We Are The Lightweight Heavyweight

Meridian is the leading full service supplier of innovative lightweight magnesium die cast components and assemblies in the global automotive market.

- Magnesium and Aluminum alloy casting capability
- Worlds largest producer of magnesium components
- Die casting magnesium since 1981
- Over 1,600 dedicated employees
- Over 450,000 ft² of manufacturing space
- Over 35,000 net metric tons of product shipped annually
- 60 total die-cast machines from 500 to 4,500 tons
- 23 die cast machines over 2,500 tons
- Secondary machining, coating, and assembly capabilities
Global Manufacturing & Customer Service Footprint

Our strategic global presence enables us to service the international needs of our automotive clients quickly and efficiently.

- Eaton Rapids, Michigan: Manufacturing Facility
- Plymouth, Michigan: Business Development, Program Management
- Strathroy, Ontario: Global Technology Center, Program Management, 2 Manufacturing Facilities
- Coahuila, Mexico: Manufacturing Facility
- Munich, Germany: Business Development, Program Management
- Sutton-in-Ashfield, Nottinghamshire, UK: Business Development, Manufacturing Facility
- Shanghai, China: Business Development, Manufacturing Facility

- 4 North American manufacturing sites
- 1 European Manufacturing Site
- 1 Asian manufacturing site
- 3 International sales offices
Meridian Product Development Timeline

1985 - 2010

- Transfer Case
- Peddle Bracket
- Seats
- Transmission Case
- Header Bow
- Engine Cradle
- Steering Wheel
- Liftgates
- Steering Column Parts
- Instrument Panels
- Front of Dash
- Center Console
- Front End Structures
- Oil Pan
## What We Offer

### Solutions: our parts are just part of the process

#### In-House Design
- Flow Sim testing
- Physical testing
- Tool design and verification
- SDRC I-DEAS
- CATIA
- UNI-GRAPHICS
- FEA analysis
- CFD capability

#### Advanced Engineering
- MSC Nastran (modal/linear)
- Patran
- LD Dyna dynamic analysis
- NVH
- Crash safety testing
- Durability testing
- Fatigue testing
- OptiStruct (part optimization)

#### Manufacturing
- Die cast equipment design
- Lubricants used for machining
- Foundry technologies
- Machining
- Coating
- Assembly
The HPDC Magnesium process is a rapid and efficient method for manufacturing complex structural components

CASTING PROCESSES
Casting Process Selection

- **High Pressure Die Casting (HPDC)**
  - PIECE PRICE: The lowest piece cost is achieved by HPDC with Tooling Cost running in the opposite direction.
  - TOOLING COST: Increasing

- **Permanent Mold Casting**
  - PIECE PRICE: Increasing

- **Sand Casting**
  - PIECE PRICE: Increasing

*Meridian*
High Pressure Die-Casting Process

The basic process consists of injecting molten metal under high pressure into a steel mold called a die. DCM’s are rated in clamping tons equal to the amount of pressure they can exert on the die. Machine sizes can range up to 5,000 tons.

A complete cycle can vary from less than one second for small components to three minutes for a casting of several pounds, making die casting the fastest technique for producing precise non-ferrous metal parts.

 REGARDLESS OF THEIR SIZE, THE ONLY FUNDAMENTAL DIFFERENCE IN DIE CASTING MACHINES IS THE METHOD USED TO INJECT MOLTEN METAL INTO A DIE. THE TWO METHODS ARE HOT CHAMBER OR COLD CHAMBER.
High Pressure Magnesium Die Casting

Typical Automotive Applications
Magnesium high pressure diecastings have wide usage application in the typical vehicle architecture. One process and one base material has more applications in a car than any other.
High Speed / High Volume Production

- Provides the most complex, highly integrated shapes in a single process step
- Longest cycle times for the largest parts are less than 3 minutes
- Hundreds of thousands of castings can be produced before additional tooling is required
Accuracy & Stability

- Parts are durable and dimensionally stable, while maintaining close tolerances.
- Tightly sealed surfaces and accurate part location
Strength & Weight

- Stronger than plastic injection moldings with tighter dimensional tolerances.
- Thin wall magnesium castings are stronger & lighter than those possible with other methods.
- Die castings do not consist of separate parts so the strength is not limited by the strength of the joint.
Simplified Assembly

- Provide integral fastening elements, such as bosses and studs.
- Holes can be cored or tapped.
- Self threading fasteners and rivets are used as cost effective joining solutions.
- Smooth or textured surfaces, easily finished with a minimum of surface preparation.
The HPDC Magnesium process is a rapid and efficient method for manufacturing complex structural components

MATERIAL PROPERTIES
# Material Property Comparison

## Die Cast Aluminum and Magnesium Alloys

Non-ferrous, die cast alloys have the range of mechanical properties required for most automotive applications.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>356-T6 SANDCAST</th>
<th>A380</th>
<th>SILAFONT-36</th>
<th>AZ91D</th>
<th>AM60B</th>
<th>AE44</th>
<th>MRI153</th>
<th>MRI230D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (MPa)</td>
<td>228</td>
<td>324</td>
<td>283</td>
<td>240</td>
<td>225</td>
<td>245</td>
<td>250</td>
<td>245</td>
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<tr>
<td>Yield Strength (MPa)</td>
<td>186</td>
<td>159</td>
<td>138</td>
<td>160</td>
<td>130</td>
<td>142</td>
<td>170</td>
<td>180</td>
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<td>Elongation</td>
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<td>3.5</td>
<td>5.0-11.0</td>
<td>3.0</td>
<td>8.0</td>
<td>10.0</td>
<td>6.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>2.68</td>
<td>2.74</td>
<td>2.64</td>
<td>1.81</td>
<td>1.80</td>
<td>1.82</td>
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<tr>
<td>Elastic Modulus (Gpa)</td>
<td>69</td>
<td>71</td>
<td>75</td>
<td>45</td>
<td>45</td>
<td>45</td>
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</tr>
</tbody>
</table>

Source: Silafont-36/Rheinfelden, www.alurheinfelden.com
Die Cast Magnesium Alloys vs Aluminum

**Magnesium AZ91D**
Most widely specified magnesium die casting alloy. Comparable yield strength to aluminum for most powertrain and chassis applications.

**AM60B**
Excellent energy-absorption characteristics, ductility and strength. Applications include safety related parts, such as seat frames, cross car beams, body structures, and closures.

**AE44, MRI153, MRI230D**
These alloys have improved performance characteristics for performance. Applications include powertrain and underbody chassis applications.

**Aluminum A380**

**Aluminum Stampings/Extrusions**

**Aluminum Silafont or 356 T6**
Ductility of Magnesium Alloys

Increasing Magnesium Content Increases Ductility without Heat Treating

Magnesium ductile properties compared to aluminum or plastic allow it to be designed in energy absorbing applications.
Aluminium structural alloys typically require a secondary heat treating process to achieve the necessary strength and ductility required.

Structural Alloy Heat Treatments

Aluminium structural alloys typically require a secondary heat treating process to achieve the necessary strength and ductility required.
Magnesium Diecast Applications
Where Strength and Ductility are Important

CROSS CAR BEAMS
- Honda Acura TLX

DOOR INNERS
- Lincoln MKT
- Ford Mondeo

FRONT END STRUCTURES
- Tesla Model S
Diecast Tooling

Magnesium Dies Last Longer

- Magnesium alloys do not have an affinity to die steel like aluminum alloys.

- Typical magnesium diecast dies get over 3 times the die life compared to diecast dies used in aluminum and up to 10 times the die life compared to structural aluminum alloys.
Regular maintenance extends die life without the use of specialty coatings on die surfaces.
Understanding how high pressure die casting can be used to create thin walled structural components for additional weight reductions

THIN WALL STRUCTURAL COMPONENTS
Variation in Nominal Thickness

The cast magnesium inner panel varies in thickness from 2mm to 7mm.

Since it is cast instead of stamped, we are able to develop variable thicknesses.
Thin Wall Structural Diecastings
Magnesium Low Density Also Provides for Good Flow Characteristics

- Lightweight is a benefit to the diecast process to allow for thin walled part manufacturing.
- Good flow modeling correlation to diecast part allows for efficient part design.
- Thermal management methods from Al, zinc and plastic injection molding are adapted to magnesium.
- Fundamentals – pressure, velocities, and temperature controls ensure repeatability.
Wall Section Weight Savings
Ford F150 Front End Module

1ST GENERATION FRONT END CARRIER 2004-2007
- Weight: 12 lbs. (25 lb. savings over steel design)
- Integration of 12 components into one casting
- Nominal wall stock: 3.0

2ND GENERATION FRONT END CARRIER 2008-today
- Weight 6.5 lbs. (5.5 lb. savings over gen1 FEC)
- Nominal wall stock: 2.4

3RD GENERATION FRONT END CARRIER 2015
- Weight 6.2 lbs. (larger part than gen2 FEC)
- Nominal wall stock: 2.0
Let it be Light
Contact Information

We extend our sincere appreciation to you for taking the time to learn about magnesium, our company and the services we provide. Please contact us to learn more.

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Thank you for your time.
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