

## Magnesium Meets Extreme Specifications

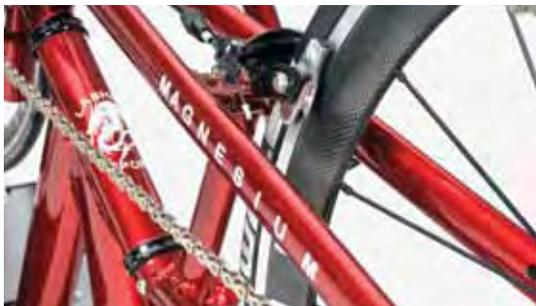
High-performance product manufacturers propel magnesium's extreme material capabilities to their ultimate limits. Whether users demand superior durability, ultra-light weight, impact and abrasion resistance, vibration and noise dampening, or precise and complex forming capabilities, magnesium pushes the envelope wide open to withstand the most extreme parameters. Magnesium gives peak performance with outstanding reliability in a diverse range of product applications that are truly *extreme*.

### Magnesium Gives Extreme Competitors Winning Mobility

Lasher Sport, LLC, Anchorage Alaska, puts a competitive spin on adaptive sports equipment by using magnesium frames in their most popular racing handcycles and sports wheelchairs. Each chair and hand cycle's magnesium frame is handcrafted and custom-welded to stringent specifications, and then put to the test by some of the most world's most remarkable athletes in paralympic-style competition.

Lasher's all-magnesium handcycle is a low-riding, three-wheel road cycle operated with riders' hands to pedal the device. The Elite is designed for on-pavement use with great handling during competition. The racer's four-pound frame is built from custom-extruded ovalized magnesium tubing for maximum strength, lightness and durability. Its seat back connects to the axle with dual adjustable supports that provide added triangulated rigidity to the design, which includes magnesium frame, fork, leg hangers, and clamps assembled with cutting-edge technology for hardcore handcyclists.

Racers take this ELITE all-magnesium competitive handcycle straight to the pavement. © Photo courtesy of Lasher Sport, LLC. Used with permission.



Its 100% magnesium parts make the Handcycle Elite light, fast and rigid, and efficiently dampen vibrations for a smoother ride. © Photo courtesy of Lasher Sport, LLC. Used with permission.

Lasher Sport CEO Bill Lasher explains why he chose magnesium for their handcycle, "The Elite's extruded magnesium tubing is 65% lighter than titanium, and is as strong as 6061-T6 aluminum. The unique dual-beam aero-shaped magnesium frame structure performs with negligible frame flex and has a very aerodynamic underside profile." Lasher touts the all-magnesium Elite as "What Fast is Made of".

The Elite weighs just 28 pounds for its 16" x 16"-long seat frame, which is lighter than many two-wheeled cycles and features ultra-light components including its magnesium frame tubing, carbon fiber seat cloth, Shimano running gear, and Spinerge wheels. The handcycle design is equipped with a Spinerge Stealth handcycle wheel set and quick-release 26-inch Schwalbe Ultremo-R tires, and top-of-the-line Shimano components.

The Elite comes in 6500 powder coat paint colors for a custom finish, and offers options like LED lights, frame-mounted bag, fenders, integrated hydration system, and frame-mounted video camera. The cycle's first-ever computer-controlled system for transitioning from outdoor road racer to indoor trainer in under five minutes via RacerMate simulator uses a custom-built roller mount attached to integrated brackets on the handcycle's magnesium forks.



**The BT-Mg magnesium sports wheelchair's transport weight without rear wheels is just 8.4 pounds – less than a gallon of milk!** © Photos courtesy of Lasher Sport, LLC. Used with permission.

available in custom colors. Specialized magnesium models include the user-requested BT-Mg-As, which further cuts weight using magnesium for a four-wheel front- and rear-suspension chair. The rear wheel's center-of-gravity placement, from 1.5" to 4.5" is easily adjusted by the user in less than five minutes with one wrench.

The BT-Mg Tennis Elite and Baller Elite wheelchairs are extremely light, rigid and tough. The Tennis Elite's magnesium frame has aluminum side guards and a welded non-folding backrest. The Baller Elite basketball wheelchair features 1.375" magnesium alloy ovalized tube framing that offers 6500 powder coat finish colors, and has tension cord adjustable seating and backrest. Newly-empowered athletes rely on Lasher Sport wheelchairs to easily navigate on the courts and engage in extreme team competition.

### Magnesium's Pop Gives Snowboarders a Smoother Ride

Riders get the ultimate extreme in snowboarding sensation and glide from magnesium. Manic Snow, Vallejo, California, has launched the world's first true suspension snowboard binding in its Massive Pop 1.0 bindings for a steadier, jolt-free ride. The ultra-light and incredibly strong bindings feature magnesium base plates and foot beds with titanium compression springs that are adjustable with the twist of an Allen wrench.



**The magnesium base plate and foot bed of the Massive Pop 1.0 give snowboarders a lighter, smoother ride and more POP for tricks and grabs and greater shock absorption on big air landings.** © Photos courtesy of Manic Snow. Used with permission.



snowboarders what they want most – more POP when riding! Magnesium bindings offer true suspension that gives riders a better feel for the snowboard and terrain, while absorbing vibrations." Magnesium's strength-to-weight ratio and rigidity allowed Lindemann to design a binding that virtually eliminates heel and toe drag, with better leverage and torque to pull cool moves with less effort. Adjustable suspension and three spring rates allow customizing according to rider weight and expertise. The added bonus: titanium springs and magnesium plates are 100% recyclable!

### Challenged Athletes Demand Equipment with a Competitive Edge

Lasher Sport's Impossibly Light™ sports wheelchair is custom-designed for its rider. Says Lasher, "We adapt new technologies to the wheelchair industry, like those used in Formula 1 racing, aerospace, and bicycles, and magnesium is a natural fit."

Magnesium's benefits to sports wheelchairs, according to Lasher, are evident: magnesium is a lighter weight structural metal, 35% lighter than aluminum; superior strength-to-weight ratio; and excellent vibration dampening abilities. The magnesium ultra-light wheelchair frame offers an end product with super-smooth ride characteristics.

The Lasher Sport BT-Mg sports wheelchair's magnesium alloy tube framing is 1.375 inches in diameter, with fully assembled weight of just 15.5 pounds without seat cushion. The magnesium frame has a lifetime warranty and offers a standard powder coat finish,

available in custom colors. Specialized magnesium models include the user-requested BT-Mg-As, which further cuts weight using magnesium for a four-wheel front- and rear-suspension chair. The rear wheel's center-of-gravity placement, from 1.5" to 4.5" is easily adjusted by the user in less than five minutes with one wrench.



**Lasher's BT-Mg Tennis ELITE (19.8 lbs.) and Basketball ELITE (22.5 lbs.) sports wheelchairs give athletes the ultimate on-court advantage.** © Photos courtesy of Lasher Sport, LLC. Used with permission.

Manic Snow's founder Carl Lindemann, an experienced motocross racer, developed the magnesium bindings after suffering a major heel bruise that prevented riding on traditional snowboard bindings. His patented design uses magnesium base plates and foot beds that work with the springs to eliminate snowboard vibration called "chatter" and provide shock absorption from big air landings, thereby reducing injuries. Says Lindemann, "The redesigned magnesium foot bed gives a true floating-on-air feeling."

Brett Curtis, Manic Snow's co-founder, notes the reasons for magnesium in the integrated design: "Magnesium is 35% lighter and 40% stronger than aluminum, and absorbs 16 times more shock with greater stiffness, giving

## Magnesium Revs Up Racing Bike

Motocross racing pushes magnesium's capabilities to extreme limits on the track for the Monster Energy racing Kawasaki team based in Irvine, California. Magnesium used in Kawasaki racing motorcycles provides load-lightening parts that give racers a winning edge, whether outdoors on the Motocross track, or inside the stadium on the Supercross track.

The 2011 Kawasaki KX™450F racing motorcycle sports three molded magnesium alloy cover components on its engine. Monster Energy racing team member Tom McGovern notes, "Magnesium engine covers make the bike substantially lighter and give the rider more maneuverability. Compared to aluminum, the lighter magnesium covers enable a much lighter engine to maintain a higher center of gravity on the bike for tighter turns and better handling."

In addition, a magnesium front brake caliper helps to shave weight off the front end of the bike, allowing quicker response and better overall weight distribution. Though light, magnesium's toughness endures through countless laps, no matter how rough the track. Says McGovern: "Our teams have relied on magnesium parts to get the most out of our bikes for more than 20 years."



Kawasaki's KX™450F motocross racer maneuvers on a dime with magnesium lightening the load. © Photos courtesy of Monster Energy Kawasaki. Used with permission.

## Magnesium Protects Extreme Riders

Professional motorcycle riders who race on the edge want extreme protection, and magnesium has got them covered. The three-generation Arlen Ness racing company, Dublin, California, uses magnesium protectors on the shoulders, elbows and knees of its men's and women's Magnesium Kangaroo Racing suits, designed for extreme motorcycle sport racing. Arlen Ness, his son Cory and grandson Zach, who design motorcycles as well as the racing suits, know exactly where the magnesium protectors are needed most in their suit designs – on vulnerable joints.



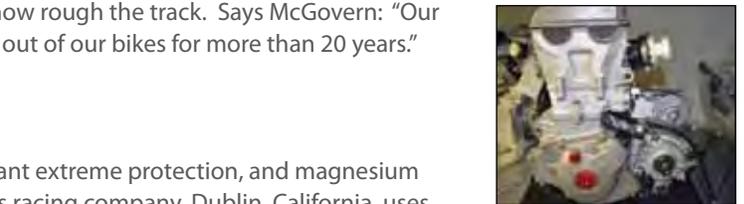
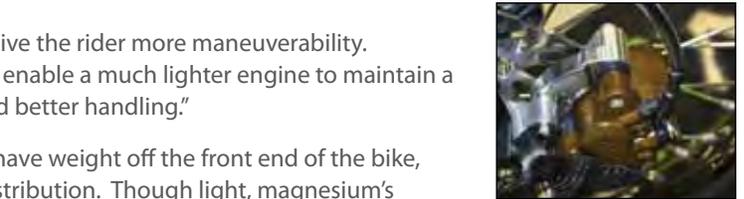
The Magnesium Kangaroo Racing Suit offers extreme racers added lightweight protection, abrasion and impact resistance at shoulders, elbows and knees. © Photo courtesy of Arlen Ness. Used with permission.

Velcro attached to the knee slide. Additional back protectors and kangaroo and Kevlar stretch panels on arms, inner thighs and backs of legs round out a protective barrier for riders who take motorcycle racing to its limits.

The protective armored joint areas are stamped from magnesium alloy sheet, and are built into a larger ventilated body pieces that are stitched into the leather suit. For the rider's knees, the magnesium protectors are attached to the outside of the suit's knee socket – a patented build of leather designed to conform comfortably around the knee for better flexibility, while the attached ventilated perforations help remove unwanted heat from areas that rarely experience air movement.

The magnesium protectors must meet CE European safety impact test requirements for the armor within the suit, and for suit construction. Magnesium joint protectors give the Kangaroo racing suit extreme impact and abrasion resistance.

Lightweight magnesium enhances the suit's ability to provide protection over ventilated shoulder, elbow and knee areas, with two layers of knee slider



Magnesium parts lighten the KX™450F's front end and engine, making both the bike and rider extreme Motocross and Supercross competitors. © Photos courtesy of Monster Energy Kawasaki. Used with permission.



American racer Kenny Noyes tears up the track wearing his Magnesium Kangaroo racing suit in the Moto2 World Championship. © Photo courtesy of Arlen Ness. Used with permission.

## A Closer Look: High-Strength Magnesium Sheet

### nanoMAG Technology Provides **EXTREME** Protection

The ultra-lightweight, high-density magnesium sheet material, made by nanoMAG LLC, Ann Arbor, Michigan, provides 200 percent higher strength and toughness than traditional magnesium sheet at one-fourth the weight of carbon steel sheet. nanoMAG is also cost-efficient and easier to form, permitting low-volume manufacturing for specialty applications at a competitive cost

The nanoMAG process offers magnesium sheet process with superior rigidity and stiffness, exhibiting the best strength-to-weight ratio of any commonly used structural metal. nanoMAG uses the Thixomolding thermal mechanical process (TTMP) to create isotropic, fine-grained strengthening on the nanometer scale (5-10µm). Grain size is refined via continuous dynamic recrystallization to 0.8-2 µm. At the same time, coarse intermetallic phases are refined in-situ to nanometer dispersions.

TTMP offers advantages of greatly reduced grain size and reduced cracking, which enhances homogeneity and improves mechanical properties, compared to developmental Twin Roll Cast (TRC) and rolled sheet. The nanoMAG magnesium sheet technology offers twice the performance of conventional magnesium products, according to nanoMAG president, Stephen Lebeau.

Lebeau notes, "The secret is our ability to control the microstructure of the material, which increases the yield strength of the original Thixomolded stock by more than 90 percent, to more than 300MPa, along with 10 percent elongation."

The patent-pending process is put to the test in extreme applications such as military vehicle and body armor applications, where nanoMAG's physical and mechanical properties compare well to steel and aluminum alloys used in conventional armor, offering substantial weight savings and reduced loads carried by troops and vehicles, protecting personnel and vehicles with greatly increased resistance to penetration. As military body armor, nanoMAG reduces the weight troops must carry making them safer and more mobile. When used in vehicle armor, nanoMAG shielding makes military vehicles lighter and more fuel-efficient, adding protection and reducing the cost of moving fuel through the field of operations. Applications such as light military vehicle armored plating use the high-density properties in nanoMAG magnesium sheet to resist penetration, vibration and noise.

For windmills, nanoMAG lightens weight and subsequent loads of small rooftop windmills with a density one-fourth that of steel, while dampening noise and vibration and reducing windmill inertial energy losses during start-up. The overall potential of the nanoMAG process bodes well for many specialty-type products, from biomedical implants and sports equipment, to structural aerospace, renewable energy, and military applications with its improved performance and reliability under extreme conditions.



The nanoMAG process uses Thixomolded magnesium alloy for 90 percent higher strength than AZ31 sheet. © Photo courtesy of nanoMAG LLC. Used with permission.



To learn more about the benefits of designing products with magnesium, contact the **International Magnesium Association**  
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