AZ31B Magnesium Alloy
- Cast slab raw material
- Fully machined to customer drawings
- Fully machined and coated to customer specifications

Key Applications

- Gamma Ray Density Logging
- Nuclear Logging Tools
- Borehole Measurement & Calibration Systems

Performance Advantages

- Proven long-term dimensional stability

- High consistency for calibration accuracy
- Suitable for harsh downhole environments
- Supplied with full material traceability

Product Forms

- Cast slab raw material
- Fully machined to customer drawings
- Fully machined and coated to customer spec

Applications

- Gamma Ray Logging
- Nuclear Logging

MACHINING AND HOUSEKEEPING



GOOD HOUSEKEEPING

When machining magnesium, good housekeeping in the workshop is very important. Chips should not be allowed to collect on or inside the equipment being used or on the floor surrounding the machine. Collected chips increase the risk of fire. Machines should be kept clean.

SEGREGATION

Magnesium chips, rasping and turnings should never be mixed with fines of other materials. Segregation of metal fines is crucial for safety and recycling.

LUBRICANT REMOVAL

Ideally fluid and chips should be separated as soon as possible after machining. Centrifuge, hydro clone, compaction or briquetting help reduce the hazards with the storage and handling of wet magnesium chips.



FIRE PRECAUTION

Bulk magnesium is extremely difficult to light but fines (chips, swarf, and turnings) can potentially ignite. In case of a fire, lit magnesium fines should be covered in dry sand, graphite powder, or Class D extinguisher to suppress its access to oxygen. Smothered fines should be left undisturbed until completely out to prevent flareups caused by reintroduced oxygen. Water should never be used on any metal-based fire as it can worsen the flames.

CLASS D FIRE EXTINGUISHER



CHIP STORAGE

Chips should never be stored in sacks. Examples of suitable storage equipment are type 1A2 UN approved steel drums with removable lids.



Wet or oily chips - These should be placed in covered but well-ventilated non-combustible containers, such as Type 1A2 UN-approved steel drums. Vents allow hydrogen gas to escape and reduce the chance of pressure buildup. The containers must be clearly labelled and stored from sources of ignition. Drums should not be stacked. The area must be well ventilated to avoid the buildup of hydrogen gas. Covered outdoor storage is preferred.



Dry chips- These should be placed in dry, tight non-combustible containers such as UN approved drums. Safely stored, kept dry and clearly lab Storage should be in a dry atmosphere and in isolation from flammable materials. Chips lightly coated in mineral oil can be stored the same way as dry chips.

Dry chips should be placed in dry, closed, non-combustible containers, such as UN approved drums. Drums and their contents should be kept dry, clearly labeled, and separate from other flammable materials or ignition sources.

DISTRIBUTION NETWORK ACROSS THE GLOBE



For more information visit: www.vulcanspecialtyproducts.com

Vulcan Metals Specialty Products

1001, College Street, PO Box 258 Madison IL 62060, USA

Tel: +1618 452 5190

Email: vm-sp-salesus@vulcanmetals.com