

Altair Enlighten Award 2015 Nomination Form

General Information

Name of System or Component

Victor Reinz® Thermoplastic Cylinder Head Cover with MuCell®

Name of nominating company(s)

Dana Holding Corporation

Lead contact

- **Name:** Wendy Dukeshire
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Description of the System or Component

To reduce weight and meet the specific needs of Ford Motor Co., its customer, Dana Holding Corporation created a Victor Reinz® Thermoplastic Cylinder Head Cover with MuCell®, a molding technology that Dana licensed from Trexel Inc. The existing head covers for this application were created with magnesium, but to secure necessary improvements, Dana sought out a different material and integrated a new manufacturing process to deliver a more cost-effective, lighter weight head cover. By using MuCell® – a microcellular foam injection molding process that utilizes nitrogen injected in a super critical state to create microscopic gas cells within plastic structures – the company was able to successfully reduce component weight, while still maintaining durability and stability. The resulting foamed structure replaces what otherwise would need to be a solid plastic part, creating improved product design flexibility and decreased use of plastic material for overall weight reduction. Furthermore, MuCell® assisted in giving the head cover the product design flexibility that it needed to meet the challenging geometric configurations of the engine.

Note: MuCell® is a registered trademark to Trexel Inc.

Vehicle application

- **Make:** Ford
- **Model name:** F-250 through F-550
- **Model year:** 2015

Eligibility - Please confirm the following:

- The nominated System or Component is fitted to a production vehicle manufactured between August 2011 and August 2014
- Permission to submit this nomination has been received from vehicle OEM
- The nominated System or Component been not been nominated for the Enlighten Award before

Check box to confirm



Weight Reduction

What are the weight savings of the nominated system or component over a comparable baseline component or system?

Dana's application of MuCell® on its cylinder head cover offers up to 29 percent in weight savings over a traditional magnesium counterpart.

What is the most significant factor in achieving the weight saving?

The most significant factor in achieving weight savings comes from MuCell® enabling the complex part to be manufactured with plastic. Based on the complexity of the part's geometry, tolerance requirements, and placement in the vehicle, converting the part from magnesium to plastic would have been increasingly challenging – if not impossible – and resulted in a lower weight savings, had MuCell® not been part of the solution. Clearances and tolerances were extremely tight and required a combination of complex tooling and dimensional stability to achieve a functional part. In addition to the tight clearances, the head cover structure presents a unique challenge to designers in order to achieve the required stiffness with the different material. MuCell®, combined with Dana's extensive analysis efforts, allowed for a plastic part design that reduced weight while also meeting the part's structural stiffness requirements.

What was the cost impact over the baseline to achieve the weight saving?

For this thermoplastic cylinder head cover with MuCell®, Dana was able to provide significant cost savings to its customer.

Design Methodology

What is innovative about this design solution?

This particular head cover application offered an extremely tight packaging space in addition to structural challenges. With the use of Mucell® and Dana's plastic design capability, all requirements were able to be met for this application. Traditional plastic head covers may take three to five iterations of analysis before reaching an acceptable design solution. Due to the complexity of the structure, Dana analyzed 24 progressively optimized designs before reaching a solution that met the requirements. Without Dana's design and analytical capability, combined with the processing and dimensional improvements from the MuCell® process, this head cover would likely remain in its original metal form.

What novel design processes were employed?

Dana used computer-aided engineering (CAE), including the Altair HyperMesh package, to rapidly construct models for analysis. HyperMesh made modifying the design (e.g. adding structural ribs) possible, without requiring the involvement of a CAD designer to generate a revised 3D model. This enabled Dana to develop an ideal design configuration that delivered the best results to its customer. In spite of challenging geometries, Dana overcame the nearly impossible, engineering intensive task of finding a design iteration that would work for this particular application. Unlike traditional cylinder head covers which have implied structural integrity based on the use of magnesium, this product needed to be designed with a material that offers less natural stiffness in order to deliver adequate weight savings. Dana was able to overcome extremely challenging design configurations and accomplish the transition in materials, while still maintaining durability, functionality and seal ability, and at the same time meeting noise, vibration, and harshness (NVH) needs.

What design challenges were overcome?

Based on the complexity of the geometry, tolerances required and structural stiffness needed for this technology to match the needs of the customer's engine, finding a solution was not easy. It was difficult to achieve the same structure because the shape of the mold required modifications to accommodate the change in materials. This particular cam cover features a serpentine sealing land and a cantilevered shape to allow it to wrap itself around the balance shaft. After applying its extensive expertise in developing high-performance, quality sealing parts, and experimenting with a variety of

different design configurations, Dana was able to secure enough structure for sealing while also reducing mass through the use of MuCell®.

Manufacturing Process

What vehicle assembly changes were required to accommodate this solution?

Since this solution resulted from a longstanding customer requesting Dana find a way to match its specific vehicle assembly needs while reducing product weight and cost, there were no vehicle assembly changes required. The product was developed to match Ford's vehicle configuration and therefore the touch points were manufactured to be identical.

What new manufacturing processes were employed?

MuCell® was the new manufacturing process that was employed to make the conversion from magnesium to plastic within this specific cylinder head cover possible. In fact, it is the first application of MuCell® in this capacity in North America.

What manufacturing challenges were overcome?

Beyond the design challenges Dana faced during this product's development, no manufacturing challenges were realized.

Industry Significance

How is this solution applicable to other applications/programs?

This solution is a candidate for designing and manufacturing other cylinder head covers and can be applied to a range of other right-sized, powertrain components, depending on the product's functionality and specifications.

Does the solution offer component/system performance enhancements in addition to weight savings?

When taking on the challenge of finding a more cost-effective and lighter weight cylinder head cover, Dana kept a key focus on (and was successful with) overcoming the difference in materials through innovative engineering, with the goal of meeting the objectives and maintaining the part's structural integrity and performance.

Has this solution been granted any patents or received any awards?

This solution has not yet been granted any patents or awards, however MuCell® itself is a patented molding process.

All entries and questions should be sent to enlightenaward@altair.com

Receipt of this nomination will be acknowledged via email

Altair Enlighten Award 2015 Rules

Eligibility

The 2015 Altair Enlighten Award (“Award”) is open to original equipment manufacturers (OEMs), systems/parts suppliers and materials suppliers from all automotive industry segments, who are nominated (as defined below) for the Altair Enlighten Award (“Nominee(s)”). Altair Engineering, Inc. (“Altair”) and the Center for Automotive Research (“CAR”) are the sponsors of this Award (Altair and CAR collectively, the “Sponsor”). These Award rules govern the Award (“Award Rules”).

Submitting a Nomination for the Award and Entry Period

- A Nomination for a Nominee may be submitted on behalf of an OEM, a supplier or may be a joint Nomination involving two or more entities such as an OEM and a supplier (“Nomination”)
 - Nominations from tier-suppliers must have received prior approval from the appropriate OEM before submitting a Nomination for designs
- Multiple Nominations by an organization are acceptable
 - A component or system can only be submitted for consideration only once
- The system or component must be fitted to an automotive vehicle (motorcycle, passenger car, light truck, commercial truck or bus) in production anytime between August, 2012, and August, 2015
 - A specific production volume is not a criteria, but a vehicle fitted with the nominated system or component must be available for purchase during the production window specified
 - Aftermarket components are not eligible for the Award nomination
- Nominations for the Award must be received between September 1st 2014 and May 29th 2015
 - Entries can only be submitted using the official nomination form available on the AltairEnlighten.com website
 - Receipt of a nomination form will be acknowledged via email
 - Additional supporting materials (including pictures, PowerPoint presentations and representative parts) may be provided but must be received before May 29th 2015.

Judging Criteria

- The judging panel consists of an Altair representative and a CAR representative who will chair a group of recognized industry experts
- Successful Nominations will:
 - Show significant weight saving over a comparable baseline component or system
 - Demonstrate a design solution that is novel to the industry
- Preference will be given to Nominations that:
 - Provide a solution that is applicable to other applications/programs
 - Deliver a cost neutral product
 - Employ an innovative design process

Preliminary Judging

- Communication about the Nomination will be directed solely to the lead contact of the nominating team specified on the nomination form
 - In the event that the lead contact leaves the organization during the judging process a replacement can be submitted
- Preliminary judging will be based solely on the quality of the entry submitted via the nomination form and any supporting material provided
 - In some instances the judging committee may contact a nominee for more information
- Selection of finalists will be made during May and June 2015.

- A joint Altair/CAR press release publicly announcing the finalists will be made after the Nominees have been informed

Final Judging

- Communication about final judging will be directed solely to the lead contact for the Nominee
- Final judging will be based on a presentation made by the nominating team
 - The logistics of the presentation will be arranged individually with each finalist and maybe either via a physical meeting or web conference
- The judging committee will meet to decide the winning entry and honorable mentions during July, 2015

Altair Enlighten Award Recognition

- The winning entrant(s) will be announced during the CAR Management Briefing Seminar (MBS) 2015 event August 3-6 2015
 - The Altair Enlighten Award trophy (the "Award") will be presented to the winner and honorable mentions will be announced
- A joint Altair/CAR news release will be made during August
 - This will announce the winner and honorable mentions
- The winning entrant will be featured in a significant advertisement placed in a major industry magazine

Requirements of Nominees and Disclosure of Entry

By entering a Nomination for the Award, each Nominee represents and warrants that any information submitted to Sponsor does not infringe the intellectual property rights of any third party. Sponsor reserves the right to independently verify the originality and ownership of any Nominee's Nomination, and to validate that said Nomination does not violate the proprietary rights of any third party. By submitting a Nomination, Nominee's ideas, methods and materials may be made available to the public.

Permission to Publish

Nominees retain ownership of their Nomination(s), including all intellectual property rights which may exist in the Nomination. However, by submitting an Nomination, Nominees grant Sponsor the unconditional and perpetual right, license and consent to reproduce, encode, store, copy, transmit, publish, post, broadcast, display, and exhibit the Nomination in any media throughout the world, without limitation, and without additional review, compensation, or approval from Nominee or any other party. Sponsor shall have the right, to use Nominee's name, product likeness, biography and other information about Nominee in connection with Nominee's Nomination. By submitting an Nomination, the Nominee further agrees not to instigate, support, maintain, or authorize any action, claim, or lawsuit against the Sponsor, or any other person, on the grounds that the Sponsor's use of Nominee's Nomination as set forth in these Award Rules infringes Nominee's rights, including, without limitation, copyrights, patent rights, or trademark rights. Nominee further acknowledges that the Sponsor is in no way obligated to protect any intellectual property rights which may exist in the Nomination. It is Nominee's sole responsibility to secure any intellectual property rights which may exist in Nominee's Nomination, whether before or after it is submitted.

Release and Limitations of Liability

By participating in the Award, Nominee agrees to release and hold harmless the Sponsor and its respective officers, directors, employees, and agents (the "Released Parties") from and against any claim or cause of action arising out of participation in the Award or receipt or use of any Award, including, but not limited to, any infringement of any third party intellectual property rights in connection with Nominee's Nomination. Nominee waives the right to claim any damages whatsoever, including, but not limited to, punitive, consequential, direct, or indirect damages.

Governing Law

The Award is subject to United States federal, state, and local laws and regulations and is void in Cuba, Iran, Libya, North Korea, Sudan, Syria, and where prohibited by law. These Award Rules shall be governed under and construed by the laws of the State of Michigan without respect to conflicts of law principles.

Sponsor's Contact Information

For all questions, please email enlightenaward@altair.com.

VOID WHERE PROHIBITED BY LAW.