

IMA Awards of Excellence Winners

The 2011 IMA Awards of Excellence Winners have achieved exceptional magnesium components through different forming methods, yet they share the common thread of achieving innovative designs that maximize magnesium's potential, significantly contributing to each product's success in the marketplace. The 2011 IMA Environmental Responsibility Award Winner demonstrates how taking environmental steps forward with carbon credits and SF₆ reduction can enhance magnesium production quality to meet the most stringent customer standards.

Magnesium Vacuum Cleaner Head Defines Efficient Design

IMA's Award of Excellence Winner in the Cast Product Design/Commercial, Non-Automotive category is the thin-walled, complex magnesium alloy vacuum cleaner head casting from Precise Cast, Commerce City, Colorado. The prototype rubber plaster mold AZ91D magnesium alloy part protects critical components used in the Oreck Magnesium Vacuum Cleaner Combo lightweight upright vacuum. The do-it-all workhorse magnesium casting reduces the overall number of parts required, lowers assembly costs and reduces parts inventory.

The magnesium casting is approximately a third lighter than comparable aluminum, making the vacuum easier to maneuver with less user fatigue. Though magnesium is ultra light, the vacuum head exhibits high dent resistance and greater vibration dampening ability than aluminum, reducing strains on the vacuum. The vacuum cleaner head's exotic shape gives Oreck a competitive edge, as the use of magnesium allows for a very strong, yet thin-walled casting to be produced with custom-contoured surfaces. The single component is fully recyclable, meeting the customer's environmental goals, compared with multiple, separate polycarbonate plastic parts.



Oreck's Magnesium Vacuum Cleaner Combo head design is a one-piece, ultra-light and fully recyclable magnesium component. © Photo courtesy of Oreck. Used with permission.



The prototype complex casting design, top view (left) creates an exotic-shaped vacuum head that lowers assembly costs and parts inventory when cast in lighter-weight magnesium, bottom view (right). © Photos courtesy of Precise Cast. Used with permission.

The winning casting encompasses multiple cross-section transitions – a challenge that Precise Cast engineers met by implementing innovative process adaptations. These rigging and manufacturing methods accommodated the design's numerous, dramatically thicker features protruding from the thin nominal casting shell. These adaptations were necessary to maintain a sound metal structure throughout the complex casting's geometry. The plaster mold for the casting consisted of a cope, drag and two cores. The cope was produced in two layers to achieve the necessary off-parting line rigging in order to feed numerous isolated heavy-section features contained in the design. Skilled Precise Cast mold-makers

kept the soft tooling from distorting during the plaster pouring process.

Finite Element Analysis (FEA) of the mold filling and solidification process followed by tooling design adjustments allowed Precise Cast engineers to avoid the typical hot and cold tearing and micro-cracking failures that are prone to occur when magnesium castings are made with abrupt variations in cross-sectional thickness. The resulting near-net casting requires minimal post-processing, secondary machining and finishing; only basic parts cleaning, decking, drilling and tapping prior to assembly are required.

The resulting magnesium component yields a lower-cost demonstration product in a short lead time, inspiring the confidence necessary to move forward with production magnesium die casting/thixoforming. Precise Cast delivered high performance, durability and value-added environmental benefits to the customer in one complex, winning casting design.

Magnesium Engine Front Covers Rev Up Two Porsche Models

IMA's Award of Excellence for Cast Product/Automotive is presented to Georg Fischer GmbH & Co., KG, Altenmarkt, Austria, for the magnesium engine front cover utilized in Porsche's G1 Panamera and E2 Cayenne model automobiles. The magnesium cover part, formed on an 1800-ton high-pressure die casting (HPDC) machine from magnesium alloy AE44, is the heavy-duty cast component that is placed over the engine's belt drive.

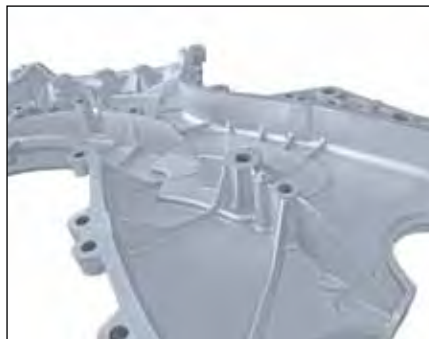


The 2012 Panamera Turbo S (top, left) and the 2011 Cayenne (top, right) feature Georg Fischer's magnesium engine front cover. The Porsche engine uses a magnesium front cover that is 45 percent lighter than the aluminum cover it replaces (right). © Photos courtesy of Porsche Cars North America, Inc. Used with permission.

Porsche engineers striving to progressively reduce engine weight and refine part production selected magnesium for the V6 and V8 engine front covers, using precisely the same lightweight cover part for both engine types. The front cover weighs just 2.14 kilograms (kg), compared to 3.89kg using an aluminum cover – a 45 percent weight savings! Georg Fischer's Altenmarkt plant produces 64,000 front covers each year.



Georg Fischer's head of engineering Gerald Widegger notes, "This weight reduction goes well beyond the reduction yielded by magnesium's lower specific density. All casting components, no matter which alloy



Georg Fischer's award-winning engine front cover design (front view, left) incorporates complex areas of varying wall thickness, ribbing and built-in reinforcement (back view, right) in lighter magnesium, without sacrificing durability. © Photos courtesy of Georg Fischer GmbH & Co., KG. Used with permission.

they are, have a limit to the relation between wall thickness and metal flow length. Regarding this relation, magnesium has an advantage over aluminum. In the development phase, magnesium's viscosity and filling behavior enable a reduced part wall thickness of 0.1mm to 0.2mm, which causes more than the difference in specific density of material to be realized."

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Magnesium Engine Front Covers Lighten the Load

Georg Fischer engineers actively assisted the Porsche design team to minimize wall thickness in the appropriate places. Wall thickness refinements occur where the magnesium's lower rigidity is taken into account around the engine's belt tensioner mounting for the timing chain adjuster. According to Widegger, the tensioner produces a relatively high bending moment in the component. The magnesium component's resulting wall thickness must be increased and the ribbing improved in this area.

Using magnesium alloy necessitates a different mounting concept be used to seal the front cover onto the engine. The solution involves re-positioning aluminum unit screws already in use on the engine to modified locating points on the cover. Widegger sums up: "Combining the lower pre-stress-loss aluminum screws with the heat- and creep-resistant magnesium alloy has produced even better creep properties than the combination of steel screws and aluminum cover used previously."

According to Georg Fischer Automotive, high-pressure die casting is an ideal process for automotive manufacturing: "Pressure die casting helps reduce fuel consumption like no other process, since it offers vehicle manufacturers and other companies searching for new kinds of components the opportunity to harmonize functionality, performance, weight reduction, and aesthetics."

Long-term engine tests conducted by Porsche on the magnesium engine front covers have proven this well-honed part to compare favorably with aluminum in terms of durability. Georg Fischer's innovative magnesium engine front cover demonstrates how considerable weight-savings potential can be achieved with systematic use of magnesium die castings in engines. As engines become ever-lighter with magnesium, automakers will realize vastly-improved fuel economy while maximizing performance.



Compared to aluminum, the area tension pulley is strengthened in the magnesium cover, due to a high bending moment and compaction behavior. © Photo courtesy of Georg Fischer GmbH & Co., KG. Used with permission.

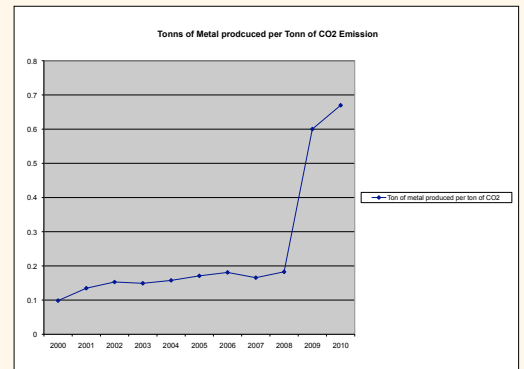
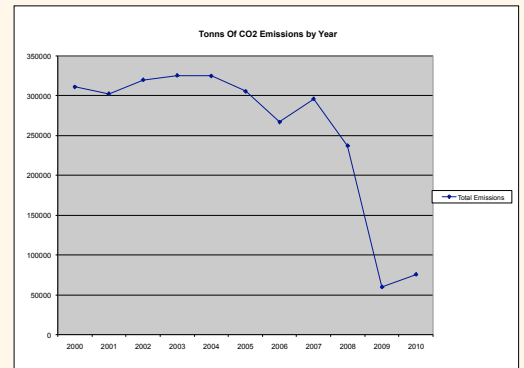
A Closer Look: Strides in Environmental Responsibility

2011 Environmental Responsibility Award Winner Raising the Bar for Sustainable Magnesium Production

Meridian Magnesium Products of America (MPA), Eaton Rapids, Michigan, USA, has won the 2011 IMA Environmental Responsibility Award in the Magnesium Production & Processing category for its outstanding success implementing reduction and elimination programs by replacing sulphur-hexafluoride (SF₆) with Novec 612 and SO₂ cover gases in its die casting and recycling operations since 2008. Meridian has significantly lowered CO₂ (greenhouse gas) emissions per ton of metal produced by 72 percent at the Eaton Rapids site during the decade from 2000 to 2010. Meridian has pioneered sustainable practices at all of its Technology plants worldwide, and the Eaton Rapids facility is a prime example of their ongoing environmental responsibility commitment.

Meridian MPA is a full-service supplier of innovative magnesium die casting components and assemblies for the global automotive industry and a founding member of the Environmental Protection Agency's magnesium group, which developed a Memorandum of Understanding committing its members to eliminating all SF₆ cover gas use by 2010. Charles Woodburn, facilities engineer at Meridian MPA's Eaton Rapids plant outlines how the new, safe cover gases are used. "Novec 612 is being used in die casting on the molten metal furnace and transfer tube, and in recycling in the alloy furnace, ingot station and cast line cooling chamber. SO₂ is solely used in the melting cell."

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Meridian MPA has substantially reduced CO₂ emissions (chart, top), while greatly increasing Tonnes of metal produced per Tonn of CO₂ emission (chart, bottom) during the past decade. © Graphics courtesy of Meridian Magnesium Products of America. Used with permission.

A Closer Look: Meridian Leads Industry-Wide Environmental Responsibility Efforts

Since 2001 when Meridian MPA registered to utilize the ISO 14001 system to manage and improve environmental performance, the company has generated more than 65 program objectives and targets to reduce environmental impacts at its Eaton Rapids facility. Woodburn elaborates on these carbon emissions reduction efforts: "Through the Environmental Management System (EMS) programs we have in place, 31 programs have had a direct impact on our carbon footprint. Programs such as electrical reduction, recycling, lower natural gas usage, and SF₆ reduction have all played key roles in the dramatic reductions we have achieved."

Meridian's groundbreaking environmental leadership solidified when co-authoring through Quality Tonnes the Clean Development Mechanisms (CDM) methodology AM0065. Meridian has made this methodology available industry-wide to all die casters, pioneering the effort to generate carbon credits by converting all production to safe alternative cover gases. Adopting consistent, industry-leading environmental standards in magnesium casting production has enhanced MPA's ability to achieve Quality-1 Certified Supplier status at Ford Motor Company, and their status as a major supplier of quality cast magnesium parts to top automakers worldwide.

The Eaton Rapids Michigan site produces more than 13,000 net metric tons of magnesium die castings per year in 15 die cast cells: two 800-ton; four 1200-ton; one 2500-ton; and eight 3000-ton cells. The plant's secondary operations include: nine CNC machining centers; two Tri-Way machining centers; special-purpose drill centers; special-purpose machines and assembly equipment; automated assembly equipment; automated vision inspection stations; leak test equipment; and paint line for its magnesium radiator support program.

Going forward, Meridian MPA plans to increase environmental improvements by working to prevent pollution, design products and processes that minimize adverse environmental impacts, maintain environmentally safe practices among all employees, and recycle scrap metal and other resources. "Our main goal is to continually improve upon the standards we have set," asserts Woodburn, "While it may be difficult to see the marked improvement we've seen in the last couple of years, we have projects in the works that will continue to push us toward reducing our emissions even further." Meridian's environmental goal as a magnesium die caster is to regard environmental protection as equally important as any part of their business, and essential to achieving positive recognition from every OEM customer.

The International Magnesium Association awards environmentally progressive and responsible companies each year at its Annual World Magnesium Conference. The IMA 2011 Environmental Responsibility Award recognizes MPA's active, long-term and ongoing commitment to the environment and to reducing the industry's carbon footprint. IMA commends MPA's company-wide efforts to advance this cause on a global scale by partnering with government and the entire magnesium die-casting industry to conduct cast magnesium manufacturing with true environmental responsibility.



Meridian MPA's Eaton Rapids, Michigan plant incorporates multiple eco-conscious programs into every aspect of its operations, including the die cast cell (top), ingot heaters (center), and recycling machinery (bottom). © Photos courtesy of Meridian Magnesium Products of America. Used with permission.



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