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.

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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.

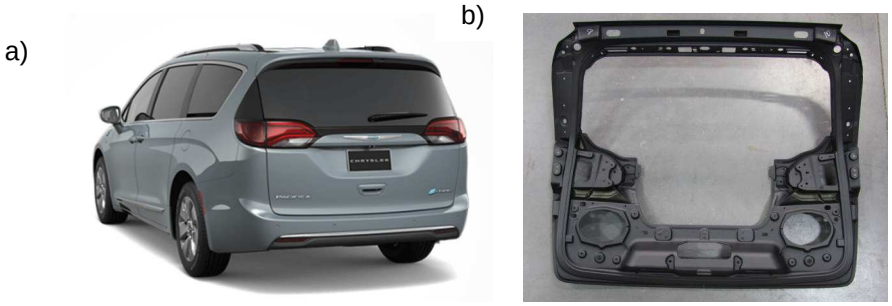


Figure 1: 2017 Chrysler Pacifica minivan, a) viewed from rear, and b) magnesium die-cast inner.

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.

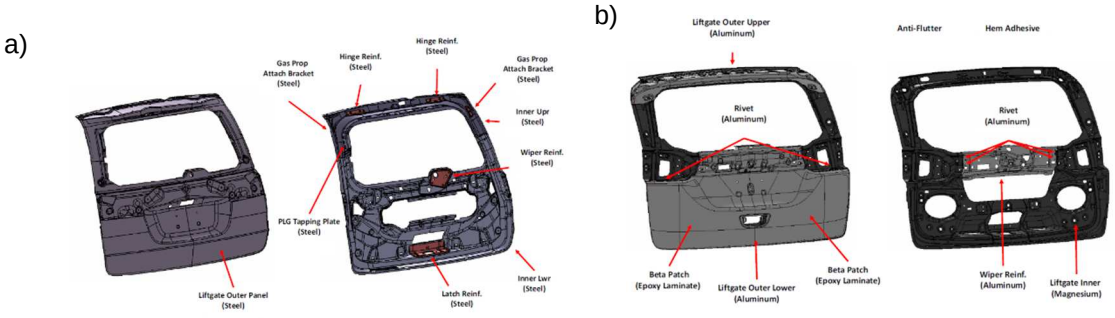
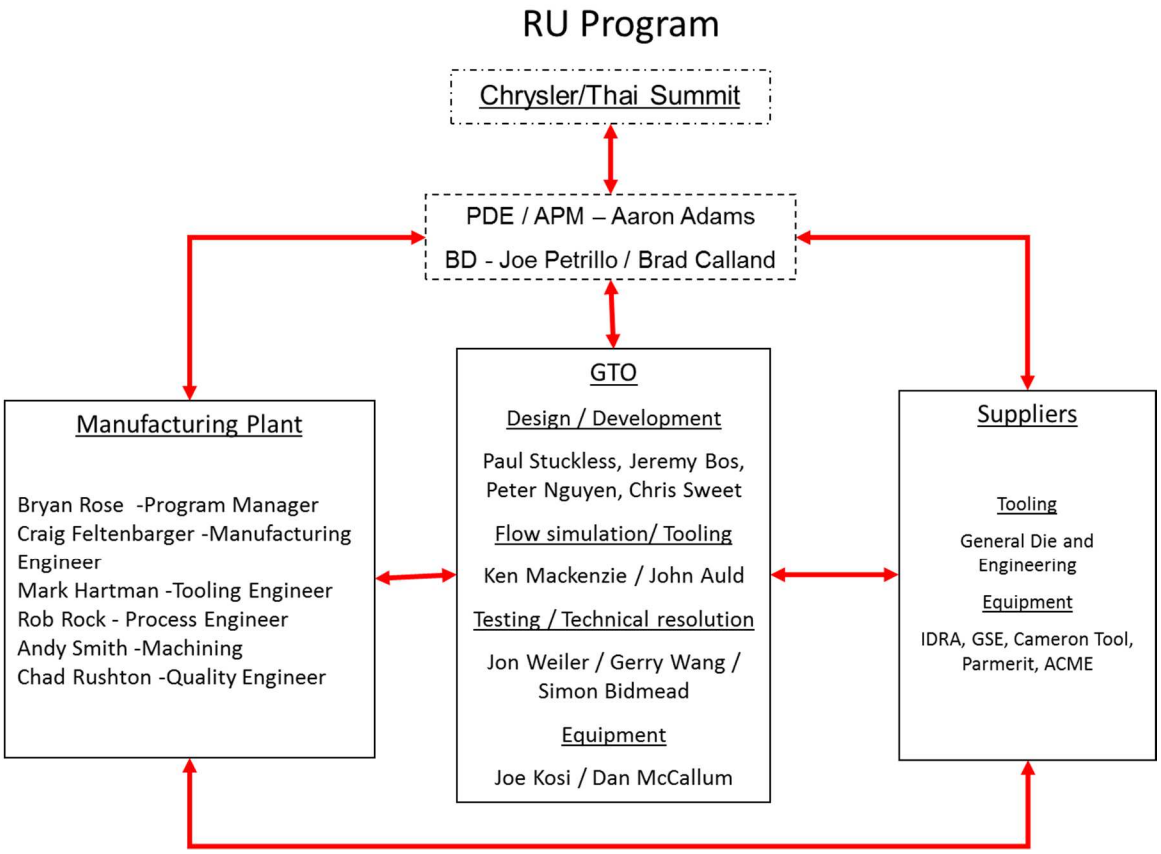


Figure 2: a) Component breakdown of previous generation lift gate assembly; b) Component breakdown of 2017 Pacifica lift gate assembly design, a weight reduction of 10kg.

Key Program Team



Departmental Leaders: Joe Petrillo – BD, Richard Berkmortel – Eng., Michael Boorsma – AE, Simon Bidmead – FP, Walt Aldrich – MPA

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

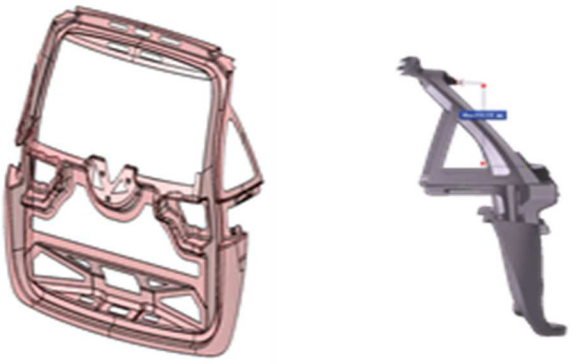
Ongoing design work, GD&T, manufacturing reviews, weekly meetings at Chrysler, flow simulations.

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

	2014					
	Jul	Aug	Sep	Oct	Nov	Dec
Design	CAD step3		CAD step 5			
Parts Delivery						
Capital		K/O DCM	K/O M/C & Buff	KO Coin & Ded M/C	K/O inspection	
Tooling	K/O – P-20		K/O H13 (1)		K/O H13 (2)	P-20 Del
Samples						P-20 (1)

2015												2016	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	TTO		VPA		VPA -2	VPB	VPB-2		PSA - PPAP				SOP
		M/C & Buff ready			Ded M/C & Inspect ready				DCM Ready				SOP
K/O H13 (3)		H13 (1) Del		H13 (2) Del	H13 (3) Del			PPAP die 1	PPAP die 2		PPAP die 3		
		H13 (1)	P-20 (2)	H13 (2)	H13 (1/3)	H13 (2)	H13 (1)	H13 (2/3)		H13 (3)			

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 learn 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.