

IMA Awards: Magnesium takes Center Stage

The IMA Awards of Excellence and IMA International Environmental Responsibility Award winners all have one thing in common: implementing magnesium design, process and applications using groundbreaking innovations. These industry leaders maximize magnesium's beneficial properties to translate design and technology into new products and processes. Winners demonstrate the highest standards of excellence while striving to preserve our planet's resources.

Magnesium Window Frame Sets Porsche Apart

Georg Fischer GmbH & Co., KG, Altenmarkt, Austria, has won the IMA Award of Excellence in the Cast Product Automotive Design category for its magnesium window frame for the Porsche Panamera sports sedan. Working closely with Porsche AG, they used magnesium alloy AM50 for the Panamera's window frames in order to further reduce weight and place the vehicle's center of gravity as low as possible.



The Porsche Panamera sedan's magnesium side window frames achieve a flat W-profile around the window with precision pressure casting. © Photo courtesy of Porsche Cars North America, Inc. Used with

The precision-cast window frame components weigh 1.7 kilograms (kg) for the front doors, and 1.6 kg for the rear doors. Georg Fischer produces 34 parts for the Panamera. For the window frame, Georg Fischer is using a 1,800-ton cold-chamber pressure die casting machine, which is the only process able to meet the high component geometries required for these window frames. The W-profile of the 1.8 – 4.0 millimeter thick-walled window frame casting must meet a dual challenge: avoiding porosity and cracking in the thick-walled portion; and achieving complex geometry where the outside of the tool is completely covered by movable parts that must not cause deformation as each component is ejected from its mold.

The inside portion of the frames are visible and this is where the frames are joined to the casting system. To accommodate this, Georg Fischer mills and grinds the framing and applies a manual finish, then drills holes and applies connection surfaces for assembly. A three-layer protective coating is applied by an external partner to prevent corrosion. Prior to completion, window frames are precisely aligned to within three tenths of a millimeter, since the plastic strip attached to the frame forms a surface that is virtually flush with the window glass. Close-tolerance screws then attach the magnesium window frames to the cast aluminum door frames at Porsche's factory in Leipzig, Germany.



Left: W-profile for window frame casting; Right: Lightweight magnesium window frames integrate perfectly with Georg Fischer's cast aluminum door frames, forming the optimal hybrid construction for Porsche's four-door Panamera sedan. (c) Graphic and photo courtesy of Georg Fischer GmbH & Co., KG. Used with permission.

Georg Fischer acknowledges that the new wave of lighter vehicles is experiencing a shift from assembled parts to integrated cast components that are ready-for-assembly. This is exemplified by their magnesium window frames, which help to meet Porsche's goal of intelligent lightweight construction that enables outstanding vehicle performance and lower fuel consumption. They view light metal use for chassis, power train and structural components as a growing trend. Ultra-light, strong magnesium meets vehicle criteria for consistent lightweight body structure using innovative and environmentally-friendly components that are easily recycled and integrate well with advanced materials.

Knee Brace gets Support from Magnesium

Bledsoe Brace Systems, Grand Prairie, Texas, has won the IMA Award of Excellence in the Application category for innovative use of wrought magnesium AZ31B-H24 specification grade sheet in its orthopedic knee braces. Bledsoe Brace, a division of Medical Technology, Inc., engineers and manufactures osteoarthritis and post-operative braces.

The 20.50 Patellofemoral, AXIOM Mg Custom and Z-12 Magnesium ACL (anterior cruciate ligament) knee braces feature ultra-lightweight, low profile designs. Their high-strength magnesium components exhibit tremendous force resistance to protect and stabilize the knee joint. Bledsoe's breakthrough magnesium brace designs are up to 50 percent lighter than prior models. Patients benefit from an exceptionally comfortable knee brace that is durable over long-term use, enabling them to return to normal activities sooner, maintain an active lifestyle and achieve stable motion when participating in sports.

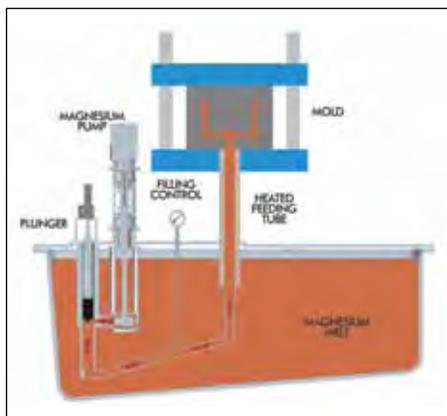


The Bledsoe 20.50 (left), AXIOM Mg (center) and Z-12 (right) knee braces use wrought magnesium framing components for exceptional stability and support following knee ligament or menisci injury or reconstruction. © Photos courtesy of Bledsoe Brace Systems. Used with permission.

The 20.50 Patellofemoral knee brace effectively stabilizes the patella as the knee bends into flexion. Its magnesium design enhances dynamic function by tightening a specialized pneumatic buttress in flexion with strongest force between 30 and 40 degrees, and relaxing tension past 90 degrees through extension. The brace's magnesium alloy AZ31B-H24 is 30 percent lighter than aluminum and its magnesium frame is the strongest on the market, providing MCL (medial collateral ligament) and LCL (lateral collateral ligament) support. The magnesium brace's structural strength counters quad muscle force and resists rotation, with improved tracking and dislocation control.

Bledsoe's lightweight 16-ounce AXIOM Magnesium Custom Functional model is a low contact sport functional knee brace that is specially designed to stabilize knee injuries to the ACL and PCL (posterior cruciate ligament). The 14-ounce Z-12 Magnesium knee brace is also a low contact sport functional brace designed to support ACL instabilities while the user remains active. Magnesium sheet supplier Magnesium Elektron NA Inc., Madison, Illinois, teamed up with Bledsoe engineers to provide material for the innovative knee brace line. Lee Barnes, Magnesium Elektron NA's V.P. of Sales and Marketing notes: "We have been very fortunate to work with a sophisticated fabricator like Bledsoe Brace, with their superior engineering and forming capabilities."

Advanced LPC Method Solidifies Magnesium Quality



Rauch's LPC system for continuous melting and pouring of magnesium melt facilitates production of molded magnesium parts without using gas as a melt delivery agent. © Graphic courtesy of Ing. Rauch Fertigungstechnik GmbH. Used with permission.

The IMA Award of Excellence winner for Process recognizes true innovation in processing technology with a superior magnesium LPC (low pressure casting) method developed by Ing. Rauch Fertigungstechnik GmbH, Gmunden, Austria. Rauch's LPC system achieves significant economic and ecological advantages for continuous melting and pouring of magnesium melt for low pressure permanent mold or sand mold parts.

Benefits of the Rauch system are felt throughout the LPC process: feeding ingots is now done during normal operation at constant melt level and monitored automatically; installing a stirring device or jet pump is easier resulting in better melt quality; the pressure pump, post-pressure hydraulic cylinder system and jet pump are easy to maintain, facilitating easy melt cleaning via standard non-pressure tight openings; far less protective gas is needed in small amounts to protect the surface, thus lowering cost, emissions, and operator and environmental impacts.

The Rauch LPC system substitutes gas pressure with a pressure pump that delivers desired melt quantity using a pre-adjusted variable flow to fill the mold. Immediate melt delivery upon starting the LPC cycle and continuous feeding

throughout the cycle enables an overall shortened cycle time resulting in up to 30 percent higher output. The crucible does not require elaborate gas pressure controls. Melt is transported from crucible to mold via a magnesium pump, which fills the mold in a pre-programmed sequence. The simple pump and pressure system with a hydraulic cylinder post-filling accurately controls mold filling and post-filling pressure.

Mold fill is accomplished with virtually no turbulence, filling even narrow mold channels without gas inclusions. Ultimately, the Rauch LPC system produces magnesium parts with improved mechanical properties including strength and less porosity than parts made with high-pressure casting systems. Magnesium components cast in smaller volumes with complex geometries and complex wall thickness benefit tremendously from Rauch LPC, such as those used in aircraft, truck and special applications.

Tablet PC Armored with Magnesium

Twin City Die Castings Co. (TCDC), Monticello, Minnesota, has won the IMA Award of Excellence in the Cast Product Design (non-automotive) for its magnesium back housing, heat sink, ring and front housing for the ARMOR™ X10mg Rugged Tablet PC manufactured by DRS Tactical Systems, Inc., Melbourne, Florida. DRS Tactical Systems designs and manufactures laptop computers and workstations for military and industrial markets. The magnesium alloy chassis features ShutOut™ ingress protection technology that is IP66 certified to keep out dust and moisture.



A magnesium housing with cast-in aluminum heat-sink achieves light weight and better heat dissipation capability.
© Photos courtesy of Twin City Die Castings, Inc. Used with permission.

TCDC's challenge was to convert an aluminum hog out housing into a die-cast magnesium housing in order to maintain size specifications while developing a lighter weight unit with the necessary heat dissipation. TCDC accomplished these goals by using a cast-in aluminum heat sink inserted into the magnesium housing. Three cast tools were created – the heat sink, housing ring and back housing. The aluminum heat sink is inserted into the magnesium back housing cast tool to combine the parts, and the magnesium housing ring is glued into the back housing.

The aluminum heat sink was pre-heated to expand so that it would shrink with the magnesium housing during the solidification process. To bond the housing and heat sink, a V-groove incorporated into the heat sink allows magnesium to encapsulate the heat sink edge, holding it in place. To maximize component space inside the housing without increasing the external envelope size specification, TCDC and DRS Tactical Systems developed a magnesium housing ring casting that is cast and trimmed separately, then bonded to the housing with adhesive.

The bonded joint design captures the outside ring edges at the inside housing wall. This strong bond must handle machining operations for the o-ring groove and stringent vibration and drop testing by the customer. The ARMOR™ X10mg rugged Tablet PC retains a lightweight yet rugged and durable framework with precision cast magnesium, while maintaining the original design integrity and heat transfer specifications. DRS Tactical Systems and TCDC's solution demonstrates how magnesium parts integrate with and enhance materials such as aluminum, resulting in a better and more efficient product.

The ARMOR™ X10mg Rugged Tablet PC has a magnesium alloy chassis and sealed fanless design that delivers all-weather functionality for rugged outdoor computing. © Photo courtesy of DRS Tactical Systems, Inc. Used with permission.



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A housing ring increases component space without increasing external envelope size. Robotic adhesion ensures proper placement and bead size.
© Photos courtesy of Twin City Die Castings, Inc. Used with permission.

A Closer Look: International Environmental Responsibility Award Winners The IMA recognizes two industry leaders in Environmental Responsibility

International Environmental Responsibility Award/Magnesium Production and Processing Winner:

Magnesium Elektron, Manchester, UK, has achieved strict environmental goals across technical and production areas during years of sustained targeted effort, significantly reducing their overall carbon footprint since the year 2000. Magnesium Elektron, a leading producer of high-performance magnesium alloy systems and products, is part of the Luxfer Group, an international manufacturer of high-performance engineering materials, including magnesium alloys.

Magnesium Elektron has developed new casting and melting techniques and intensively researched environmentally-friendly protective gases to achieve a 90 percent reduction in its equivalent carbon dioxide (CO₂) emissions and a dramatic drop in cover gas use. Magnesium Elektron UK became accredited to BS EN ISO 14001:2004 in 2008, and has since achieved full compliance, using innovative solutions to reduce and remove waste and pollutants, notably reducing the use of Sulphur hexafluoride (SF₆) cover gas with an alternative gas that emits substantially less CO₂ into the air.

Auditors acknowledge that the company's approach embraces business growth while at the same time minimizing environmental impact. Magnesium Elektron has successfully implemented advanced methods to achieve environmental benefits. Company teams examined magnesium operations, identifying ways to eliminate waste and pollutants to reduce emissions and create value. In one such example, Magnesium Elektron has installed a metal recovery system in its main foundry to separate recyclable magnesium metal from drosses present at the end of the casting cycle. Research and development continues, as the company targets further substantial reductions over the next three years.

International Environmental Responsibility Award/Magnesium Applications and Components Winner:

Oskar Frech GmbH + Co., KG, Schorndorf, Germany, has developed two machined components that individually save up to 70 percent of energy consumed during the die casting process. Oskar Frech's patented nozzle and gooseneck heating system optimize energy efficiency using a special heating element to direct precisely where and when heat is required during the casting process. This system greatly reduces energy losses due to partial overheating and heating of associated components. Regulating and monitoring heating circuits yields exact, repeatable temperature control for all hot chamber die casting machines. This avoids excessive heating while providing process safety during heating, start-up and production. The innovative nozzle and gooseneck equipment provides the basis for a die casting tooling technology that allows reduction of runners and spreaders, which in turn reduces the amount of return material.

Oskar Frech's award also recognizes their two-chamber insulated magnesium melting/holding furnace system innovations. Tremendous energy-saving potential of a die casting cell occurs in the melting/holding furnace. When combined with a specially insulated crucible cover, 30 to 40 percent less energy is required to maintain a constant melt temperature. These technical insulation advances effectively reduce CO₂ contamination in every die casting cell and achieve significant energy and cost savings.

Oskar Frech's Managing Director, Dr. Norbert Erhard asserts:

"The die casting process itself must be included purposefully in developments to reach an effect beyond pure energy savings. Our furnace system creates new possibilities in die design, so that deep immersing in the die is possible in magnesium die casting. Gating can be shortened and return material reduced, giving further savings in total ecological balance of the production process. Without including the die casting process when designing the heating system, this potential would not be realized."

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IMA applauds these pioneering magnesium companies that have taken essential steps and made outstanding progress in environmental responsibility. In doing so, they are revitalizing manufacturing and product innovation capabilities while saving energy, resources, time, and money. IMA urges all those involved in the production, processing, forming, manufacturing, and recycling of magnesium and magnesium alloys to set the bar ever-higher to achieve sustainable innovation and best practices.



(Left) Resistance-heated nozzle heating, as mounted on a machine; (Right) Insulated furnace system optimizes heat distribution. © Photos courtesy of Oskar Frech GmbH + Co., KG. Used with permission.



To learn more about the benefits of designing products with magnesium, contact the
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