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SUPERPLUG® DOOR HARDWARE MODULE IS 2011 *HALL OF FAME* WINNER AT SPE® *AUTO INNOVATION AWARDS COMPETITION*

TROY, (DETROIT) MICH. – The *SuperPlug*® integrated composite door-hardware module—which first debuted on 1997 model year (MY) Chevrolet® Venture® and Malibu®, Pontiac® Transport®, Oldsmobile® Silhouette® and Cutlass®, and Opel® Sintra® vehicles from then General Motors Corp. (GM)—was selected as the 2011 ***Hall of Fame*** winner of the ***Automotive Division of the Society of Plastics Engineers'*** (***SPE®'s***) 41st-annual ***Automotive Innovation Awards Competition***. To be considered for a *Hall of Fame* award, an automotive-plastic component must have been in continuous service in some form for at least 15 years and preferably have been widely adopted within the automotive or ground-transportation industries. As the first all-plastic integrated door-hardware module, it reduced components and fasteners by up to 75% by molding features into a single gas-assist injection-molded composite frame that literally "plugged-into" the inner door on the vehicle-assembly line, improving ergonomics and quality, saving labor time and costs, and reducing warranty claims.

According to SPE Hall of Fame committee co-chair, Nippani Rao, president, Rao & Associates, "The success of the *SuperPlug* program is easily seen when you consider that industry sources estimate that over 250-million integrated composite door-hardware modules have been produced globally by all suppliers since 1997 and used on over 60-million vehicles worldwide. At an average of 5 pounds of plastic per module, that's over a billion pounds of resin consumed in just this one automotive application. That makes it an ideal example of the type of component that warrants an SPE *Hall of Fame* award."

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First Door Hardware Module Named Hall of Fame Winner
2-2-2-2

The module was jointly developed during a 5-year program that started in 1990 by then Delphi Interior & Lighting Systems (at the time a division of GM, and whose business, production, and patents have since been transferred to Inteva Products, LLC) and GE Plastics (now SABIC's Innovative Plastics business unit). The collaboration this program fostered between the suppliers would eventually become a model of close business and technical alliances between members of the automotive supply chain.

At that time, the interior of conventional automotive doors featured dozens of separate components and subassemblies that were installed individually and had to be bolted, screwed, welded, and/or riveted into place in a labor-intensive process. Delphi had previously been successful with its steel back-plate door modules, which had moved assembly labor out of GM's vehicle assembly plants and into the supplying plant. However, these modules did not eliminate labor; they only relocated it to a facility with more efficient assembly operations. As engineers at Delphi's Advanced Development Group began working on the next-generation door-hardware module, they wanted to minimize labor, not just relocate it, and they proposed doing so by taking advantage of the design flexibility and parts consolidation possible with injection-molded plastics. Additional program goals were to meet GM's targets for mass, parts, and cost reduction; investment savings; and shorter development times.

Through an iterative design process, using finite-element analysis, moldfilling analysis, design of experiments, design for assembly, process optimization, and extensive real-world production validation, a new design was created that could be molded to replace the sheet-metal module back plate with a single-piece modular frame. Gas-assist injection molding—which produces hollow sections in an otherwise solid-plastic part via injected gas that hollows out channels—was attractive for the module since it could produce lightweight parts with excellent stiffness and dimensional stability in a cycle time of 80 seconds without need for special (and costly) tooling features like slides. And a new grade of glass-reinforced Xenoy* polycarbonate/polybutylene terephthalate (PC/PBT) resin, specially developed by GE for the application, was specified for stiffness, strength, impact resistance, compatibility with automotive chemicals, and to improve energy absorption of the door panel vs. steel.

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First Door Hardware Module Named Hall of Fame Winner
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With the new module, many key components—including wire harnesses, the door handle, window guidance channels, stereo speakers, and electric motors—were snapped into place at Delphi's assembly plant and pretested before being shipped to GM's assembly lines. This improved the OEM's material-handling situation and potentially reduced subsystem rejects by up to 96%. The modular design not only improved assembly but also made later serviceability/repair much simpler. Assembly ergonomics were further improved, since line workers no longer had to "fish" components into the door in various locations to be riveted or bolted in place, and the molded frame eliminated the die grease and sharp edges typical of traditional metal components. The module even had a molded-in carrying handle that made it easier for workers to remove it from shipping crates and position it inside the door cavity. With fewer attachments needed, fewer tools were required for assembly, lowering investment costs and assembly-line labor time by 3 minutes, netting a 10% cost savings.

By molding features into the plastic carrier, over 40 metal parts plus 15-25 fasteners were replaced with a single composite module and 5-6 fasteners. Hence, labor at all points in the build process was reduced, fewer components needed to be purchased, inventoried, and used, and a host of other benefits were also gained including over 50% reduction in warranty costs thanks to parts reductions and easier repair. Additionally, replacement of metal parts and fasteners with sound-absorbing plastics reduced high-frequency vibration and led to quieter motor/gear operations and hence doors with lower buzz/squeak/rattle (BSR) values. Scrap was reduced, since the new gas-assist process had a 99% yield quality. Weight was reduced approximately 3.3 lb/1.5 kg per door, which helped improve fuel economy and lower emissions. And the module, which was fully melt reprocessable once components were unloaded, met European recyclability requirements.

Interestingly, at the time it launched, the *SuperPlug* module represented three untried technologies: it was the first complex part ever produced with gas-assist injection molding; it used a new grade of glass-reinforced PC/PBT; and the component itself represented the highest level of parts integration then achieved with door modules.

So significant was the technology developed for this program that nine key patents were issued between October 1993 and June 1998. The module also won numerous prestigious awards, including: SPE ANTEC's Plastics Industrial Product Design Award; Modern Plastics International magazine's Process Award; Plastics & Rubber Weekly (PRW) magazine's Award of Excellence in Transportation Category; the International Body Engineering Conference's (IBEC's) Design Award; and Design Fax magazine's Five-Star Product of the Month Award.

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First Door Hardware Module Named Hall of Fame Winner
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On November 9 at SPE's annual ***Automotive Innovation Awards Gala*** at Burton Manor (www.Burtonmanor.net) in Livonia, Mich., Kelly Gladney, director-Interior & Safety at GM will accept the award on behalf of the original GM team that worked on the program. Other team members who will be recognized on stage include William Hanna, vice-president and executive director-Closure Systems, Inteva Products, LLC; Suresh Shah, senior technical fellow, Delphi Corp.; and Matthew Marks, automotive marketing manager, SABIC Innovative Plastics.

The 2011 SPE Automotive Division *Hall Of Fame committee* was co-chaired by Nippani Rao, Rao & Associates and Dave Reed, *retired*, General Motors Corp. Committee members include Bonnie Bennyhoff, ExxonMobil Chemical; Terrence Cressy, DuPont Automotive; Fred Deans, Allied Composite Technologies, LLC; John Fialka, Styrolution Group GmbH; Ed Garnham, *retired*, General Motors Corp.; Anthony Gasbarro, Marubeni America Corp.; Jeffrey Helms, Ticona Engineering Polymers; Norm Kakarala, Inteva Products, LLC; James Kolb, American Chemistry Council; Mark Lapain, Magna International Inc.; Josh Madden, *retired* General Motors Corp. and Volkswagen North America Inc.; Gordon Miesel, *retired*, Ashland, Inc.; Allan Murray, Allied Composite Technologies, LLC; Kevin Pageau, Tegrant Corp.; Tom Pickett, General Motors Co.; Irv Poston, *retired* General Motors Corp.; Suresh Shah, Delphi Corp.; Venkatakrishnan Umamaheswaran, SABIC Innovative Plastics; and Bill Windscheif, Advanced Innovative Solutions, Ltd.

This year's ***Automotive Innovation Awards Gala*** begins with the VIP Cocktail Reception at 4:30 p.m., generously sponsored by Ticona Engineering Polymers. At 5:00 p.m. the main exhibit area will open for general admission and guests can review this year's ***Automotive Innovation Awards*** part nominations, as well as enjoy the specialty and antique vehicles that are always a highlight of the show. Dinner will begin at 6:30 p.m. and the awards program itself will last from 7:00-9:00 p.m. For those who wish to extend merrymaking and networking activities, the ever-popular *Afterglow* – also sponsored by Ticona – will run from 9:00-11:00 p.m.

SPE's Automotive Innovation Awards Program is the oldest and largest competition of its kind in the world. Dozens of teams made up of OEMs, tier suppliers, and polymer producers submit nominations describing their part, system, or complete vehicle and why it merits the claim as the Y*ear's Most Innovative Use of Plastics*. This annual event typically draws 600 to 800 OEM engineers, automotive and plastics industry executives, and media. As is customary, funds raised from this event are used to support SPE educational efforts and technical seminars, which help educate and secure the role of plastics in the advancement of the automobile.

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First Door Hardware Module Named Hall of Fame Winner
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The mission of SPE is to promote scientific and engineering knowledge relating to plastics worldwide and to educate industry, academia, and the public about these advances. SPE's Automotive Division is active in educating, promoting, recognizing, and communicating technical accomplishments for all phases of plastics and plastic-based-composite developments in the global transportation industry. Topic areas include applications, materials, processing, equipment, tooling, design, and development.

For more information about the ***SPE Automotive Innovation Awards Competition and Gala***, please visit the ***SPE Automotive Division*** website at **http://speautomotive.com/inno** and **http://speautomotive.com/awa**, or contact the group at +1.248.244.8993, or write SPE Automotive Division, 1800 Crooks Road, Suite A, Troy, MI 48084, USA. For more information on the ***Society of Plastics Engineers*** or other society events, visit the ***SPE*** website at **www.4spe.org**, or call +1.203.775.0471.

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ATTENTION EDITORS: High-resolution digital part photography for all of the 2011 nominations, including the Hall of Fame winner may be found at http://www.flickr.com/photos/speautomotive/collections/72157627886707996/.

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