Summary of 2017 Chrysler Pacifica Lift gate Inner and Casting of the Year Award by American Foundry Society Summary

Meridian Lightweight Technologies and Fiat-Chrysler Automotive, Ltd.

By: Richard Berkmortel, P.Eng. Chief Engineer.

Name of Component:  Magnesium Liftgate Inner Casting
End-Use Industry:  Automotive
Component’s Function/Application:  2017 Chrysler Pacifica liftgate closure inner casting
Metal:  AM60B Magnesium alloy   Weight: 15.1 lbs
Dimensions:  1450mm x 1210mm x 315mm
Casting Process:  Cold chamber High-pressure die-casting
Converted From:  Steel stampings/welding. Activity started in 2012.
Savings (Time/Cost/Weight Provided:  Reduction in pieces from 7 to 1, reduction in weight from 24 lbs to 15.1 lbs from previous generation. Allows for total assembly weight reduction of over 22 lbs.
Summary.

The lift gate closure inner casting for the 2017 Chrysler Pacifica (Figure 1) is a collaboration between Fiat Chrysler Automobiles and Meridian Lightweight Technologies. This application represents the first high-volume application (greater than 250,000 annual volume) of its kind in the industry, and accounts for nearly 10% of the overall vehicle weight reduction. The Magnesium casting forms part of a four piece assembly with an Aluminum sheet outer (Upper & Lower) and Aluminum stamping wiper reinforcement to reduce weight of the entire assembly by over 22lbs and nearly 50% from the previous generation. The die-cast magnesium lift gate inner, (Figure 1) measures 1450mm in width, 1210mm in height, and weighs 6.9kg. The Magnesium casting replaces seven steel stampings and two plastic pieces that were welded and/or joined together including steel reinforcements in the hinge and latch areas. Consolidating steel/plastic components into one casting also reduces joining technologies required (i.e. spot welds, rivets, etc.) from 84 to 10 (6 rivets and 4 welds) from the previous generation. Figure 2 highlights the part consolidation realized in the lift gate assembly. The design of the lift gate inner was optimized for die-casting technology and specifically for magnesium die-casting allowing for an improved rearward visibility by 20mm per side. The casting also improves noise, harshness and vibration (NVH) by over 16 Hz in bending and prevents cavitation from idle boom and road boom by local ribbing, integrated gussets and thickness additions. The magnesium casting was designed to meet all dimensional and structural engineering requirements with a nominal wall stock of 2.3mm and localized ribbing and thick patches.

Figure 1: 2017 Chrysler Pacifica minivan, a) viewed from rear, and b) magnesium die-cast inner.

The casting design incorporates an Aluminum stamping wiper bracket reinforcement in part to provide for the gating area to feed the extremities of the casting. The die-casting die design additionally incorporates pockets for tail lamps and rear speakers during subsequent vehicle assembly. Further, utilizing advanced thermal management technologies was imperative in the thick mass regions to properly manage heat transfer and maintain a consistent temperature in the die steel to achieve high volume cycle times. The volume of the program requires multiple dies in rotation producing castings merging into a single process flow. The single process flow includes surface preparation, dimensional measurements, piercing and machining operations, followed by powder coating.

Figure 2: a) Component breakdown of previous generation lift gate assembly; b) Component breakdown of 2017 Pacifica lift gate assembly design, a weight reduction of 10kg.
Key Program Team

Assembly Leaving Thai Summit.
History

Introduction of Magnesium closures started in 2006 with a development program based on the 2007 CT which led to prototyping (P20 die) of an Mg Lift gate. This prototype proved the mass reduction capability of an Mg Inner Lift gate while meeting all performance requirements. FCA committed to the further development of an Mg Lift gate Inner for production in 2011 by targeting the WM/W166 Program as its lead program and when it was cancelled in 2012 the engineering work and knowledge gained was converted over to the RU Lift gate program. As part of the RU lift gate, we had a development phase with Chrysler with a 2.0mm wall stock prototype tool but for risk issues only a 2.3 mm wall stock production tool was implemented in production.

April, 2012  WM/W166 Lift gate initial program kick off - early design

May, 2012  Initial concepts developed to improve Chrysler design and provide better manufacturing concept.

May, 2012 - March 2013  
Ongoing design work, GD&T, manufacturing reviews, weekly meetings at Chrysler, flow simulations.

June, 2013  WM program cancelled at Chrysler

Jan, 2013  RU lift gate program start - initial discussions on program

Jan, 2013  Downloaded RU data from Chrysler for initial review. Single Surface Data. Meridian created a solid body at 2.3mm thickness to determine a quick weight.

Feb, 2013  Meridian rec'd new data again from Chrysler with more cutouts trying to decrease projected area. Meridian to review model for manufacturing concerns. Modify a model to review Projected Area and gating options.

March, 2013  RFQ from BD – 2013 – 1st. First cost model on program

Jan – Dec, 2013 Prototype design development - Design reviews, weekly meetings at Chrysler, GD&T, Manufacturing reviews etc.

Dec. 2013  P-20 tool kick off (2.0mm wall stock) and die build
May, 2014  Prototype sample builds - sample preparation, cast. Laser machining etc.

Onward  Follow key program dates.

**Key Program Dates**

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**Summary of Technical Issue resolved for the program**

- Develop cost efficient secondary process 100+ features.
- Develop process to “true” the parts to meet dimensional requirements.
- Implement lessons learnt on previous programs.
- Develop visual acceptance criteria standard.
- Develop processes to best help hide cast defects and a visual quality standard that is agreed upon by FCA Engineering and FCA Assembly plant.
- Develop paint process parameters to allow for RU LG to be coated on current paint line.
- Understand and report root causes for corrosion and paint related issues reported by FCA.
- Understand and report root causes for mechanical properties reported by FCA. Understand effect of trueing process on mechanical properties of casting.
• Determine gating/runner system, identify opportunities for thermal improvements, and attempt to predict distortion using CAE software.
• Determine optimum fastener specification (hole diameter, fastener coating, torque specification) for M6 and M8 fasteners, and support FCA issue resolution.