AUTOMOTIVE PLASTICS News

A PUBLICATION OF THE AUTOMOTIVE DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS

December 2007 - Volume 37, Issue 1

SPE Announces Winners for the 37th-Annual Innovation Awards Competition.

The Automotive Division of the Society of Plastics Engineers (SPE®) International announced this year's nominations, finalists, and winners in the 37th-annual SPE Automotive Innovation Awards Competition, the oldest and largest recognition event in the automotive and plastics industries. Category, Hall of Fame, and the prestigious Grand Award winners were announced the evening of November 7 during the SPE Automotive Innovation Awards Gala.

The 37th-Annual SPE Automotive Innovation Awards Gala commenced at Burton Manor in Livonia (Detroit), Michigan to once again honor winners of the competition for the year's *Most Innovative Uses of Plastics* in transportation applications.

This year's event kicked off with a press conference to introduce members of the media to SPE's Executive Award Winners and the Gala's major sponsor, Ticona Engineering Polymers. The media briefing rolled into the VIP cocktail reception sponsored by Ticona. Dinner was served to a near-capacity audience starting at 6:30 pm and the event formally began at 7 and ended just after 9 pm. Like last year, an Afterglow reception followed for those able to stay longer. The gala was attended by transportation engineers, business executives, materials suppliers, and media.

AUTOMOTIVE INNOVATION AWARDS COMPETITION & GALA

HONORING THE BEST IN AUTOMOTIVE PLASTICS

The ***SPE Automotive Innovation Awards Competition*** is the oldest and largest recognition event in the automotive and plastics industries, and is considered to be among the best networking opportunities in the North American automotive communities.

The **Grand Award** winner - the most prestigious award of the evening - went to the winner of the **Materials** category, an application called Backlighting using Color-Converting Plastic, used on the '07 MY

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Elias Boueri of General Motors accepts the Grand Award from Brian Grosser, SPE Innovation Awards Program Chairman.

Treasurer's Report

John Fialka

The SPE Automotive Division bank account balance is in good standing with $109K in checking and $27K in savings. The Golf outing was break-even this year with income and expenses netting out at $12K. The Composites Conference was a success with excellent attendance and sponsorship. The income reported to date for the ACCE is $136K. Expenses recorded thus far are $102K. I will have a final update on the financial results for the conference in the next newsletter. The income reported to date for the awards event is $115K, expenses are $60K. A final report from the awards event is expected by year-end. A copy of the 2006-2007 financial report and copy of taxes were sent to SPE International.

Automotive Division Meeting Schedule and Special-Events Calendar

Division Board of Directors Meeting ACC, Troy, MI	January 21, 2008
Division Board of Directors Meeting APC, Troy, MI	March 17, 2008
AutoEPCON Best Western Sterling Inn Sterling Heights, MI	April 22, 2008
ANTEC 2008 Midwest Express Center & Milwaukee Hilton City Center Hotel Milwaukee, Wisconsin	May 4 -8, 2008
Division Board of Directors Meeting APC, Troy, MI	May 12, 2008
Automotive Composites Conference & Exhibition (ACCE) MSU Management Education Center Troy, MI	September 16-18, 2008

Automotive Division Board of Directors meetings are open to all SPE members, and are usually held at the American Chemistry Council (ACC) in Troy, MI. Call Brian Grosser at (248) 941-9368 for more information.

www.speautomotive.com

QTI running at the Detroit Technical Center.

Chairman's Message

Brian Grosser

This newsletter highlights the 37th- Annual Automotive Innovation Awards Competition and Gala, which was held on November 7 at Burton Manor in Livonia, MI.

The Innovation Awards continues to be the premier recognition event within the automotive plastics community and it provides us an opportunity to properly recognize novel advancements and the key executives that help cultivate innovation.

While the automotive industry is enduring some challenging times, this event allows us step back for a night, and celebrate some of our victories and reflect on the progress we continue to make. As always, we encourage your feedback. We are continually looking for ways to improve this event and how we honor the best in automotive plastics.

I would like to give my sincere thanks to all of our sponsors that make the Innovation Awards possible each year. Their generous support has enabled us to improve the overall quality and elegance of the event.

In addition, the proceeds from the Innovation Awards and our technical conferences help to fund the Automotive Division's educational outreach. This includes scholarships for students pursuing degrees in plastic related fields, PlastiVan visits to local schools, and plastics-related design projects.

Congratulations once again to our executive award Recipients: Lawrence (Larry) Burns, vice-president of R&D at General Motors, received the Global Executive Engineering Leadership Award; James Queen, group vice-president for Global Engineering at General Motors, received the Executive Leadership Award; Josh Madden, won the Lifetime Achievement Award, and Hiroaki Yamamoto, chief technology officer at Green Tokai Company, received special recognition for Global Plastics Engineering. Each award was well deserved and the presence of these people during the Awards night made the event even more special.

The Innovation Awards planning committee did an outstanding job. While many people contributed to the success of this event, I would be remiss if I didn't recognize some key contributors.

Suzanne Cole did a great job in assisting with the executive award winners; Mark Lapain handled sponsorship; Peggy Malnati, as Communications Chair pulled together our literature, press conference and press releases; Kevin Pageau, facilitated our nomination process and first round judging; Monica Prokopyshen coordinated our Blue Ribbon Judging.

Last, I would like to remind everyone that our next event is AutoEPCON, a one-day conference that focuses on advancements in engineering thermoplastics. It will be held on April 22, 2008 at the Best Western Sterling Inn. This year, Tom Pickett of General Motors and Nippani Rao of Chrysler LLC are leading the charge and the event is really starting to take shape. If you are interested in presenting at this conference, being a sponsor or just want to attend, please note the conference flyer within this newsletter.

Thanks for making 2007 another great year for the SPE Automotive Division. I look forward to seeing you at our SPE Automotive events next year.

AUTOMOTIVE SPE INNOVATION AWARDS COMPETITION & GALA

HONORING THE BEST IN AUTOMOTIVE PLASTICS

Continued from Page 1

General Motors Chevrolet® Tahoe SUVs. The Blue-Ribbon judges felt this application was the most innovative in this year's entire competition.

This patented system for producing custom-colored interior backlighting via LEDs (fed through light distribution pipes) relies on patented fluorescing dyes and proprietary light-scattering additives in translucent resins used to mold buttons, knobs, and backlit plates rather than far more costly custom-colored LED bulbs. Moving color control from the LED to the plastic button not only results in more uniform, controllable emitted color, but also makes backlighting in low-volume, niche colors economically feasible. The system supplier and processor is Delphi Electronics and Safety Systems. Bayer, BASF, and RTP provided materials, and Kno-Mar Tool provided the tooling.

In the category of **Body Exterior**, the category winner is the Composite Step Assist on the '07 MY General Motors Trailblazer® / Envoy® SUVs. Innovation in rib design and use of weatherable material enabled this 1-piece running board to withstands higher loads with lower deflections than the 5-piece steel and plastic assembly it replaced. It is produced in a 2-stage injection molding process and provides a 50% mass reduction and a direct cost savings in excess of $19 USD / vehicle, while also lowering assembly complexity, improving aerodynamics, eliminating corrosion, and quieting buzz/squeak/rattle noise. The system supplier is Magna/Decoma, with the parts supplied by Mytox Division of Magna.

For **Body Interior**, the category winner is the Door Trim & Hardware Module on the '06 MY Chrysler® Caliber / Compass / Patriot SUVs from Chrysler LLC - This unique assembly combines all door hardware components plus trim panel in a single module produced via injection molding and the 2-shot bolster process. It is directly sequenced into the plant, arriving fully tested to reduce door dress-up at the vehicle assembly plant, and offers 10% weight and $10-$17 USD OEM cost savings per vehicle. The System Supplier is Grupo Antolin, molders include International Automotive Components, Dow Automotive supplied the PP material, and HiTech is the tooling supplier.

This year's **Chassis/Hardware** category winner is the Extruded Seal for HIM Door Modules on the '07 MY Dodge® Nitro / '08 MY Jeep® Liberty SUVs from Chrysler LLC. This is the first time a TPE has been extruded directly onto a door module carrier, providing a 360o seal that acts as a water barrier between wet/dry sides, an acoustic barrier, and seals out dirt and dust. The seal is fully recyclable, simplifies assembly, is more robust than previous technology, and reduces material costs 53%, capital expenses

15%, seal mass 48%, and tack/cure time 90%.. Faurecia Interior Systems serves as the system supplier and processor. Reis Robotics provides tooling and ExxonMobil is the material supplier for both the polypropylene substrate and Santoprene seal.

The winner in the **Performance & Customization (Automotive Aftermarket)** category this year is the Folding Pickup Bed Extender on the '06 MY Ford® F250 pickups by Ford Motor Co. This is the first blow-molded pickup bed extender, replacing roll-formed steel or aluminum profiles, while reducing part count, weight, cost, assembly, and quality costs. The high-strength fully-recyclable composite solution features in-mold-color and grained texture to meet OEM Class A specs, retaining excellent grain quality in such a large blow-molded part. The system's unique design provides 3 methods of use: cargo, storage, and stowaway to increase usable bed space on pickups. ABC Group designed and produced the blow molded and injection molded parts, with material provided by Salflex Polymers.

In the **Powertrain** category the winner is the Electronic Throttle Control Module on the '07 MY Chrysler® Pacifica cross-over vehicle from Chrysler LLC. This is the first plastic ETC housing, which replaces machined cast aluminum at mass savings of 28% and costs savings of 18%, while also reducing warranty costs and potential for ice freeze-up and potential throttle blade stick. A special zero-shrink BMC grade was used and the units tight concentricity better controls air flow at idle. The system supplier is Bosch, tooling and part processing by Christophery and the material supplier is BMC Inc.

The winner In the **Process / Assembly / Enabling Technology** category, is the Front End Carrier on the '07 MY Volkswagen® Golf® / Bora® / Jetta® passenger cars. This is the first direct-long fiber thermoplastic (D-LFT) composite front-end carrier compounded with a twin- instead of single-screw extruder during the inline compounding (ILC) portion of the process. ILC provides cost and weight savings vs. conventional injection and GMT composites, while also eliminating many secondary operations. The material suppliers are Basell & Owens Corning while the processor and System supplier is Aksys de Mexico.

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The winner in **Hall of Fame** category - for applications in continuous use for at least 15 years, is the Glass Reinfored Nylon Radiator End Tank on the '82 MY Ford® Escort® / Mercury® Lynx® compact cars from Ford Motor Co. As one of the first major underhood applications for engineering plastics, the radiator end cap broke ground for many future engine-compartment applications. The objectives for converting the application from aluminum to nylon were parts integration and cost reduction, weight reduction, and equal or better performance.

It was particularly challenging to develop and test materials in hot ethylene glycol (antifreeze) solutions. DuPont developed new grades of their glass-reinforced nylon resin and tested prototypes in a "jungle room" with hot antifreeze running through the parts 24 hours a day. Mold design with movable cores, design for low part warpage, and multifunctional design were all partnered in this application among Ford PPD, Hoover Universal, and DuPont. The success of this application was later expanded by recycling strategies that included a novel chemical recycle method for radiator end caps that was honored with the 2004 Environmental Award for New Technology in Materials and Processes given by the Environmental Division of SPE at the Global Plastics Environmental Conference.

Innovations in processing, materials, and design used in this application were later translated to charge-air coolers, thermostat housings, and many other powertrain applications that continue to this day. The system supplier was Ford Plastics Product Division , the material processor Hoover Universal, and the resin was supplied by DuPont Automotive.

According to Kevin Pageau, account manager, Tegrant Corp. and also SPE Automotive Innovation Awards past-chair and current Innovation Awards nominations chair, "While this year's pool of accepted nominations wasn't the largest we've seen in the last decade, the quality of the technology represented was really high. This made it difficult for judges in both the first and second rounds of presentations to pick a few finalists and a single winner in each category."

Brian Grosser, automotive business manager for Samsung Chemical USA, and the '06 & '07 SPE Automotive Innovation Awards program chair as well as SPE Automotive Division chair, added, "The competition in each category was especially intense

"Most Innovative Use of Plastics" Trophy

this year because there were so many interesting applications this year representing novel uses of technology. What you will see represented in this nomination pool is a true global gathering of the most innovative automotive plastics applications of the year.

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

The mission of SPE International 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 Gala, visit the SPE Automotive Division's website at www.speautomotive.com/inno.htm, or contact the group at +1.248.244.8993, or write SPE Automotive Division, 1800 Crooks Road, Suite A, Troy, MI 48084, USA.

Main Reception Sponsor

The SPE Automotive Division would like to recognize and thank SABIC Innovative Plastics for their support of the 2007 SPE Innovation Awards Gala and Competition.

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Blue-Ribbon Judges for 37th-Annual Innovation Awards Competition

- Jim Best, Market Search
- Sara Black, Composites Technology and High-Performance Composites Magazines
- Lindsay Brooke, Automotive Engineering International
- Subi Dinda, Chrysler LLC (retired)
- Bob Eller, Eller & Associates
- Fred Garnham, Becker Group, JCI (Retired)
- Joe Grande, Plastics Technology Magazine
- Jim Kolb, American Chemistry Council
- Ralph Kummler, Wayne State University
- Josh Madden, Material Engineering Services
- Rhoda Miel, Plastics News
- Al Murray, SPE and Ford (retired)
- Tom Murphy, Wards AutoWorld
- Irv Poston, General Motors (retired)
- Ron Price, Global Polymer Solutions
- Tom Russell, TD Russell & Associates LLC
- Roy Sjoberg, Team R2S LLP
- Mike Tolinski, Plastics Engineering Magazine
- Bill White, Lawrence Technological University
- Conrad Zumhagen, The Zumhagen Company LLC

2007 SPE Automotive Division Grand Award Winner

"Most Innovative Use of Plastics"

Backlighting using Color-Converting Plastic on the 2007 MY General Motors Chevrolet® Tahoe

The Grand Award Winning Team: Irv Karwick, Micheal Fye, Ray Lippman, Elias Boueri, Brian Grosser (SPE), Gail Sylvester, and Tim Kenworthy

Materials and Grand Award Winner

Backlighting using Color-Converting Plastic

'07 MY General Motors Chevrolet® Tahoe SUV 2007

System Supplier:	Delphi Electronics & Safety
Material Processor:	Delphi Electronics & Safety
Material Suppliers:	RTP, BASF, and Bayer MaterialScience
Resin:	Makrolon® 2405 PC (Bayer)
Tooling Supplier:	Kno-Mar Tool

This innovative, patented system for producing custom-colored interior backlighting via LEDs (fed through light distribution pipes) relies on patented fluorescing dyes and proprietary light-scattering additives in translucent resins used to mold buttons, knobs, and backlit plates rather than far more costly custom-colored LED bulbs. Moving color control from the LED to the plastic button not only results in more uniform, controllable emitted color, but also makes backlighting in low-volume, niche colors economically feasible.

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2007 Innovation Awards Competition Category Winners

Body Interior Category Winner

Door Trim and Hardware Module

’06 MY Chrysler® Caliber / Compass / Patriot SUVs

System Supplier: Grupo Antolin
Material Processor: IAC
Material Supplier: Dow Chemical
Resin: 702-20 polypropylene
Tooling Supplier: HiTech

This unique assembly combines all door hardware components plus trim panel in a single module produced via injection molding and the 2-shot bolster process. It is directly sequenced into the plant, arriving fully tested to reduce door dress-up at the vehicle assembly plant, and offers 10% weight and $10-$17 USD OEM cost savings per vehicle.

Chassis/Hardware Category Winner

Extrucded Seal for HIM Door Modules

’07 MY Dodge® Nitro / ’08 MY Jeep® Liberty SUVs

System Supplier: Faurecia Interior Systems
Material Processor: Faurecia Interior Systems
Material Supplier: ExxonMobil
Resin: Santoprene® TPE
Tooling Suppliers: Reiss Robotics / Gepoc

This is the first time a TPE has been extruded directly onto a door module carrier, providing a 360o seal that acts as a water barrier between wet/dry sides, an acoustic barrier, and seals out dirt and dust. The seal is fully recyclable, simplifies assembly, is more robust than previous technology, and reduces material costs 53%, capital expenses 15%, seal mass 48%, and tack/cure time 90%.

David Carr and Kevin Pageau (SPE)

Chris McCalvin, Jerry Wenzloff, Steve Jones, Bonnie Bennihoff (SPE), Bill Grabowski, John Kargilis, James Coleman, and Mike Twork

2007 Innovation Awards Competition Category Winners

Body Exterior Category Winner

Composite Assist Step

’07 MY General Motors Trailblazer® / Envoy® SUVs

System Supplier: Magna Decoma – Mytox Div.
Material Processor: Magna Decoma – Mytox Div.
Material Supplier: Magna Decoma – Mytox Div.
Resin: Myplas 40 long-glass polypropylene

Innovation in rib design and use of weatherable material enabled this 1-piece running board to withstands higher loads with lower deflections than the 5-piece steel and plastic assembly it replaced. It is produced in a 2-stage injection molding process and provides a 50% mass reduction and a direct cost savings in excess of $19 USD / vehicle, while also lowering assembly complexity, improving aerodynamics, eliminating corrosion, and quieting buzz/squeak/rattle noise.

Process / Assembly / Enabling Technologies Category Winner

Front End Carrier

’07 MY Volkswagen® Golf® / Bora® / Jetta®

System Supplier: Aksys de Mexico
Material Processor: Aksys de Mexico
Material Suppliers: Basell Polyolefins (resin) & OwensCorning (glass)
Resin: In-line compounded GF PP
Equipment Supplier: Krauss-Maffei

This is the first direct-long fiber thermoplastic (D-LFT) composite front-end carrier compounded with a twin- instead of single-screw extruder during the inline compounding (ILC) portion of the process. ILC provides cost and weight savings vs. conventional injection and GMT composites, while also eliminating many secondary operations.

Maria Ciliberti (SPE) and Paul Viscomi

Michel Klotz, Suresh Shah (SPE), Thomas Loafman, and Martin Popella

2007 Innovation Awards Competition Category Winners

Powertrain Category Winner

Electronic Throttle Control Module

’07 MY Chrysler® Pacifica cross-over vehicle

System Supplier:	Bosch
Material Processor:	Christophery
Material Supplier:	BMC, Inc.
Resin:	Tetradur BMC TD 455
Tooling Supplier:	Christophery

This is the first plastic ETC housing, which replaces machined cast aluminum at mass savings of 28% and costs savings of 18%, while also reducing warranty costs and potential for ice freeze-up and potential throttle blade stick. A special zero-shrink BMC grade was used and the units tight concentricity better controls air flow at idle.

Len Nunnery, John Cook, Jay Raisoni (SPE), Edward Luibrand and Greg Waelchli

Performance & Customization Category Winner

Pickup Bed Extender

’06 MY Ford® F250 pickups

System Supplier:	ABC Group
Material Processor:	ABC Group
Material Supplier:	Salflex Polymers (ABC Group)
Resin:	Salflex® S 815 GF PP
Tooling Supplier:	Supreme Tooling (ABC Group)

This is the first blow-molded pickup bed extender, replacing roll-formed steel or aluminum profiles, while reducing part count, weight, cost, assembly, and quality costs. The high-strength fully-recyclable composite solution features in-mold-color and grained texture to meet OEM Class A specs, retaining excellent grain quality in such a large blow-molded part. The system’s unique design provides 3 methods of use: cargo, storage, and stowaway to increase usable bed space on pickups.

Ron Price (SPE), Karl Willi Meyer, Scott Miller, Kian Huat Tan, and John Sudak

2007 Hall of Fame Inductee

First Plastic Radiator End Tank

'82 MY Ford® Escort® / Mercury® Lynx® compact cars

System Supplier: Ford Plastics Product Division
Material Processor: Hoover Universal
Material Supplier: DuPont Automotive
Resin: Zytel® glass-reinforced nylon 6/6

The Hall of Fame category is for applications in continuous use for at least 15 years. As one of the first major underhood applications for engineering plastics, the radiator end cap broke ground for many future engine-compartment applications. The objectives for converting the application from aluminum to nylon were parts integration and cost reduction, weight reduction, and equal or better performance. It was particularly challenging to develop and test materials in hot ethylene glycol (antifreeze) solutions.

DuPont developed new grades of their glass-reinforced nylon resin and tested prototypes in a "jungle room" with hot antifreeze running through the parts 24 hours a day. Mold design with movable cores, design for low part warpage, and multifunctional design were all partnered in this application among Ford PPD, Hoover Universal, and DuPont. The success of this application was later expanded by recycling strategies that included a novel chemical recycle method for radiator end caps that was honored with the 2004 Environmental Award for New Technology in Materials and Processes given by the Environmental Division of SPE at the Global Plastics Environmental Conference. Innovations in processing, materials, and design used in this application were later translated to charge-air coolers, thermostat housings, and many other powertrain applications that continue to this day.

Jeff Helms of Ford Motor Company accepts the Hall of Fame Award from Nippani Rao (SPE).

First Plastic Radiator End Tank
on the 1982 Ford® Escort® and Mercury® Lynx®

Executive Leadership Award

James E. Queen, group vice-president for Global Engineering at General Motors Corp. (GM) has been named the 2007 recipient of the prestigious Executive Leadership Award.

Started in 2004, the Executive Leadership Award honors transportation-industry executives who have demonstrated leadership in integrating polymeric materials on global vehicle platforms and who are recognized - both within their industry as well as in their community - as leaders. The honoree will also have led his/her company to profitability, increased market share, and been at the helm of new vehicle launches that were considered a commercial success. Only three previous executives have received this award. These include: James Padilla, chief-operating officer and president, Global Automotive Operations, Ford Motor Company; Tom Edson, director, Applied Material and Manufacturing Technology, Advanced Vehicle Engineering, at Daimler Chrysler; and James. A. McCaslin, president and chief-operating officer at Harley-Davidson Motor Company.

"Jim Queen was selected as this year's recipient because he is the quintessential automotive leader," explains Brian Grosser returning SPE Automotive Innovation Awards program chair and SPE Automotive Division chair-elect. "As an executive engineer, he has identified opportunities for platform-sharing and lightweighting vehicles targeted for global markets. Throughout his career, Jim has shown leadership on value creation and innovation. For example, he championed the successful introduction of the Cadillac CTS performance luxury sedan and now is the production advocate for the Chevrolet Volt electric vehicle with a target launch of 2010. Jim believes that in order to build efficient, profitable global architectures, the engineering organization has to be seamlessly aligned."

When asked what typifies global success, Queen explained that "The actual goal is to use a standardized process, follow best practices, eliminate redundancies, increase throughput, and leverage the scale that arises from producing many variants off a common architecture around the globe. To do all this, however, required a realignment of GM's engineering resources. We started down the road to a standardized global engineering structure in 1997. In North America alone this has allowed us to reduce the cost of doing engineering work here 40% and increased our throughput 33%."

Dave Reed (SPE) with Executive Leadership Award Winner James Queen

James Queen, General Motors Corporation

Queen has held the title of group vice president of Global Engineering at GM since April 1, 2007. He also continues to lead GM's Vehicle Engineering Operations worldwide, a position he assumed responsibilities for in March 2005. Queen has held the position of vice-president, GM North America Engineering since July 2001. Prior to this, Queen held numerous positions at GM, including Vice-President, Vehicle Systems (2001); Vice-President and Group Director, Engineering - GM North America Car Group (1999); Group Director, Engineering - GM Small Car Group (1997); and Engineering Director, North American Operations Chassis/Electrical/Interior Engineering Activities at GM's Technical Center in Warren, Mich. (1995).

Queen began his career with General Motors in 1977 as a salaried employee-in-training with the Buick Motor Division in Flint, Mich. Prior to joining GM, he served with the U.S. Marine Corps from 1971-1977.

Born in Zanesville, Ohio in 1949, Queen earned a Bachelor's Degree in Aeronautical & Aerospace Engineering from the U.S. Naval Academy (1971) and also has participated in the Amos Tuck Executive Development Program at Dartmouth College in 1990.

Innovation Awards Program Media and Association Sponsors

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Innovation Awards Program Questions and Answers

How does my company benefit from participating?

☛ Involvement in the process drives and rewards innovative thinking, and promotes excellence.

☛ Keep up to date on the latest innovations from other engineers, designers, competitors, and customers.

☛ Reward your team and company through worldwide recognition.

Is there any cost to make a nomination?

☛ No, there is no application fee. You must supply SPE a representative part/assembly, and be willing to make presentations to the judging committee(s).

Who can make a nomination?

☛ Nominations can be made by anyone knowledgeable of the achievement - material supplier, molder, Tier 1, OEM, etc.

☛ OEM approval is required for the nomination to be considered.

Where do I get the nomination form, and when is the deadline for nominations?

☛ The electronic nomination form can be downloaded from our website at **www.speautomotive.com**. It is usually posted by early June. The deadline for nominations varies each year, but is usually around the middle of September.

Is my application eligible?

☛ Parts must be in mass production and on a vehicle that is available for purchase by November 1 of the year of the judging.

☛ The vehicle can be manufactured anywhere in the world.

☛ There is no minimum number of vehicles required.

☛ The application (innovation) cannot have previously been nominated.

How do I know if my application has been previously nominated, and/or whether it is innovative enough?

☛ You really can't know. The past 5 years of the Award Program can be viewed at our website, but it can be tedious reviewing the previous nominations. You can contact the SPE Automotive Division board for guidance.

☛ If there is any doubt, we strongly encourage you to nominate your application. If it has been nominated previously, we will let you know. Many times people are so involved in the application development process that innovation and uniqueness of their application has become transparent to them.

What are the categories, and is the judging criteria the same for each category?

☛ The categories are **Body Interior, Body Exterior, Chassis/Hardware, Powertrain, Materials, Environmental, Process/Assembly/Enabling Technologies, Performance and Customization, Safety, and Hall of Fame**.

☛ For Interior, Exterior, Chassis/Hardware, and Powertrain, the judging compares the attributes of the nomination to the others in the same category. These tend to be design-related innovations, but often have process or materials innovations that helped the application succeed. Examples might include a new invisible airbag tear-seam design, a new bumper energy absorber, metal replacement for powertrain, a new plastic door module, etc.

☛ In the Materials category, the focus of the evaluation is how innovative is the material used in the application, and the benefits the new material provides, with less emphasis on the actual part or application. Past winners include nano-composite TPO, carbon fiber SMC, and UV-stable TPU.

☛ The Environmental category looks at the long-term sustainability of plastics. Applications should be nominated if they make use of post-industrial or post-consumer recycle, especially in decorative or structural applications. Also, if an application is uniquely designed for recycling, it may compete well.

☛ The Process category is straightforward, where the primary innovation is in the process (gas-assist, multi-layer blow molding, co-extrusion, etc). Once a process has been submitted, another unique part made with the same process cannot be submitted in this category in following years; the part can compete in any of the other categories. Assembly/Enabling Technologies is a "catch-all" category where the primary innovation is related to unique assembly methods (welding, snap fits) or some other technology that contributes to the overall application development process.

☛ In the Performance and Customization the judges will be evaluating how plastics contributed to the important industry trends in personalization and vehicle enhancement. Nominations will be judged on the effective and creative use of plastics to enhance vehicles.

☛ Applications in the Safety category will be judged regarding the effective application of plastics to improve the safety performance of vehicles.

☛ The Hall of Fame Award will be presented for an innovative application that has stood the test of time, being in continuous production for over 10 years.

My part/application could fit multiple categories; which one do I enter it in?

☛ This often happens when a new design requires development of a new resin and/or new processing techniques. By answering the questions in the nomination form, this can often lead you to identify the single most innovative aspect of the application. The review committee may recategorize the nomination upon review.

☛ The nomination may also be moved to another category if that category is filled with strong nominations. For example, an exterior nomination with unique process may be moved to the Process/Enabling Technologies if that category has a low number of nominations.

☛ Our objective is to get nomination in the category in which it will compete best, and have the best chance to win.

Who judges the competition?

☛ The first round of judging is by the Board of Directors of the SPE Automotive Division and select industry experts. The finalists that will move on to the Blue Ribbon Judges are selected.

☛ The Blue Ribbon judging panel consists of leading industry experts, including journalists from automotive and plastics publications, university professors, automotive/plastics consultants, and retired automotive engineers.

☛ The Blue Ribbon panel selects the category winners from the list of finalists in each category, and the Grand Award Winner from the list of category winners.

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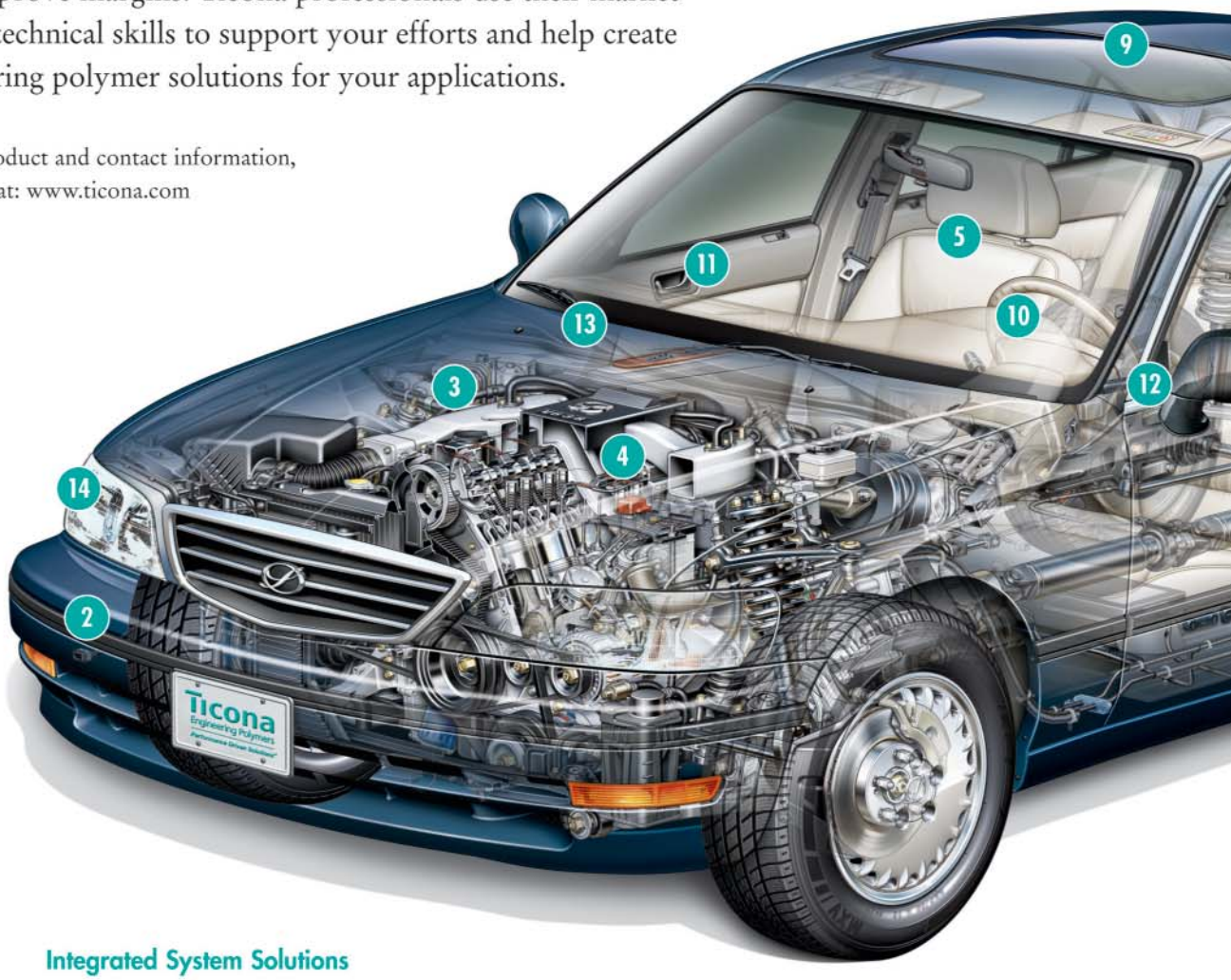

Integrated System Solutions

1 **Door/Lock/Window**
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4 **Power Distribution**
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8 **Seating & Restraint**
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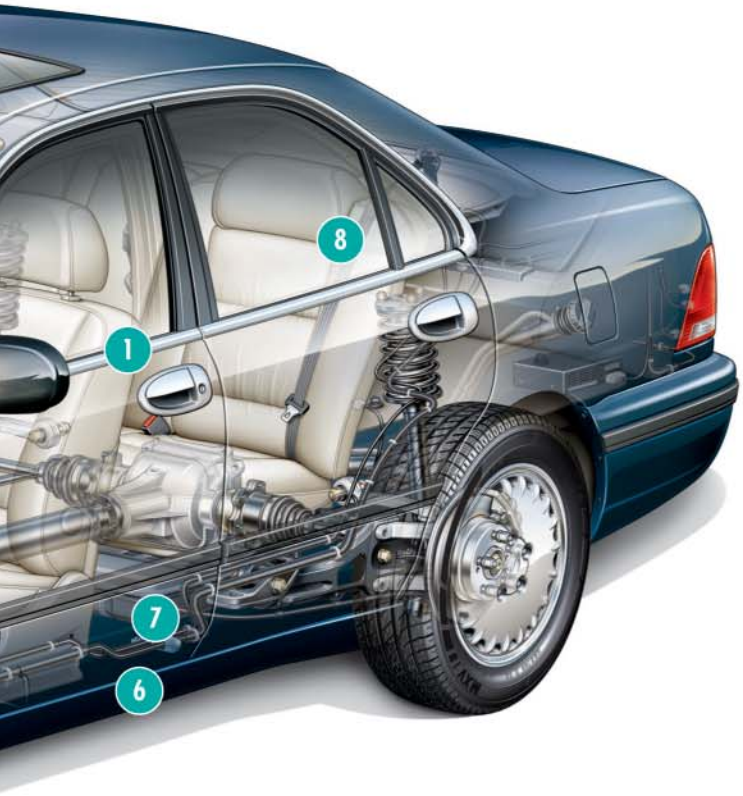

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- Broad temperature use range

Celstran® and Compel® Long Fiber Reinforced Thermoplastic
- High stiffness
- Exceptional toughness
- Long-term dimensional stability
- Wide temperature use range

Fortron® Polyphenylene Sulfide
- High continuous use temperature
- Resistance to auto fuels and fluids

Impet® Thermoplastic Polyester
- Outstanding physical properties
- Superior thermal and chemical resistance
- Toughness
- Rigidity
- Dimensional stability
- Wide temperature use range

Riteflex® Thermoplastic Polyester Elastomer
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- Outstanding chemical resistance
- Good low temperature impact
- Wide temperature use range

Vandar® Thermoplastic Alloys
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- High impact strength at low temperatures

Vectra® Liquid Crystal Polyester
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- High strength and modulus
- Broad chemical resistance
- Low mold shrinkage
- Excellent electrical properties
- Inherent flame resistance

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Executive Engineering Leadership Award

Lawrence (Larry) Burns, vice-president, Research & Development and Strategic Planning at General Motors Corp. (GM) is the 2007 recipient of the SPE® Automotive Division's Global Executive Engineering Leadership Award. He is the second GM executive to be named to an executive leadership award by the SPE Automotive Division in 2007.

The Global Executive Engineering Leadership Award was created to recognize an executive who has exhibited outstanding engineering leadership throughout his/her career and is considered to be an "Automotive All-Star" within the global transportation industry. Candidates are evaluated on their overall leadership in engineering roles throughout their careers, as well as the success of their performance in these roles, such as the number of new vehicles the candidate championed, had significant involvement in, or launched. This award was first given last year to Chris P. Theodore, vice-chairman of American Specialty Cars (ASC).

Burns was selected as this year's recipient for a number of reasons. In his current role, Burns oversees GM's advanced technology, innovation programs, and corporate strategy. He is a member of GM's Automotive Strategy Board and Automotive Product Board. In addition to driving innovation in today's vehicles, Burns also champions GM's "reinvention" of the automobile around technologies such as advanced propulsion, electronics, telematics, and materials technologies. According to GM, the goal of this initiative is to "realize sustainable mobility with vehicles that are aspirational and affordable."

Burns began his career at GM in 1969 as a member of the Research & Development staff, where his work focused on transportation, logistics, and production systems. He subsequently held executive positions in several GM divisions in the areas of product program management, quality, production control, industrial engineering, and product and business planning. In May 1998, he was named as a vice president of General Motors with responsibility for R&D and Planning.

Larry Burns, Executive Engineering Leadership Award Winner with Suzanne Cole (SPE)

Larry Burns, General Motors Corporation

Burns is very active outside his direct work at GM. He is a member of the USCAR Operating Council and the FreedomCAR Partnership Executive Steering Committee. He serves on the University of Michigan's Automotive Research Center board and recently completed a 6-year term on its College of Engineering National Advisory Council. Additionally, he is a member of the Advisory Council for the University of California Berkeley's Institute of Transportation Studies and a member of the Board of Trustees of the Midwest Research Institute. Burns also sits on the board of the University of Michigan Center for Hearing Disorders and is a member of the National Advisory Group for the National Technical Institute for the Deaf at Rochester Institute of Technology.

In 2000, Burns received Kettering University's Engineering Alumni Achievement Award for his contributions to the engineering profession. In 2002, the Deafness Research Foundation recognized him with its National Campaign for Hearing Health Leadership Award. In 2005, he was a member of a General Motors team awarded the Franz Edelman Award from the Institute for Operations Research and the Management Sciences. Burns is also the recipient of the 2005 Alumni Merit Award from the University of Michigan Industrial and Operations Engineering Department. He recently completed a 2-year term as National Honorary Chairman for the MATHCOUNTS Foundation.

Burns holds a Ph.D. in Civil Engineering from the University of California at Berkeley. He also has a Master's Degree in Engineering/Public Policy from the University of Michigan, and a Bachelor's Degree in Mechanical Engineering from the former General Motors Institute (GMI), which is now called Kettering University.

Global Excellence in Plastics Engineering Award

Mr. Hiroaki Yamamoto, chief technology officer of Green Tokai Company, Ltd. (Brookville, Ohio) received a special award for Global Excellence in Plastics Engineering presented by the Automotive Division of the Society of Plastics Engineers (SPE®) International at its 37th-annual SPE Automotive Innovation Awards Gala on November 7. The first recipient of this new award, Yamamoto was chosen for his extensive work on paintfilms for molded plastic parts and his efforts to localize significant plastics content from U.S. suppliers at Japanese automakers producing vehicles in North America.

The Global Excellence in Plastics Engineering Award recognizes an individual's technical contributions in plastics engineering that have advanced the state-of-the-art, as well as engineering leadership that has led to the adoption of more polymeric materials on ground-transportation vehicles through the efforts of technical teams under the honoree's management.

Yamamoto has 2 decades of experience in automotive product design and development at Green Tokai, where he has made significant technical contributions to advance the use of plastic and rubber parts. He holds 15 U.S. patents as well as numerous joint filings in the European Union and Japan. A significant component of his research relates to breakthroughs that enabled paintfilms to be used more effectively on molded plastic parts, particularly those with complex surfaces.

Other patented innovations from Yamamoto include improved ejector-plate structures and methods for demolding plastic parts; methods for producing automotive trim components with bi- and plural-component show surfaces; and methods for minimizing shrink lines on molded trim parts. Another notable development by Yamamoto in the early 1990s was the 1-piece exterior weather seal with an elastomer sealing lip and PVC molding. It replaced the more costly 2-piece EPDM rubber lip and PVC molding design, which had been the industry standard at that time. This improvement provided significant weight and part cost saving along with a 50% reduction in tooling expenses. The new design was initially used on the 1992 MY Oldsmobile® Cutlass® passenger car from General Motors Corp. (GM). The concept later became the standard for exterior weather seals at GM.

Hiroaki Yamamoto, Green Tokai Company, Ltd.

Hiroaki Yamamoto, Global Excellence in Plastics Engineering Award Winner wth Teri Chouinard (SPE)

Still another important contribution by Yamamoto was his demonstrated leadership in localizing the raw material base used by Green Tokai to suppliers in North American rather than Japan, as is more common. In a single year, he localized more than 90% of Green Tokai's raw material purchases, including plastics, adhesives, flocking, and metals. His work in finding domestic suppliers for Green Tokai also led to other Japanese suppliers in North America switching a portion of their supply base to local providers.

His efforts in educating the automotive industry on the benefits of plastics have been recognized with 2 prestigious awards. In 1999, Yamamoto led the team that received the Ohio Society of Professional Engineers' award for New Product of the Year for developments on paintfilms for plastic parts. In 2001, his team received the organization's national award for Best New Technology.

According to Jeff Bailey, vice-president - Operations, at Soliant LLC, one of Green Tokai's suppliers, "Hiro Yamamoto is greatly respected by his peers in the industry, including those at Green Tokai, OEM customers, suppliers, competitors, and more because of his plastic material and automotive design knowledge, experience, and ideas. Many OEM customer and suppliers come to see him on a dally basis or call for information – even from Japan. He leads and encourages his team members to develop challenging part programs and he is admired for his 'never give up' attitude. He is also a respected father and family man."

Lifetime Achievement Award

Joshua (Josh) Madden, who has had a long and distinguished career at both General Motors Corp. (GM) and later Volkswagen (VW) of America, and was responsible for numerous automotive plastics "firsts," has received the prestigious Lifetime Achievement Award from the SPE® Automotive Division. Madden was honored at the 37th-annual SPE Automotive Innovation Awards Gala - an event he helped develop - on November 7.

The Lifetime Achievement Award recognizes the technical achievements of automotive industry executives whose work - in research, design, and engineering, etc. - has led to significant integration of polymeric materials in vehicles. First given in 2000, past winners of the award include:

- **J.T. Battenberg III**, former chairman and chief-executive officer of Delphi;
- **Bernard Robertson**, executive vice-president of DaimlerChrysler;
- **Robert Schaad**, chairman of Husky;
- **Tom Moore**, retired vice-president, Liberty and Technical Affairs at DaimlerChrysler;
- **Mr. Shigeki Suzuki**, general manager - Materials Division at Toyota Motor Company; and
- **Barbara A. Sanders**, director -Advanced Development & Engineering Processes at Delphi Thermal Systems.

For a man who is an SPE director emeritus and whose list of automotive plastics innovations is legendary, ironically Madden began his career as a metallurgist. He started with GM in 1954 at the Pontiac Motor Division working in Product Engineering. He moved from the position of senior experimental metallurgist, to become a rubber & plastics engineer, and then to the position of staff materials engineer.

Fred Deans (SPE) presents the Lifetime Achievement Award to Josh Madden

Josh Madden, SPE Director Emeritus

After 23 years at GM, Madden was recruited to join Volkswagen (VW) of America, in the role of executive engineer. There, he was responsible for setting materials engineering specifications, overseeing product translations, running production engineering, and liaising with VW headquarters in Germany. His responsibilities were expanded when he became chief engineer - Product Engineering. In 1984, VW made a decision to close its U.S. manufacturing operations in order to pursue the goal of becoming Europe's largest automaker. Despite the closure, Madden was retained as an active engineering consultant to VW's vice-president of Engineering, and also acted as VW.s technical representative in Detroit.

In recent years, Madden has put his expertise to use as a materials and processing consultant to industry. He has also appeared as a guest lecturer at Wayne State University, Akron University, University of Wisconsin, Yale University, Purdue University, Lawrence Technological University, Oakland University, and the College for Creative Studies.

Throughout his career, Madden has been a member of and often held leadership roles in a broad range of technical committees, engineering societies, and professional organizations at GM, VW, SPE, the Society of Automotive Engineers (SAE), the American Society of Materials (ASM), the Detroit Rubber Group, Engineering Society of Detroit (ESD), Verein Deutscher Ingenieure (VDI, the German Society of Engineers), and the American Iron & Steel Institute (AISI). He also presented papers at numerous technical conferences and was invited to a government-sponsored event in South Africa on automotive components.

Madden received a national award presented by the Society of the Plastics Industry (SPI) for his work on the 1976 MY GM Pontiac all-plastic Phoenix Project car. He also accepted the Hall of Fame Award at last year's SPE

Automotive Innovation Awards Gala for an application he personally developed: the thermoplastic front grille on the 1966 MY GM Pontiac® Bonneville®, Catalina®, and Tempest® cars. This was the first thermoplastic part used on a passenger-vehicle exterior and its conversion from steel saved a whopping 6.4-8.2 kg (14-18 lb) depending on model.

Other innovations that Madden was personally involved with during his career include the first:

- Acetal IP cluster (replacing die-cast zinc) on the 1963 MY Pontiac Tempest;
- EPDM radiator hoses on all models of 1965 Pontiacs;
- Use of ABS parts on 1965 MY Pontiacs;
- Glass-reinforced HDPE structural front fender liner for the 1965 MY Pontiac Bonneville;
- Painted SMC timing-belt cover on the 1966 MY Pontiac Tempest;
- HDPE fuel tanks on passenger cars in the 1968 MY Bonneville station wagon;
- Cast PUR painted bumper on the 1968 MY Pontiac GTO®;
- BMC hood scoops on the 1968 MY Pontiac GTO;
- PC headlamp mounting panels on the 1969 MY Pontiac Firebird®;
- SMC rear spoiler on the 1969 MY Pontiac Trans Am®;
- SMC headlamp mounting panels on the 1969 MY Pontiac Grand Prix®;
- SMC engine mounted air-intake hood scoop on the 1970 MY Pontiac Trans Am;
- ABS painted wheel-opening spoilers on the 1970 MY Pontiac Trans Am;
- Injection-molded painted TPU front end panel on the 1973 MY Pontiac Grand Am®;
- SMC front end panel (a precursor to GOR panels) on the 1973 MY Pontiac Grand Prix;
- Automotive use of GMT composites as dunnage/hangers to hold parts as they moved through the paint line (1973);
- GMT grille-opening reinforcement panels for the 1974 MY Pontiac Tempest;
- Fiberglass-reinforced PUR rigid cast foam painted rear spoiler on the 1975 MY Pontiac GTO Judge;
- Lightweight composites demonstration car, the 1975 MY LeMans® (Phoenix Project), which allowed GM to drop 2 C.A.F.E. levels by reducing vehicle curb weight from 2,650 to 1,950 lb, and whose technology was later used for the Pontiac Fiero®; and the
- Use of GMT composite for the parcel shelf of the 1978 MY VW Rabbit.

Originally from Drifton, Pa., Madden attended the Mining & Mechanical Institute as well as Muhlenberg College. He has taken graduate-level courses at Wayne State University, University of Michigan, GMI Institute (now Kettering University), and Mercy College. He achieved the rank of 1st lieutenant in the Army. He was a Kiwanis member for 25 years. And he was Operations chair at the Meadow Brook Concours d.Elegance in Detroit for 23 years. His hobbies are photography and fly fishing. He is also a member of the vestry at All Saints Episcopal Church in Pontiac, Mich.

Mark Lapain of Magna received the Past-Chairman's Award for his leadership of the SPE Automotive Division for fiscal year 2006-2007.

ANTEC 2008

Annual Technical Conference Milwaukee, WI May 4-8

The SPE Annual Technical Conference (ANTEC) will take place in Milwaukee, Wisconsin from May 4 - 8, 2008. It is the world's largest international gathering of engineers, scientists, and business professionals in plastics. SPE plans to collocate the Plastics News' Plastics Encounter trade show with ANTEC.

If you want to learn about the latest developments in plastics automotive, plan to attend the Automotive Division Session of ANTEC. This session is well attended each year by leaders in the Automotive Industry. This year Chair of the Automotive Division Session is Tom Pickett. Helping Tom review papers for the ANTEC Automotive Session are Norm Kakarala, Jay Raisoni, Suresh Shah, and Michael Shoemaker.

For more information about ANTEC, visit SPE website: **www.4spe.org**.

AutoEPCON

Third-Annual Conference Announced

The Detroit Section and Automotive Division have again teamed up to host a special one-day technical conference and exhibition on advances in engineering plastics for the automotive industry. Called Design & Developments with Automotive Engineering Plastics (or AutoEPCON for short), the event will be held April 22, 2008 at the Best Western Sterling Inn in Sterling Heights, MI.

Last year's AutoEPCON was successful with great attendance from OEMs and tier suppliers. The 2008 AutoEPCON will feature technical presentations on the newest advances in materials technology & design, process enhancements, and application developments for thermoplastic and thermoset engineering materials for the automotive industry. Tabletop exhibits will be on display throughout the event. A lunch and an Afterglow, plus several coffee breaks will also be provided throughout the conference to allow further networking opportunities for all who attend.

For more information on this program, contact Pat Levine, SPE Automotive Division, p.levine@yahoo.com or call +1.248.244.8993.

Design and Development with

Automotive Engineering Plastics

AUTO EPCON

One Day Technical Conference & Exhibition

Date of Conference: Tuesday April 22, 2008

Best Western Sterling Inn, Sterling Heights, MI

Call for Technical Presentations

Deadline for Abstracts
Friday February 15, 2008

Contact Information:

Technical Presentations:
Dr. Norm Kakarala, Delphi Corp.
248-655-8483
norm.kakarala@delphi.com

Sponsorship:
Nippani Rao, Chrysler LLC
248-576-7483
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Program Co-Chairs:
Tom Pickett, General Motors
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Nippani Rao, Chrysler LLC
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Program Scope: The **Automotive Division** and **Detroit Section** of the Society of Plastics Engineers (SPE®) International invite you to attend a 1-day technical conference & exhibition showcasing innovative developments in the Design, Materials, Processing, & Use of Engineering Plastics for the Global Automotive Industry.

Who Should Attend: This conference is specifically designed to inform, update and educate the OEM & supplier communities about advances in both thermoset & thermoplastic engineering polymers. Learn how these widely-used materials can help improve performance & productivity, while reducing cost and mass.

Presentations: Hear Technical Presentations on the Newest Advances in Engineering Materials related to:

> Design Engineering
> Materials Development
> Processing & Enabling Technologies
> New Applications & More

Exhibits: See Exhibits from Engineering Plastics Suppliers, Molders, Compounders, Additives & Reinforcement Suppliers, Design & Engineering Firms, & Machinery Suppliers. Experts will show you how to apply the latest technologies to your next program.

Conference Includes:

> One Full Day of Innovative Presentations, Lunch & Coffee Breaks, Exhibits of Advanced Technologies & Practices, and Keynote Speaker

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2007 Innovation Awards Program

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VIP Reception 2007

The VIP cocktail reception (reserved for program sponsors and senior-level automotive executives) was one of the absolute best networking opportunities in town, according to several supplier executives in attendance. This year's VIP reception featured lighted General Motors vehicles, a unique Ice Sculpture bar, and a string quartet. This created a very conducive environment for Jim Queen, Larry Burns, Hiroaki Yamamoto, Josh Madden and top level OEM executives to interact with program sponsors and VIPs.

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The Effect of Injection Molding Parameters on Low Gloss TPE Compounds for Automotive Safety Restraint Systems Applications

Nadeem A. Bokhari[1)], Jinwoong Shin[2)], Raman Patel[2)], Sachin Sakhalkar[2)]

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[2)] Teknor Apex Company, 505 Central Avenue, Pawtucket, Rhode Island 02861, USA

This paper was presented at the 2007 Detroit Section TPO Conference.

Abstract: Automotive safety restraint system components increasingly use flexible styrenic and olefinic TPEs. With continued evolution in automotive interior design and performance requirements, demands on material technology are concomitantly rising. A growing trend towards molded in color solutions with low gloss aesthetics require TPE materials with very low gloss, improved scratch resistance, and low temperature ductility.

Innovations utilizing Teknor Apex's compounding technology have enabled the development of low gloss styrenic elastomers for airbag door applications that provide an optimized combination of low temperature performance, surface aesthetics (low gloss and improved scratch resistance), and ease of processing. This paper highlights the salient features of these new compounds and the effect of injection molding condition on the gloss at the surface of the cover.

Key words: Molded-in-color (MIC), Airbag door, Thermoplastic Elastomer (TPE), Tekron 5600K, Tekron 5600M, Injection molding, Processibility

1. INTRODUCTION

Ductility of TPE materials[1] at extreme cold temperatures is highly desired for automotive airbag door applications. Simultaneously, higher flow properties and better processibility of TPE materials is of great importance since it reduces the cycle time and provides better cosmetic appearance. Higher performance TPE materials should have both of the following properties; ductility at extreme cold temperatures and best cosmetic appearance.

It is also true that global automotive markets require molded-in-color TPE materials for airbag door cover applications that are cost effective, easy to process, recyclable and good deployment performance as compared to current non-paintable materials such as thermoplastic Polyether Ester block copolymers[2].

Autoliv has been actively engaged in the development of high performance TPE materials for automotive safety restraint system component applications. Autoliv North America evaluated several TPE materials including Teknor Apex Company's Tekron TK-5600K molded in color material for driver airbag door applications. Autoliv evaluated the processibility of TK-5600K on production scale equipment using different airbag tools. This material processed well and showed good cosmetic appearance.

2.1 EXPERIMENTAL SETUP

Experiments were performed on a Shinwa DL-110 injection-molding machine. Gloss measurements were determined from a grained rectangular plaque with dimensions of 152mm x 101mm x 32mm as shown in Figure 1.

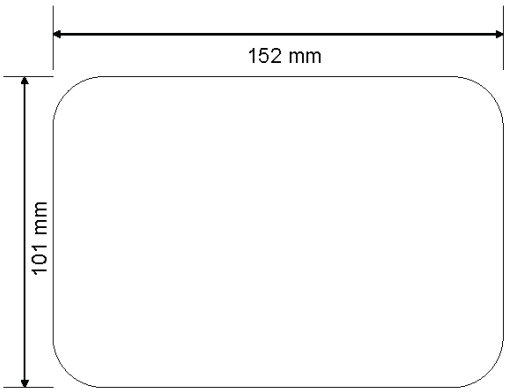


Figure 1. Schematic of plaque tool dimension.

The Gardco 60° NOVO GLOSS glossmeter provided the means to measure the gloss of each plaque.

The material used in this study is a MIC styrenic TPE product namely Tekron TK-5600K and TK-5600M. During molding, processing parameters reached a steady state prior to collecting molded specimens for gloss measurements.

For extreme cold temperature ductility and parts performance, door covers were molded at Autoliv North America production molding facility using prominent North American SUV model as shown in Figure 2. The Toshiba 390 ton injection molding machine was utilized to produce the door cover.

Figure 2. Airbag door utilized for deployment performance test.

Molded airbag doors were subjected through Autoliv's standard evaluation and assembly operations including emblem/horn weldability.

Airbag modules were then assembled with the production hardware and components for the deployment testing. Assembled airbag modules were conditioned in two different conditioning chambers at extreme cold (-35 °C) and hot temperatures (80 °C) prior to deployment testing.

Continued Page 28

Technical Article

Continued from page 27

2.2. EXPERIMENTAL DESIGN

The effect of various processing parameters on gloss was studied using an experimental design (D.O.E)[3]. The six molding parameters, shown in the header of Table 1, are the control variables.

These variables as evaluated by the DOE provide statistically the same information as a full factorial experiment using fewer experimental runs.

The primary response variable for the D.O.E is gloss. The gloss measurement is the average of five (5) randomly selected samples from each experimental number.

Below are the four different conditionings used for deployment performance tests;

1. 4 hours of conditioning at extreme cold and hot temperatures

2. Temperature shocks, high humidity and life cycle and deployed out of chamber at extreme cold and hot temperatures.

3. Heat aged and deployed out of chamber.

4. Extreme cold temperature conditioning and in chamber deployment

3. RESULTS AND DISCUSSION

3.1 Gloss

Gloss is an optical property resulting from the interaction of light with physical characteristics of a surface. It is actually the ability of a surface to reflect light into the specular direction (the angle of incidence equals the angle of reflection). The factors that affect gloss are the refractive index of the material, the angle of incident light and the surface topography. Normally, materials with smooth surfaces appear glossy, while very rough surfaces reflect no specular light and therefore appear dull 4. Complex polymer flow over a grained surface generates the molded surface topography of the air bag door cover. The replication quality of the grain depends on the properties of the plastic material, the tooling topography, and the process conditions.

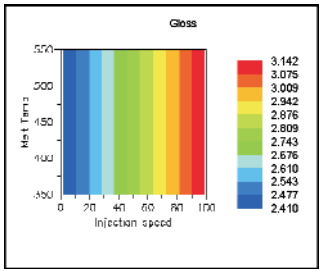
The DOE results shown in Figure 3a thru 3d are contour plots. The contour plots show gloss as a function of the injection molding parameters. The creation of contour plots occurs by holding molding parameters constant while other parameters in the X and Y change. The linear optimum values are obtained by interpolating the liner model of D.O.E. The linear optimum value of each parameter is; injection speed = 2 sec, melt temp. = 450 F, mold temp = 80 F, cooling time = 27.5 sec, packing time = 16.5 sec and packing pressure = 50%.

The contour plots clearly show that gloss increases with increasing injection speed and mold temperature. The other molding parameters melt temperature, packing time, cooling time and packing pressure are independent of gloss. The probability value (p-value) of the injection speed from the statistical data analysis was 0.000, indicating statistical significance. Mold temperature shows an effect, but not as influential as injection speed.

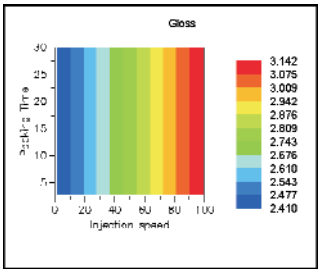
Experiment Number	Injection Speed [%]	Melt Temp [F]	Mold Temp [F]	Cooling Time [sec]	Packing Time [sec]	Packing Pressure [%]
1	L	L	L	L	L	L
2	H	L	L	L	H	L
3	L	H	L	L	H	H
4	H	H	L	L	L	H
5	L	L	H	L	H	H
6	H	L	H	L	L	H
7	L	H	H	L	L	L
8	H	H	H	L	H	L
9	L	L	L	H	L	H
10	H	L	L	H	H	H
11	L	H	L	H	H	L
12	H	H	L	H	L	L
13	L	L	H	H	H	L
14	H	L	H	H	L	L
15	L	H	H	H	L	H
16	H	H	H	H	H	H

Table 1. Design of experiment and processing conditions

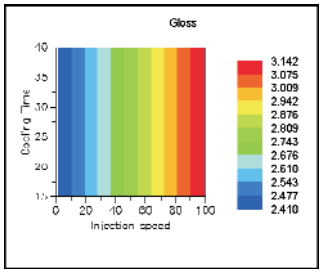
Injection speed:L=2, H=99 Melt temp: L=350, H=550 Mold temp: L=80, H=150
Cooling time: L=15, H=40 Packing time: L=3, H=30 Packing pressure: L=10, H=90



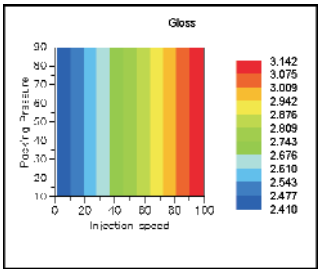
a) Melt temp and injection speed



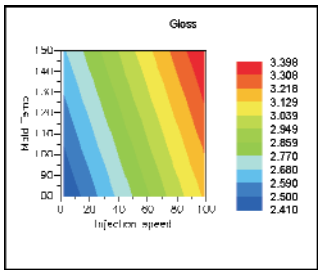
b) Packing time and injection speed



c) Cooling time and injection speed



d) Packing pressure and injection speed



e) Mold temp and injection speed

Figure 3. Contour plots of the Gloss as functions of injection molding parameters

High injection speed reduces the replication of the tools grain. The limited replication is the result of limited flow into the grain due to high speed. At high speed the polymer melt skips over the grain and solidifies. At low injection speed the grain is filled and solidifies resulting in better height replication. Therefore, injection speed influences the specular reflectance levels. Figure 4 depicts the reflection at an angle θ on a rough surface with a roughness height h.

The path difference between lights reflected from the top and bottom of the surface is:

$$\Delta r = 2h\cos i$$

When the wavelength of the light is λ, the phase difference will be:

$$\Delta\phi = \frac{4\pi h\cos i}{\lambda}$$

If $\Delta\phi$ is small, the two beams are nearly in phase and therefore the specimen surface can be considered smooth. But when, $\Delta\phi = \pi$ then beams are not in phase and through interference, cancellation of each other will occur. Low intensity of specularly reflected light means the surface is rough and it scatters the light in other directions[4].

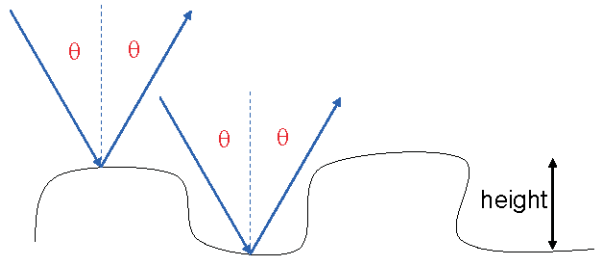


Figure 4. The reflection at an angle θ on a rough surface.

3.2 Low temperature deployment

Figure 5 shows deployed air bag assemblies conditioned 4 hours prior to deployment at both extreme cold and hot temperatures. With the standard deployment, airbag doors have not caused any fragmented and detached splinters.

Figure 5. Airbag door cover deployed 4 hours prior to deployment at extreme cold (left) and hot (right) temperatures.

For temperature shocks, high humidity and life cycle, the door covers satisfied the federal motor vehicle safety standard5 (FMVSS208) as shown in Figure 6.

Figure 6. Airbag door cover deployed after temperature shocks, high humidity and life cycle and deployed out of chamber at extreme cold and hot temperatures.

The use of Heat aged cycle test also exhibited clean deployment without any fragmented pieces as shown in Figure 7.

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Figure 7. Airbag door cover deployed after heat aged cycle.

After the successful performance at various conditions using TK 5600 K with prominent SUV design cover, same material was molded in a different tool in order to validate the most stringent testing, in chamber deployment. The assembled airbag modules were then conditioned in the conditioning chamber for several hours at -35ºC in chamber (with no window or delay). The airbag module successfully passed this stringent cold deployment testing.

4. CONCLUSION

In conclusion, the experimental results indicate that, within the process windows studied, the injection speed has a significant effect on the surface gloss. Alternatively, the mold temperature is an important processing factor in controlling the surface gloss. The DOE method is a good method to correlate processing parameters and gloss for Mold-in-Color airbag door covers.

In addition, Tekron TK-5600K processed well providing superior cosmetic appearance in actual door cover production. The door covers also show good ductile behavior at extreme cold temperatures after 4 hours of conditioning, temperature shocks, high humidity and heat aged cycles. Tekron TK-5600K successfully passed -35ºC in-chamber deployment testing

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