# The Future Looks Light

EID



## November 11, 2015



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# Welcome to the 2015 Innovation Awards Gala

#### November 11

Velcome to the 45th-annual SPE® Automotive Innovation Awards Gala, sponsored by the Automotive Division of the Society of Plastics Engineers (SPE). I'm once again honored to chair this year's program, *the world's oldest and largest recognition event in the automotive and plastics industries.* My colleagues in the Automotive Division are excited to offer this tribute to the latest innovation in plastics and composites in ground transportation.

This year's theme is *The Future Looks Light*, reflecting the increasing attention being paid to weight, safety, and performance in the global automotive industry to meet ever more challenging emissions and fuel efficiency targets in nearly all regions. Automakers and their suppliers must comply with these standards and still deliver vehicles that customers want, can afford to own, and that provide ever more content within program cost targets. These challenges are part of what makes the automotive space so intriguing to all of us. New ways of executing design create new opportunities for plastics and composites through material and processing innovation, and component integration. Many of these new technologies, materials, and processes will be presented tonight. We at the SPE Automotive Division are passionate about highlighting and communicating technology and information to support the ongoing automotive challenges through our yearly technical programs, educational activities, and this annual recognition event.

Tonight's program will recognize accomplishments for design, materials, and process developments in specific areas of the vehicle, at both the OEM and aftermarket level. It will honor those select individuals and teams judged to be *the Year's Most Innovative Use of Plastics/Composites* with awards in the following areats:

- Aftermarket
- Body Exterior
- Body Interior
- Lifetime Achievement
- Chassis & Hardware
- Environmental

- Hall of Fame Materials
- Powertrain
- Process, Assembly & Enabling Technologies
- Safety
- Grand Award

Before we begin tonight's program, I would like to thank the many volunteers, sponsors, and judges who make this event possible. It is their dedication and commitment – their passion for innovation – that enable the SPE Automotive Division to recognize the industry's most innovative use of polymeric materials in automotive applications.

Welcome to the 45th-annual SPE Automotive Innovation Awards Gala. The Automotive Division thanks you for joining us tonight and we are confident that you will enjoy the event.

Sincerely,

Jeffrey Helms

Jeffrey Helms Global Automotive OEM Corporate Accounts Director Engineered Materials, Celanese 2011-2015 SPE Automotive Innovation Awards Program Chair

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## SCHEDULE OF EVENTS

5:00-6:30 pm Reception / Preview of Nominated Parts & Vehicle Displays

#### 6:30 pm Seating Begins

6:45-7:00 pm Welcome / Dinner

Jeffrey Helms, Celanese, '11-'15 SPE Automotive Innovation Awards Program Chair

Teri Chouinard, Intuit Group

Todd Elliott, Vice President and General Manager Global Sales, Celanese

#### 7:00-9:00 pm Gala Program

Aftermarket Kevin Pageau, International Marketing Alliance Body Exterior Tom Pickett, General Motors Co.

Body Interior Yvonne Merritt, Ford Motor Co.

Lifetime Achievement Nippani Rao, Asahi Kasei Plastics North America, Inc.

Chassis & Hardware Rose Petrella-Lovasik, Ford Motor Co.

Environmental Monica Prokopyshen, retired - Chrysler LLC Hall of Fame David Reed, Retired - General Motors Co.

Materials Anthony Gasbarro, Marubeni Specialty Chemicals, Inc. Powertrain Joel Meyers, Hyundai-Kia Technical Center America

Process, Assembly & Enabling Technologies Steven VanLoozen, BASF Safety Suzanne Cole, Miller Cole LLC Grand Award Todd Elliott, Celanese

9:00-11:00 pm Afterglow Reception Everyone Invited to Attend

## BLUE RIBBON JUDGES

Suzanne Cole MillerCole LLC

Bob Eller Robert Eller & Associates

John Fillion retired-Chrysler Group LLC

Allan Murray AlliedCompositeTechnologies LLC, SPE *Emeritus* 

Ron Price Global Polymer Solutions

Nippani Rao Asahi Kasei Plastics North America, Inc., SPE *Emeritus* 

Tom Russell Allied Composite Technologies LLC

Lilli Sherman Plastics Technology magazine

Doug Smock TheMoldingBlog.com & PlasticsToday.com

Chris Theodore Theodore & Associates LLC

Roy Sjöberg Team R2S LLP

Conrad Zumhagen The Zumhagen Company LLC

Special recognition for the rest of the committee members and judging coordinators: Fred Deans, Mark Lapain, Peggy Malnati, Norm Kakarala, Kevin Pageau, Jay Raisoni, Suresh Shah, & Dawn Stephens.

Special thanks to our student usher organizers, Teri Chouinard, Monica Prokopyshen, and Dave Reed.

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## Common Abbreviations

#### Plastics Terms

i iustics i	СППЭ
ABS	acrylonitrile butadiene styrene
ACM	alkyl acrylate copolymer
ASA	acrylic-styrene-acrylonitrile
CF	carbon fiber
CFRP	carbon fiber-reinforced plastic
D-LFT	direct-(ILC) long-fiber thermoplastic
EPP	expanded polypropylene foam
GF	glass fiber (reinforced)
GMT	glass-mat thermoplastic
GR	glass (fiber) reinforced
ILC	inline compounded
ITR	isophthalate terephthalate resorcinol
LCP	liquid crystal polymer
LFT	long-fiber thermoplastic
MIC	molded-in-color
MPPE	modified-polyphenylene ether
	(also called MPPO, modified-polyphenylene oxide)
OOA	out-of-autoclave (process)
PA	polyamide (also called nylon)
PC	polycarbonate
PC/ABS	polycarbonate/acrylonitrile butadiene styrene
PC/ASA	polycarbonate/acrylic-styrene-acrylonitrile
PC/PBT	polycarbonate/polybutylene terephthalate
PMMA	polymethyl methacrylate (also called acrylic)
POM	polyoxymethylene (also called acetal)
PP	polypropylene
PPA	polyphthalamide
PPS	polyphenylene sulfide
PVC	polyvinyl chloride (also called vinyl)
PVDF	polyvinylidene fluoride or polyvinylidene difluoride
SMA	styrene maleic anhydride
SMC	sheet-molding compound
TPC-ET	thermoplastic copolyester elastomer
TPE	thermoplastic elastomer
ТРО	thermoplastic polyolefin
TPV	thermoplastic vulcanizate

#### Automotive Terms

BEV	battery-electric vehicle		mm
BIW	body in white		MN
BSR	buzz/squeak/rattle		MP
CAD	computer-aided design		MPI
CAE	computer-aided engineering		Ν
CLTE	coefficient of linear thermal expansion		sec
CNC	computer-numerical control		SG
CUV	cross-over (sport-) utility vehicle	(+) 199	169

EA / EAs	energy absorber(s)
EGR	exhaust-gas recirculation
EPA	U.S. Environmental Protection Agency
EU	European Union
FIP	foam-in-place
FMVSS	U.S. Federal Motor Vehicle Safety Standard
GOR	grille-opening reinforcement
HDT	heat-deflection temperature
HEV	hybrid-electric vehicle
HIC	head-injury criterion
HID	high-intensity discharge
ICE	internal combustion engine
IP	instrument panel
LED	light-emitting diode
Li-lon	lithium-ion
MPV	multi-purpose vehicle
NVH	noise/vibration/harshness
OEM	original-equipment manufacturer
PCR	post-consumer recyclate
ped-pro	pedestrian protection (requirement)
PHEV	plug-in hybrid-electric vehicle
PIR	post-industrial recyclate
SUV	sport-utility vehicle
TPC-ET	thermoplastic copolyester elastomert
VOCs	volatile organic compounds

#### Other Terms

2D	two-dimensional
3D	three-dimensional
cm	centimeter
CO <sub>2</sub>	carbon dioxide
ft	foot
g	gram
in.	inch
kg	kilograms
lb	pound
KMPH	kilometers/hour
km/h	kilometers/hour
m	meter(s)
mm	millimeter
MM	million(s)
MPG	miles/gallon
MPH	miles/hour
N	Newtons
sec	second
SG	specific gravity
699616	dollars

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Aftermarket



Transparent Lightweight Wind Deflector 2016 General Motors Co. Corvette Stingray convertible sports car



Material / Process: Lexan PC 9043 with Exatec 900 coating / CNC trimmed sheet

This is the first use of a self-mounted, transparent and frameless wind deflector for convertible cars that meets AS2 ANSI and ECE requirements. The steeply raked design minimizes air turbulence and noise when the top is down. Replacing glass with PC lowered mass 33% and allowed a contoured shape to be achieved that would have been difficult and costly in glass. A laser-etched monogram under the surface is unobtrusive to vision during driving, yet visible during inspection and meets regulatory requirements for glass marking. A plasma coating enhances scratch, chemical, and UV resistance for long use life.

#### Wiper Components 2015 Aftermarket ANCO 31 S Series & Walmart SuperTech wipers



System Supplier:	Federal-Mogul Corp.
Material Processor:	Federal-Mogul Corp.
Material Supplier:	Asahi Kasei Plastics North America
Tooling Supplier:	Various
Material / Process:	Thermylene P9-38FG-0801 BK711 PP / Injection molding

The engineering challenges of converting from GF PBT to GF PP without changing tooling (across 16 part numbers, 208 cavities, and 26 tools -- some of which were 20 years old) was monumental. The new injection-molded grade had to meet the same cold-temperature impact, shrinkage, appearance/color, and 1-year weathering requirements as the incumbent material. A battery of tensile tests were used to qualify each part number and cavity. The result lowered weight 20% (reducing wear on wiper motors), and saved \$0.20 USD/ lb, while offering better cold-temperature impact performance.

Interior Floormat 2015 General Motors Co. Chevrolet Colorado & GMC Canyon pickups



System Supplier:	Thermoflex Corp.
Material Processor:	Thermoflex Corp.
Material Supplier:	Star Thermoplastic Alloys & Rubbers, Inc.
Tooling Supplier:	Thermoflex Corp.
Material / Process:	90 Shore A proprietary TPE / Injection molding
Tooling Supplier:	Thermoflex Corp.

This genuine OEM part features divisional branding and offers customers better vehicle/carpet coverage (better 3D fit with more depth), better foot traction, better safety (uses common OEM retention system), and true color matching. The mats, which are injection molded from a proprietary 90 Shore A TPE, are 100% recyclable and easy to clean. Thanks to improved design flexibility, mats for the second row even feature a patent-pending 2-piece interlocking design that facilitates installation and removal and save 1.7 kg of weight per side for the second row.

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Front-End Module / Grille-Flushness Bracket 2015 Ford Motor Co. Ford Edge CUV



System Supplier:	Flex-N-Gate
Material Processor:	KN Rubber LLC
Material Supplier:	Chase Plastics
Tooling Supplier:	Standard Tool & Mold Inc.
Material / Process:	PA 6/6 / Injection molding

The engineering challenge on this project was to control flushness variability between grille and headlamp while accounting for service constraints as well as the front-end module (FEM) build requirements. The solution was a lightweight inexpensive hook bracket injection molded from PA 6/6 that is tunable, allowing the grille to be pushed or pulled to achieve the desired level of flushness for improved fit & finish. The bracket also allows the fascia/ grille assembly to be removable at the plant without loss of function.

Emblem Front-Camera Deployment Mechanism 2016 Ford Motor Co. Lincoln MKX CUV



System Supplier:	Huf North America
Material Processor:	Laudenbach Formtechnik GmbH & Co. KG
Material Supplier:	Lanxess Corp., DuPont Automotive, BASF Corp., Celanese
Tooling Supplier:	Yantai Huf Tools Co. Ltd., Laundenbach Formtechnik GmbH & Co. KG
Material / Process:	Multiple / Injection molding

To avoid blemishing the face of the vehicle withh the mechanical appearance of an exposed camera, but satisfy the global customer, the camera had to be hidden and deployed only when required. Traditional deployable cameras were on the rear of vehicles and required bulky and heavy metallic housings and components. Front mounting required the lightest possible solution to avoid fascia deformation and vibration during road loads. Converting to an all-plastics mechanism saved 41-55% mass with no loss of function, allowed a camera washer nozzle to be hidden so camera is washed in stowed position, and led to multiple patent filings.

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Body Exterior

Push-to-Release Exterior Serviceability Fastener 2015 Ford Motor Co. Ford Mustang sports car



System Supplier:	ITW Deltar Fasteners
Material Processor:	ITW Deltar Fasteners
Material Supplier:	Ascend Performance Materials, LLC
Tooling Supplier:	A&P Tool, Inc. & M&M Tool and Mold, LLC
Material / Process:	PA 6/6 / Injection molding

Compared to other easy-service fasteners, which have twist heads to release, this injection-molded PA 6/6 fastener only requires that you push the center pin to the service position to remove. This fastener cannot back out or be removed from the installed position without deliberate actions by the customer. The pin and body are designed to not be easily separated; however, the fastener is reusable, unlike other push pins that become damaged in the process of removal. It meets EU lamp serviceability requirements, reducing the time needed to remove the fastener by 90% without tools.

Charge-Port Bezel 2016 General Motors Co. Chevrolet Volt BEV



System Supplier:	ITW Fuel Systems
Material Processor:	ITW Fuel Systems
Material Supplier:	Celanese
Tooling Supplier:	ITW Fuel Systems
Material / Process:	MetaLX Hostaform POM / Injection molding

Thanks to use of elastic averaging, this injection-molded charge-port bezel is located very precisely with no gaps or movement normally associated with typical cantilevered snap-fit components. The application also used molded-in-color POM material, which provided the appearance of chrome without the cost or environmental concerns. Additionally, the design helped reduce labor to install and ensure the part was centered in the charge-port opening.

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#### Race-Like Front-Door Windows 2015 FCA Italy S.p.A. Abarth 695 Biposto supermini sports car



System Supplier:	ISOCLIMA
Material Processor:	Exatec LLC
Material Supplier:	SABIC
Tooling Supplier:	None
Material / Process:	Lexan PC with Exatec coating 9030HO-GN9018T / Thermoforming & injection molding

This application is the first, fully homologated, lightweight, race-like front door with sliding window in polycarbonate glazing and protective plasma surface treatment that met all performance and homologation requirements. The door's polycarbonate glazing also features a sliding rail and small moving plastic glazing with water management. Although the solution is not feasible in conventional glass, the current design is approximately 40% lighter than glass would have been. The application is a good example of using plastics to excite and better appeal to customer while enabling regulatory compliance, homologation, and mass reduction for better performance.



## Body Interior

#### 2015 SPE Automotive Innovation Awards Competition & Gala

2-Shot Injection-Molded Cluster Bezel 2016 General Motors Co. Chevrolet Camaro sports car



System Supplier:	Visteon Corp.
Material Processor:	Windsor Mold Group
Material Supplier:	SABIC
Tooling Supplier:	Windsor Mold Group
Material / Process:	Lexan SLX1432 PC-ITR, PMMA / Injection molding

In this application, a 2-shot component produced on a rotary injectionmolding press replaces a standard clear lens + painted bezel. This allows removal of an assembly joint, creates a unique cut-out in the instrument panel over the instrument cluster, and produces an A-surface with molded piano-black finish, eliminating post-mold painting. The result is increased craftsmanship and design quality by eliminating a sealing defect. Thanks to formation of a chemical bond between PMMA and PC-ITR materials, eliminating variance due to welding, spacing is consistent.

#### 2-Shot Molded Crash Pad Garnish with 3D Patterns 2015 Hyundai Motor Group Kia KX3 CUV



System Supplier:	Hyundai Mobis
Material Processor:	Dong Kook Ind. Co., Ltd.
Material Supplier:	Samsung SDI
Tooling Supplier:	Woosung Precision Co.,Ltd.
Material / Process:	Starex LX-0760 ABS / Injection molding

This 2-shot injection-molded garnish features a transparent PC layer with unique, low-cost 3D patterns molded in and a second ABS layer with molded-in metallic color. The metallic ABS of the second layer showcases the 3D patterns molded into the transparent PC layer, creating an effect that cannot be reproduced using traditional decorative processes, such as insert-molded film, while lowering cost 56%. To eliminate weldlines and flow lines and improve the luminous appearance, size of the hybrid metallic flake system in the ABS was optimized and a hot/cool mold process was used.

Compact Driver's Side Bin 2015 Ford Motor Co. Ford Edge CUV



System Supplier:	Yanfeng USA Automotive Trim Systems Inc.
Material Processor:	Yanfeng USA Automotive Trim Systems Inc.
Material Supplier:	Celanese, Advanced Composites, Inc., Ineos Group Ltd., Trinseo
Tooling Supplier:	Circle 5 Tool & Mold Inc.
Material / Process:	Celcon UV140LG XAP &, LW90-52 POM, ADX 5017 TPO, Ineos HH1891 ABS, & Pulse 2000 EZ PC/ABS / Injection molding

Thanks to a simple, non-binding, all-plastic rail system, this bin box is quiet, fully dampened, and requires no grease. The self-centering POM snap-in rail caps and molded-in lower stabilizing rails allow full extension of the bin drawer while providing smooth, durable function. No screws, mechanical fasteners, welding or heat staking were required in the mating process, eliminating secondary operations and lowering assembly labor.

#### Illuminated Beverage-Holder Assembly 2015 Ford Motor Co. Lincoln MKC luxury sedan & MKX CUV



onics Corp.
olding

This patented and package-friendly application takes advantage of the optical transparency of PMMA and geometrically mirrored surfaces to move light in an innovative and efficient manner upward from the bottom of the cupholder via a single cup-plate component. By eliminating a 2-shot illuminated ring sitting on the side of the cupholder, glare is avoided, scrap-rate is reduced, and there is no need for a special press and tooling, helping reduce costs.



Rear-Seat Folding Head Restraint 2015 Ford Motor Co. Ford F-150 pickup





System Supplier:	Windsor Machine Group
Material Processor:	Hawk Plastics Ltd.
Material Supplier:	ExxonMobil Chemical Co
Tooling Supplier:	IRC Engineering
Material / Process:	PP copolymer / Injection molding

This rear seat, folding head restraint eliminates a welded steel structure and replaces it with a single-piece, living hinge plastic core as its main structural component. As a result, thickness is reduced 33 mm for improved comfort and rear visibility; mass is reduced 624 g/vehicle; manufacturing complexity is significantly reduced (eliminating the need for special tooling processes thanks to consolidation of 5 parts into 1); tooling costs are lowered; and piece price is reduced \$1.50 USD/vehicle, while still meeting or exceeding all global safety requirements.

> Active Glove Box System 2016 Ford Motor Co. Lincoln MKX CUV

System Supplier:	International Automotive Components Group
Material Processor:	International Automotive Components Group
Material Supplier:	Advanced Composites, Inc., Mitshibushi IDK & IDC, CGT
Tooling Supplier:	B&B Tooling Inc.
Material / Process:	ADX 5028 PP & Thermorun TT850N TPO / Multiple

To refine the active glove box (AGB) system to meet luxury-segment customer expectations without losing functionality or safety, the door was hand wrapped and the inner door was flocked, eliminating cut lines for a separate airbag door. The occupant protection zone was increased by 35%, the inflator was precision tuned, and the bladder design was optimized, leading to a larger weld-surface area. A cost savings of \$8/vehicle and a mass reduction of 2.25 lb/vehicle were achieved and the vehicle received a 5 Star Frontal Crash Impact rating.



System Supplier:	Lumens High Performance Lighting, & Lear Corp.
Material Processor:	0
Material Supplier:	BASF Corp. & DuPont Automotive
Tooling Supplier:	Multiple
Material / Process:	Delrin 500P POM, Ultramid B3ZG3 PA 6, Santoprene 65M300 TPE, Hostacom ERC 213N TPO, Pro-fax 7823 PP, and Hostacom X M2 U34 PP / Injection molding

This seat-back mounted tablet docking station and charger allows for smooth, 1-handed loading/unloading of a tablet (or other 12 V-powered devices). The unit meets OEM head-impact requirements (will not fragment or release during impact) and has a range of automatic and synchronized convenience features that are totally new to the tablet holder market. When not in use, the holder rotates downward and stows tightly in the seat back and a tambour door covers the lock if no device is in use.

#### Magnetic Glove Box Light 2016 Ford Motor Co. Lincoln MKX CUV



System Supplier:	International Automotive Components Group
Material Processor:	AGM Automotive
Material Supplier:	Not available
Tooling Supplier:	AGM Automotive
Material / Process:	PP & PC / Injection molding

This hidden lighting component illuminates the glove box through the use of a rare earth magnet (mounted to the moveable door) and composite light housing (fixed in place) without any customer-visible switch. Magnetic flux lines trigger the sensor to turn on/off as the door opens/closes, increasing styling flexibility, reducing complexity, and facilitating material recyclability. The system is very package friendly, saves 10% costs and 20% mass from earlier systems.



2015 SPE Automotive Innovation Awards Competition & Gala

ifetime Achievement Award



Fred Deans Named 2015 SPE® Automotive Division Lifetime Achievement Award Winner

**Frederick** (Fred) Deans, P.E., who has more than 45 years' experience at companies like Continental Structural Plastics, AZDEL, Inc., General Electric Co., and Pittsburgh Plate Glass (PPG) working in the automotive, architectural, and industrial market segments, has been named the 2015 *Lifetime Achievement Award* winner by the Automotive Division of the *Society of Plastics Engineers (SPE\*)*. Deans is an expert in composite materials and molding processes, product engineering, specification development, global sales and marketing, and new product introductions.

First given in the year 2000, the SPE Automotive *Lifetime Achievement Award* recognizes the technical achievements of individuals whose work – in research, design, and/or engineering, etc. – has led to significant integration of polymeric materials on passenger vehicles.

Deans is currently chief-marketing officer, and a co-founder and principal of Allied Composites Technologies, LLC (ACT) as well as the owner of F. Deans & Associates, a Michigan-based enterprise. Previously he has held a variety of positions including director-New Business Development at composites molder and tier 1 supplier, Continental Structural Plastics, Inc., market and industry manager at GE Plastics; program manager at the GE Plastics'-PPG Industries' joint venture, AZDEL, Inc.; application development engineer at PPG Fiberglass AZDEL Products; OEM glass sales representative at PPG; and he started his career as a production engineer at PPG Industries' Works 1-Automotive Windshield plant and moved on to the roles of technical service engineer-Architectural Glass and Solar Products, and sales representative-OEM Automotive Products.

Among his accomplishments, Deans led development of the first unidirectional glass-mat thermoplastic (GMT) composites for new-generation automotive bumper systems. The first application of this technology was a single 12-million lb/5.4-million kg application program with a Japanese automaker. Within three years, every Japanese OEM was using GMT composite for bumper beams. He managed the commercialization and use of next-generation direct-long-fiber thermoplastic (D-LFT) composites for passenger car underbody shields and underhood applications, as well as load floors for off-road vehicles and heating/ventilation/ air-conditioning (HVAC) bases. He also helped develop and commercialize an automotive glass-forming process and introduced monolithic tempered privacy glass for sport-utility vehicles (SUVs).



## 2015 LIFETIME ACHIEVEMENT AWARD



Deans has a strong history of volunteering for engineering societies. He is a long-time member of the board of directors of the SPE Automotive Division (30+ years) and SPE Composites Division (13 years), as well as an intersociety volunteer on the Formula SAE<sup>®</sup> student design competition organized by SAE International<sup>®</sup>. Additionally, he is a co-founder of and three-time conference chair or co-chair for the SPE

#### Past SPE Automotive Lifetime Achievement Award Winners include:

- J.T. Battenberg III, former chairman and chiefexecutive officer of Delphi Corp.;
- Bernard Robertson, then executive vice-president of DaimlerChrysler;
- Robert Schaad, chairman of Husky Injection Molding Systems, Ltd.;
- Tom Moore, retired vice-president, Liberty and Technical Affairs at then DaimlerChrysler;
- Mr. Shigeki Suzuki, general manager Materials Division, Toyota Motor Co.;
- Barbara Sanders, retired director-Advanced Development & Engineering Processes, Delphi Corp.;
- Josh Madden, retired executive at General Motors Corp. (GM) & Volkswagen of America;
- Frank Macher, former CEO of Collins & Aikman Corp., Federal Mogul Corp., and ITT Automotive;
- Irv Poston, retired head of the Plastics (Composites) Development-Technical Center, GM.;
- Allan Murray, Ph.D., retired technology director at Ford Motor Co.;
- David (Dave) B. Reed P.E., retired staff engineer, Product Engineering, GM;
- Gary Lownsdale, P.E., chief technology officer, Plasan Carbon Composites;
- Roy Sjöberg, P.E., retired, General Motors Corp. & Chrysler Corp.; and
- Dr. Norm Kakarala, retired, Inteva Products LLC.

Automotive Composites Conference & Exhibition (ACCE, in years 2001, 2004, and 2015). Deans' efforts were recognized by the SPE *Honored Service Member* award in 2003 and the SPE Composites Division's *Composites Person of the Year* in 2006. He is a licensed professional engineer in the Commonwealth of Pennsylvania and holds a BSME degree from Valparaiso University and an MBA degree in Business Administration from the University of Pittsburgh.

"Fred Deans has been a pillar of the automotive-composites community for decades, and he's long been a cornerstone of the SPE Automotive Division as well," notes David Reed, General Motors Corp.-retired and also SPE *Lifetime Achievement* committee cochair. "He's someone who truly has dedicated his career to developing innovative automotive composites applications, like the first GMT [glass-mat thermoplastic] composite bumper on the *Chevrolet Corvette* sports car, an application which, coincidentally, has been named our *Hall of Fame* award this year for its enduring industry impact. Fred's ability to combine a straight-forward, factual manner with a jovial disposition, an amazing network of contacts, and consistent dedication to engineering excellence and professionalism made him a great choice for this year's *Lifetime Achievement Award* winner.

"For over 35 years, Fred Deans has been a key resource for me when I had questions about a supplier, needed a contact, or when I wanted information on a material," adds Nippani Rao, RAO Associates and Chrysler LLC-retired, as well as co-chair of the SPE Automotive Division *Lifetime Achievement* committee. "Even if he didn't have an answer right then and there, he followed up and was always helpful. He always had a great network of contacts that he shared freely – which is definitely not something everyone will do. He's a great example for the rest of us to aspire to."

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#### 2015 SPE Automotive Innovation Awards Competition & Gala

Carbon Composite Grille-Opening Reinforcement 2016 Ford Motor Co. Shelby GT350 Mustang sports car



System Supplier:	Magna Exteriors
Material Processor:	Plastcoat Div. of Magna International
Material Supplier:	BASF Corp.
Tooling Supplier:	Tycos Tool & Die Co.
Material / Process:	Ultramid A3WC4 PA6/6 / Injection molding & RIW

This is the first GOR panel using short carbon fiber-reinforced PA 6/6 and the unique joining process of resistant implant welding (RIW) to produce a highly structural and lightweight part from a 2-piece injection-molded box section design. Versus the plastic-metal hybrid construction it replaced, the new material/process eliminated 5 steel stampings, reducing costs 75% and mass 24% (2.5 lb). Aesthetics also were improved, which allowed elimination of the beauty cover with its associated labor, cost, and weight, and the VOC emissions associated with rust-coating the steel stampings. Further, NVH values were improved by 2 Hz.

> Door-Trim Clip 2016 Ford Motor Co. Lincoln MKX CUV



System Supplier:	Termax Corp.
Material Processor:	Not available
Material Supplier:	Not available
Tooling Supplier:	Not available
Material / Process:	Thermoplastic Rubber / Injection molding

A new thin-wall 1-piece overmolded TPE clip design completely seals door-trim panels, eliminating the need for a foam-gasket barrier and pressure-sensitive adhesive (PSA), reducing labor and saving \$1.24 USD/ vehicle. The clip design was tuned to meet NVH requirements and seal against air and water leaks. It provides more consistent NVH values and water management while reducing manufacturing-assembly error.



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#### Fan Shroud 2015 General Motors Co. Chevrolet Colorado & GMC Canyon pickups



System Supplier:	Valeo
Material Processor:	Johnson Electric Automotive
Material Supplier:	Asahi Kasei Plastics North America
Tooling Supplier:	Cavalier Tool & Manufacturing Ltd.
Material / Process:	Thermylene P10-30FG-0604 PP / Injection molding

This very-thin-wall (1.124 mm), lightweight fan shroud meets the high heat deflection temperature and strength targets of the incumbent 30% GF PA 6/6 material with a 30% GF PP grade. Significant work was done to modify resin chemistry to optimize morphology, crystallinity, molecular weight, process conditions, low-temperature impact, heat stabilizer additives, and coupling agents for the polymer. This is the first PP compound to meet the applications requirements. The solution lowered cost 33% and weight 16.8% while saving an estimated 1,270 tonnes of CO<sub>2</sub> emissions annually.

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## Chassis / Hardware

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- Martha Graham

Engine-Room Partition Wall 2015 Hyundai Motor Group Hyundai Genesis coupé



System Supplier:	NVH Korea
Material Processor:	NVH Korea
Material Supplier:	KOPLA
Tooling Supplier:	Hyundai Motor Co.
Material / Process:	Kopla KDX 1065 PA 6/6 / Injection molding

This all-plastic engine-room partition wall provides excellent sound insulation between engine and passenger compartments thanks to the use of long-glass PA 6/6 with barium sulfate. Replacing stamped steel plus a sound-deadening pad, the patented injection-molded plastic partition reduces engine noise 8 dB, lowers part count and assembly time, and offers a 20% weight reduction without increasing costs.

Brake-Booster Water Shield 2016 FCA US LLC Jeep Grand Cherokee SUV



System Supplier:	Continental Teves, Inc.
Material Processor:	Unique Fabricating, Inc.
Material Supplier:	Sekisui Voltek, LLC
Tooling Supplier:	Unique Fabricating, Inc.
Material / Process:	XL PP / Vacuum forming

This brake-booster water shield provides a water-tight cover without compression or adhesive, protecting the weld seam from water intrusion and possible corrosion. A working prototype was developed within 14 hours off a wax casting tooling, and production parts were installed on vehicles within 7 weeks. Cross-linked PP, which is vacuum formed and die cut in a single step, also provides NVH reduction and enabled the brake-booster housing to be changed from steel to aluminum, providing cost and weight savings.

#### Surround-Molding Retention Mechanism 2015 Ford Motor Co. Ford Edge CUV



Cooper Standard
Cooper Standard
Exstar Inc.
MGS Mfg. Group, Inc.
D4066 PA 6/6 / Injection molding

This surround-molding retention mechanism makes use of a unique injection-molded PA 6/6 multi-function clip with locating pin to provide a 4-way locating strategy that improves fit & finish to front and rear doors in both black and bright surround moldings. Other benefits include reduced wind noise, water leaks, and edge drips, and lower closing effort. The easy-to-install patent-pending design also reduces repetitive-motion injuries on line workers and eliminates 4 metal fasteners.



 

 Door Protection Device 2015 Ford Motor Co. Ford Focus All Models

 System Supplier:
 WITTE Automotive

 Material Processor:
 WITTE Automotive

 Material Supplier:
 DuPont Automotive

 Tooling Supplier:
 WITTE Automotive

Material / Process: Delrin POM, PA 7, PP / Injection molding This articulating plastic door-edge protector extends when the door opens, helping prevent damage to the door and other nearby vehicles. By reducing door dings and dents, \$1.5MM USD warranty paint repairs can be saved plus another \$500K USD indirect costs due to prevention of damage during shipping. It also helps maintain craftsmanship of the vehicle over its use life. Fiberglass/Epoxy Composite Coil Spring 2015 Audi AG Audi A6 Avant 2.0-L TDI Ultra wagon



System Supplier.	S. Ala Composite S.A.S.
Material Processor:	S. Ara Composite S.A.S.
Material Supplier:	Hexion Inc.
Tooling Supplier:	Not available
Material / Process:	Epikote epoxy + fiberglass / Modified filament winding

This weight-saving epoxy/fiberglass composite coil spring is the first of its kind to be used in the suspension system of a series-production vehicle. Using a patented, modified filament winding process, the application replaced traditional steel coil springs, reducing weight 40% and enabling the suspension system to react more quickly to changing road surface conditions, thereby improving vehicle handling and NVH. Significant work was done on resin chemistry and resin/fiber interface to ensure efficient load transfer and long-term mechanical performance, as well as finding an efficient, cost-effective production method capable of meeting build volumes.

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### Environmental



Natural Fiber-Reinforced PP 2013 PSA Peugeot Citroën Peugeot 308 hatchback



System Supplier:	Faurecia
Material Processor:	Faurecia
Material Supplier:	Automotive Performance Materials - APM
Tooling Supplier:	Not available
Material / Process:	Nafilean PF2 natural PP/20% NF / Injection molding

This 20% hemp-filled PP reduces part weight up to 25% vs. higher density glass-reinforced PP and allows wall stock to be lowered to 2 mm. Thanks to the 20% bio content, this also reduces the part's  $CO_2$  emissions 20% during its use life. The material is fully recyclable, and can be processed on conventional molding machines at lower energy consumption.





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For rates & information, please contact Teri Chouinard at Intuit Group, teri@intuitgroup.com +1.810.797.7242 Seat Fabric from Recycled Materials 2015 Ford Motor Co. Ford F-150 pickup



System Supplier:	Johnson Controls Inc.
Material Processor:	Sage Automotive Interiors
Material Supplier:	Unifi Manufacturing, Inc.
Tooling Supplier:	Not available
Material / Process:	Repreve PET / Multiple

The fiber used in this innovative seat fabric is made from a hybrid blend of 100% recycled materials, including post-industrial fiber and post-consumer water bottles. The fabric meets Ford design and comfort requirements without any compromise in quality, durability, or performance. The switch from virgin fiber was achieved at cost parity, while providing significant environmental benefits, including diverting over 5-million water bottles from landfills just this year. To help close the loop further, there are now PET bottle collection bins installed at the Ford Research & Engineering campus, which are recycled to help form this fiber.

#### Short-Glass/PP Replacement for Long-Glass/PP 2015 Ford Motor Co. Ford F-150 pickup, Escape CUV, & Fusion midsize sedan



System Supplier:	Summit Polymers, Inc.
Material Processor:	Summit Polymers, Inc.
Material Supplier:	TMG Automotive
Tooling Supplier:	Summit Polymers, Inc.
Material / Process:	Optipro CP2510GM GF-PP / Injection molding

In this application, a glass and mineral-reinforced PP copolymer containing 65% post-industrial recycled scrap polymer was used to replace a virgin long-glass PP with no loss in performance and no tooling changes. A battery of tests showed the new recycled short-glass/mineral PP had comparable mechanical performance to the incumbent virgin long-glass PP while providing environmental benefits and saving \$2-3 USD/vehicle.







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## Environmental





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In this application, underbody shields using virgin glass/PP LWRT composites were replaced by a material made from PET fibers, half of which were sourced from recycled water bottles. The result was lower cabin noise/better acoustics, better thermal performance, a 2% cost savings, and a more environmentally responsible solution.



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Become a Member Today http://www.4spe.org/membership/ PCR Cam Cover 2015 Ford Motor Co. Nano 2.7L and 3.5L IVCT GTDI engines



System Supplier:	ElringKlinger North America, Inc.
Material Processor:	Bruss North America Inc.
Material Supplier:	Wellman Advanced Materials
Tooling Supplier:	Not available
Material / Process:	EcoLon GF1960 PA 6/6 (100% PCR) / Injection molding

This is the first time a 100% post-consumer recycled PA 6/6 resin with 33% short-glass reinforcement has been used for a demanding cam cover application to replace die-cast aluminum. The PCR PA 6/6 offered excellent weldability to attach a high-efficiency air-oil separator and was molded in very-thin walls (to 2.0 mm for the Nano-model cover). The result is a part that is 30% lighter than incumbent aluminum, offers lower NVH values and a 20% material cost reduction vs. virgin resin, and diverts carpet from landfills.

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# Hall of Fame Award

First GMT Composite Bumper on 1984 *Corvette* Sports Car is 2015 SPE<sup>®</sup> Automotive *Hall of Fame* Winner

The first use of glass-mat thermoplastic (GMT) composite on the front bumper of the 1984 model year (MY) *Chevrolet Corvette* sports car from then General Motors Corp. (GM) has been named the 2015 Hall of Fame winner by the *Automotive Division of the Society of Plastics Engineers (SPE®)* for the group's 45th-annual *Automotive Innovation Awards Competition*. To be considered for a *Hall of Fame* award, an automotive plastic or composite component must have been in continuous service in some form for at least 15 years and preferably have been broadly adopted within the automotive or ground-transportation industries. GMT bumpers meet this criteria having been in continuous use on a variety of passenger vehicles for more than three decades and having proliferated beyond GM to vehicles built by automakers in North America, Europe, and Asia. In fact, many of the different GMT bumper design variants over the years have been category or *Grand Award* winners of the *Automotive Innovation Awards Competition*.

"The front bumper on the 1984 *Corvette* not only was the first in a long line of weight- and cost-saving front and rear bumper beams in GMT composites" explains Nippani Rao, RAO Associates and Chrysler LLC-retired, as well as co-chair of the SPE Automotive Division *Hall of Fame* committee, "but it also led to increased use of GMT as well as other thermoplastic composites in a broad range of interior and exterior automotive applications worldwide."

"GM's first use of a GMT bumper on the 1984 *Corvette* involved a number of firsts," adds David Reed, General Motors Corp.-retired and also SPE *Hall of Fame* committee co-chair. "This two-piece, compression-molded, induction-welded, box-section design used Azdel® PM 400 40% continuous-strand, randomly oriented glass fiber in a polypropylene matrix from PPG Industries. The application, which was molded by LOF Plastics Inc., also represents the first use of EMA weld<sup>1</sup> welding."

Shortly after the *Corvette* bumper was commercialized, GM launched C-section GMT designs on the front bumper of the D-body platform, which included models like the *Cadillac DeVille, Fleetwood*, and *Brougham* sedans. The GMT beams were mounted to the car frame using ACDelco shock absorbers, which further increased the impact energy the beam could absorb. Another C-section design was used on *Cadillac Seville* sedan. This design incorporated a single in-turned upper flange, a development that later led to the creative use of a double in-turned flange on models from Oldsmobile.

By 1986, GMT bumpers had moved to Ford Motor Co. and were featured on the front bumper of the *Ford Mustang* sports car. These GMT beams were mounted using Ford's polygel mitigators (PGMs) Two years later, GMT bumpers were used for the first time on the rear of the *Ford Continental* DN9 sedan as well as the front of GM's N-body cars. The latter were notable for being the first compression-molded beams with two in-turned flanges, which were notoriously challenging to mold.

In 1989, Honda Motor Co. used C-section GMT bumpers on both the front and rear of the *Honda Accord* compact cars produced in North America and Japan. Not only were these the first non-Big 3 use of the material/application, but they also were the first GMT beams combining both unidirectional and randomly oriented continuous glass mats, and the first composite beams that were hard



#### mounted

to vehicles (fixed directly to

the rail beams without the use of shock absorbers). By 1990, GM used

GMT bumpers on the front of the *Buick LeSabre* sedans, which featured a "peekaboo" stainless steel, in-molded chrome strip. The Japanese automakers were back in 1991 with GMT bumpers on multiple mid-size models produced by Toyota Motor Corp., Suzuki Motor Corp., Nissan Motor Co. Ltd., and Mazda Motor Corp.

During the 1990s, over 16% of all passenger cars globally sported GMT bumper beams, consuming over 500-million pounds/226,796 tonnes of the material. Another design evolution occurred in 1998 with the development of the I-beam, which was the first GMT bumper to use a new discontinuous chopped-fiber mat because it was better at penetrating deep into the complex rib structures that distinguished this beam. So novel was the design that it won the 1998 *SPE Automotive Innovation Awards Competition's Grand Award* and it also was cited by the Insurance Institute for Highway Safety (IIHS). By 2000, South Korean GMT producer and AZDEL licensee Hanwha was developing GMT beams for all Korean passenger car models and the company still supplies to these OEMs.

GMT bumpers also proliferated on vehicles produced by European automakers. In France, PSA Peugeot Citroën Group used GMT with randomly oriented continuous glass and unidirectional continuous glass reinforcements on front bumpers of *Peugeot 309* sedans from 1986 to 1992. GMT combining mats of chopped glass and glass fabric (laid up 0°/90°) moved to rear bumpers from 1995-2002 on vans from PSA (*Peugeot 806* and *Citroën Evasion*) and Italian automaker, Fiat Group (*Fiat Ulysse* and *Lancia Zeta*). Rear GMT beams moved to PSA cars in 2004 on the *Citroën C5* (random glass mat) and *Peugeot 407* sedans, and *Peugeot 407 SW* wagon (random plus fabric mats).

Versus steel, the incumbent bumper beam material at the time, GMT composite beams offered a number of benefits, including 30% lower weight, greater design flexibility, lower tooling costs (especially beneficial for low-volume specialty models), elimination of rust/corrosion, and better impact performance (less vehicle damage) during low-speed impacts.

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The 2015 SPE Automotive Division Hall Of Fame committee was co-chaired by Nippani Rao, Asahi Kasei Plastics North America, Inc. and Dave Reed, retired, General Motors Corp. Committee members include:

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- John Fialka, Styrolution Group GmbH;
- Jeffrey Helms, Celanese;
- Norm Kakarala, retired-Inteva Products, LLC;
- James Kolb, retired-American Chemistry Council;
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**Plastics Division** 

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## Materials

#### 2015 SPE Automotive Innovation Awards Competition & Gala

Ultralight Class A Body Panels 2016 General Motors Co. Chevrolet Corvette sports car



System Supplier:	Continental Structural Plastics
Material Processor:	Continental Structural Plastics
Material Supplier:	Continental Structural Plastics
Tooling Supplier:	Century Tool & Gage, Paragon Die & Engineering Co.
Material / Process:	TCA Ultra Lite SMC / Compression molding

A new 1.2 SG SMC eliminated 9 kg of body-panel weight after a running change from a mid-density grade, where no tooling changes were required. Suitable for Class A or structural components, the new composite offers 28% mass reduction vs. mid-density (1.6 SG) grades and 43% vs. conventional (1.9 SG) SMC. It provides greater benefits vs. metal, including reduced weight and tooling costs, enhanced design flexibility, corrosion and dent resistance, and superior surface finish. Key to achieving the ultralow density was replacement of CACO<sub>3</sub> with hollow-glass microspheres and use of a proprietary surface treatment to improve the resin/reinforcement interface.

Blow-Molded Spoilers 2015 General Motors Co. Cadillac Escalade, GMC Yukon & Chevrolet Tahoe SUVs



ABC Inoac Exterior Systems, LLC
ABC Inoac Exterior Systems, LLC
Mitsubishi Rayon Co., Ltd.
Tooling Technology LLC
Bulksam EX45G ABS / Blow molding

Because it was difficult to blow-mold spoilers over 50 in. in length with existing resins, innovative chemistry was used to tailor the ABS molecule to increase molecular weight (for better parison control), and improve thermal performance and boost impact strength. The new material met or exceeded all functional and aesthetic requirements and was used to drop a 22 lb parison and to mold spoilers that are 57 x 14 x 5 in. with uniform wall thickness.

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Materials



Carbon Composite Wheel 2015 Ford Motor Co. Ford Mustang Shelby sports car



System Supplier:	Carbon Revolution
Material Processor:	Carbon Revolution
Material Supplier:	Not available
Tooling Supplier:	Carbon Revolution
Material / Process:	Carbon fiber-reinforced composite /
	Resin transfer molding

This is the first high-volume OEM carbon composite wheel designed to meet all OEM requirements and quality standards, and produced and sold with full warranty coverage. The one-piece wheel is molded by resin transfer molding over a dry carbon fiber preform, then fully infused with a proprietary resin. Hollow core spokes are designed to provide maximum wheel stiffness, and aluminum lug seats and backer plate sandwich the carbon composite structure for a robust joint. An embedded RFID chip in the spoke allows manufacturing and quality history for each wheel to be tracked. Weight and rotational inertia are significantly reduced.

#### Rear Lamp Reflector 2015 FCA US LLC Dodge Challenger sports car



System Supplier:	Varroc Lighting Systems
Material Processor:	Varroc Lighting Systems
Material Supplier:	SABIC
Tooling Supplier:	Not available
Material / Process:	Lexan LUX 2289 PC / Injection molding

Rear lighting plays an important safety and branding role. New lighting technologies have been combined with plastics to create innovative new designs, such as this rear lamp with unique lit and unlit appearance. The system uses high specular and diffuse reflection from multiple LEDs to create a homogeneous light glow. Thanks to a special color additive, the white polymer's high reflectivity after molding and heat aging, and minimal color shift eliminates the need for direct metallization or painting. Injection molding also enables design features like clips to be integrally molded close to LED circuit boards.

Thermally Conductive Thermoplastic Heat Sink 2015 Ford Motor Co. Ford Mondeo sedan



System Supplier:	Valeo
Material Processor:	Valeo
Material Supplier:	Celanese
Tooling Supplier:	Not available
Material / Process:	CoolPoly E3609 PA 6 / Injection molding

This metal-to-plastic conversion of an LED lighting-module heat sink was made possible thanks to a new injection molded thermally conductive polymer. The plastic heat sink is 45% lighter, has thinner walls than die-cast aluminum, and uses 2/3s less energy to produce. It also eliminates deburring, deflashing, the use of corrosion-resistant coatings, and machining of critical surfaces. Additional benefits are that it provides equivalent thermal performance at lower cost, and tool life is projected to be 6x longer than that for die-cast metal.

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### 2015 SPE Automotive Innovation Awards Competition & Gala

Heated-Tip Fuel Injector 2015 Honda Motor Co. Honda Fit subcompact & City sedan



System Supplier:	Delphi Powertrain
Material Processor:	Delphi Powertrain
Material Supplier:	DuPont Automotive
Tooling Supplier:	Coltelleria Baldi
Material / Process:	Zytel HTN54G35EF BKB336 PPA / Injection molding

An electrical heater within the injector is energized by the vehicle controller, rapidly heating the ethanol fuel and dramatically improving vaporization while reducing emissions. Ink materials used in construction of the heater, body design, the ink-printing process on the body, and overmolding with PPA (which was designed for flow, heat resistance, and electronic compatibility) were all key to the success of this application. The technology saved \$60 USD/vehicle as well as 8.8 kg, while improving cold starts on E100 fuel and eliminating the need for a redundant gasoline fuel system on the vehicle.

Overmolded Chain Snubber with Integral Baffle 2016 General Motors Co. Chevrolet Volt BEV



System Supplier:	GM Powertrain
Material Processor:	Parker Hannifin Chomerics Div.
Material Supplier:	DSM Engineering Plastics
Tooling Supplier:	Advanced Tool & Mold Inc.
Material / Process:	Stanyl TW341 PA 4/6 & Hytrel TPC-ET / Injection molding

This application represents the first time that chain-noise reduction (snubbing) and fluid-sealing functions have been integrated into a single compact component with 2 thermoplastic materials for a soft/hard combination. It also is the first time that a snubber has been used on the coast side of the sprockets, and the first time "stitching features" have been used to mechanically attach 2 materials in little space to meet packaging constraints. The PA 4/6 material was selected for its outstanding wear resistance. The final component was 31% lighter than the previous system, while meeting stringent noise requirements of the EV.



Powertrain



### Transmission Heat Exchanger Cradle 2015 Ford Motor Co. Lincoln MKC CUV



System Supplier:	A. Raymond Tinnerman
Material Processor:	A. Raymond Tinnerman
Material Supplier:	SABIC
Tooling Supplier:	Not available
Material / Process:	Noryl GTX 840 PPE/PA 6/6 / Injection molding

A streamlined snap-fit design of a structural cradle eliminated the need for metal fasteners and typical welded/bolted on metal designs. This led to significant cost savings thanks to lower assembly time for the cradle itself and the entire front engine module consisting of 15 components. By eliminating the corrosion risk associated with die-cast aluminum and stamped steel in conventional designs, the MPPE/PA unit improves structural performance at elevated temperatures, and saves cost and weight vs. specialty materials.

### PHEV Battery Pack General Motors Co. 2016 Chevrolet Volt BEV



System Supplier:	General Motors Co.
Material Processor:	MH, ICB&ICB flex-board supplers
Material Supplier:	SABIC
Tooling Supplier:	Multiple
Material / Process:	Noryl SE1GFN2 MPPE / Injection molding
Material / Process:	Noryl SE1GFN2 MPPE / Injection molding

This next-generation battery pack features significant design improvements from its predecessor, including greater component integration, robust fuseable ICB board, and lightweight all-plastic structural elements, which eliminated a steel endplate and saved approximately 15% of the weight of the earlier system. As an added safety feature, the new design circuit contains fuses intended to interrupt the circuit in the event of a downstream short circuit. The MPPE/PA resin's dimensional control and property retention in coolant helped achieve a durable thin-wall design.

### External Air Oil Separator 2015 General Motors Co. Chevrolet LT1 Camaro SS sports car & Cadillac LT4 CTS-V sedan



System Supplier:	ElringKlinger North America, Inc.
Material Processor:	ElringKlinger North America, Inc.
Material Supplier:	DuPont Automotive
Tooling Supplier:	Not available
Material / Process:	Zytel PLS95G35DH1 PA / Multiple

Multiple manufacturing technologies, including injection molding, vibration welding, and spin welding, were all used to create a new design that achieved superior oil separation in very limited package space. The resin's special oxidation-barrier technology helps preserve mechanical properties at elevated temperatures and prolong the unit's service life.

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### Process, Assembly & Enabling Technologies



Blow-Molded Air Deflector 2014 General Motors Co. GMC Sierra & Chevrolet Silverado pickups



System Supplier:	Metelix Products, Inc.
Material Processor:	Metelix Products, Inc.
Material Supplier:	Washington Penn Plastics Co., Inc.
Tooling Supplier:	Metelix Products, Inc.
Material / Process:	7622LW UV 598F TPO / Blow molding

This blow-molded 1-piece air deflector, mounted near the wheels to deflect air, improve fuel efficiency, and reduce dirt and ice retention, replaced a 2-piece injection-molded deflector. An innovative blow-molding technique involving high pressure and high vacuum in the tool enabled uniform wall stock and fine-texture graining on both sides of the part to help it harmonize with nearby injection-molded parts. A special blow-moldable TPO grade was developed to maintain impact and ductility to -30C at lower density. Vs. the earlier injection-molded design, mass was reduced 5%, tooling costs were lowered, and a welding operation was eliminated.

### Class A Compression-Molded Carbon Composite Hood 2016 General Motors Co. Cadillac ATS-V / CTS-V sedans



System Supplier:	Magna Exteriors
Material Processor:	Magna Exteriors
Material Supplier:	Barrday Advanced Material Solutions
Tooling Supplier:	Century Tool & Gage
Material / Process:	CF-reinf. epoxy / Compression molding

This compression-molded carbon composite hood utilizes fast-curing epoxy/ carbon fiber prepreg (6 plies of unidirectional 50K tow carbon fiber for outer panel; fabric weave for inner panel). Patent-pending tool design, robotic preform, and material loading processes help produce the Class A painted hood in a sub-10-min cycle that is capable of volumes as high as 30,000/ year on a single set of tools. The bonded 2-piece hood is 20-30% lighter than aluminum and exceeds pedestrian protection requirements. This is the first compression-molded carbon composite hood on a production vehicle and is offered painted with optional decorative exposed weave inner panel.



### Lower Rocker Panel 2016 Ford Motor Co. Mustang Shelby GT350R Hummingbird sports car



System Supplier:	Flex-N-Gate
Material Processor:	ABC Group
Material Supplier:	LyondellBasell / Reedy International Corp.
Tooling Supplier:	Concours Mold Inc.
Material / Process:	Hifax/SAFOAM TYC852P E/FPE-20
	TPO(PP+EPDM-M22) + Foaming Agent /
	Gas-counterpressure structural foam molding

This gas-counterpressure structural-foam molded 1-piece rocker panel has Class A surfaces front and back, solves gap and fit issues, and eliminates the need for fasteners on the back. The fully recyclable 15% talc-filled TPO eliminates 5 previous components, eliminates warpage, and shows no surface porosity or sink marks. It offers increased strength and passes all high-speed flutter tests, achievable with variable wall thicknesses thanks to gas-counterpressure. The final product eliminated 100% of the assembly labor and components in the earlier multi-piece design and offered the highest guality and durability at the lowest cost and weight.



### Process, Assembly & Enabling Technologies

### 2015 SPE Automotive Innovation Awards Competition & Gala

Press Bonding with Edge Folding & CNC Deco Stitch 2015 Ford Motor Co. Ford F-150 pickup



System Supplier:	Faurecia
Material Processor:	Faurecia
Material Supplier:	Haartz Corp.
Tooling Supplier:	FRIMO Group GmbH
Material / Process:	Multiple / Multiple

A combination of high-speed decorative stitching and press lamination with automatic edge folding and wrapping helped bring the look and quality of cut-&-sew and hand wrapping to a high-volume production vehicle. The innovative new process combination saves approximately 8 oz of weight by using lightweight TPO skins instead of heavier PVC, 10% scrap, 55% cycle time, \$10 USD/vehicle direct costs, and approximately \$1-million USD in tooling savings.

Blow-Molded Spoiler Assembly 2016 General Motors Co. Cadillac ATS V Series



System Supplier:	Metelix Products, Inc.
Material Processor:	Metelix Products, Inc.
Material Supplier:	Trinseo
Tooling Supplier:	Metelix Products, Inc.
Material / Process:	Magnum 1250BG ABS / Blow molding
0 11	

This blow-molded spoiler features a complex triangular-shaped design and 1-piece construction while maintaining uniform wall thickness and product integrity. Achieving the complex deep-draw features required a unique 3-piece tool including a large slide that extends the entire rear edge of the mold cavity. Timed slide operations enabled the parison to expand with minimal stretch, and laser venting improved air evacuation for wall-thickness control. The final part meets aggressive styling objectives at 10% cost and 20% weight savings vs. conventional blow molding.

### Tonneau Cover 2016 Toyota Motor Corp. Toyota Tacoma pickup



System Supplier:	ASC Inc.
Material Processor:	Nyloncraft, Inc.
Material Supplier:	Asahi Kasei Plastics North America
Tooling Supplier:	Briadco Tool & Mould Inc.
Material / Process:	Thermylene P6-30FM-0829 PP /
	Injection-compression molding

Injection-compression molding was used to produce this lightweight (65 lb), thin-wall lockable tonneau cover, allowing a much smaller press to be used. Once molded, top and bottom halves, reinforcement bars and assembly clips are added and the two halves are vibration welded. One of industry's largest high-frequency vibration-welding machines is used to bond up to 70 in.<sup>2</sup> of welded surface. The PP grade used was specifically formulated to reduce warpage and facilitate proper welding/assembly.



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### Process, Assembly & Enabling Technologies



IMX Instrument Panel 2014 Hyundai Motor Group Hyundai i20 supermini



System Supplier:	Hyundai-Mobis
Material Processor:	HanilEhwa
Material Supplier:	Hanwha L&C
Tooling Supplier:	Hyundai-Motor Co.
Material / Process:	Multiflex 3202 TPO /
	Compression-injection molding

To eliminate scratches and a hard "plastic" feel, a 2-shot compressioninjection soft IP was developed. The back-foamed TPO foil is compression-injected with the PP substrate, which in turn is integrally injection molded with the TPO passenger-side airbag door. All the work is done in a single tool. To increase foam softness and stability of the integral injection molding, the TRIZ method and design of experiments tools were used. The resulting part saves \$10 USD/ vehicle and reduces mass 300 g.

2-Shot Selective Chrome & Paint Finish Panels 2016 Ford Motor Co. Ford Explorer SUV



System Supplier:	Summit Polymers, Inc.
Material Processor:	Lawrence Automotive Interiors Ltd.
Material Supplier:	SABIC
Tooling Supplier:	Not available
Material / Process:	Cycolac ABS, Cycoloy PC/ABS / Injection molding

To meet program direction for a multi-colored finish panel within the same package space (without incremental space for attachments) meant a 2-shot selective chrome and paint solution in a single molded piece with similar materials was needed. In the first shot, PC/ABS is injected into a dual cavity tool on a rotary platen. In the second shot, a very-thin plateable ABS grade is overmolded. Dip plating plus masking and painting offer numerous finish options with lower gloss over plating and MIC applications. The result achieves a very-good bond, has zero-margin gap, and no BSR issues.

A-Side Scoring in Seamless Leather FIP IP 2016 Ford Motor Co. Ford Explorer SUV



Eissmann Group Automotive	
Faurecia	
KEM ONE	
Fichtner & Schicht GmbH	
Nakan DSY300/15 PVC / Multiple	

For seamless-leather IP applications, positional tolerance between the leather scoring line and the underlayment PVC skin's scoring line was reduced 80% vs. conventional Class B weakening methods. This patentpending method significantly improved deployment performance for seamless leather FIP systems, which led to substantial validation savings.

#### Door-Trim Switch Bezel 2016 Ford Motor Co. Ford Edge CUV



System Supplier:	Yanfeng USA Automotive Trim Systems Inc.
Material Processor:	Yanfeng USA Automotive Trim Systems Inc.
Material Supplier:	BASF Corp.
Tooling Supplier:	Michael Tool & Mold (Windsor) Ltd.
Material / Process:	Ultramid A3L PA 6/6 / Injection molding

By combining a heated mold and a special stainless-steel cavity with extra cooling on the grained surface, it was possible to create the look of 2 parts (one in high-gloss piano black and one in a low-gloss grained surface) in a single tool while achieving impeccable fit and finish and craftsmanship. This eliminated the need to mold multiple parts and/or paint, saved 200 g and \$4 USD/vehicle, and eliminated the VOCs and cost of a painting operation.



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### Door Bolster Tuned Safety Targets 2016 Ford Motor Co. Super Duty pickup



System Supplier:	Yanfeng USA Automotive Trim Systems Inc.
Material Processor:	Yanfeng USA Automotive Trim Systems Inc.
Material Supplier:	LyondellBasell & Borealis AG
Tooling Supplier:	Hi-Tech Mold & Eng., Inc.
Material / Process:	Pro-fax SG702 PP Copolymer, Daplen
	WN100AI 10% talc-filled PP / Injection molding

After 40 revisions on CAE, this door bolster was improved to meet sideimpact as well as vertical-load requirements without changing the airbag, adding energy-management beams in the door, or changing the structure of the sheet metal. No new secondary tooling was required and only minor Class A surface changes were needed. The resulting part saved 2.6 lb, \$1.87 USD in material costs, and reduced side-impact forces 400%. The patent-pending design took just 20 months to be implemented.

> Direct Sensor Mounting to Fascia 2015 Ford Motor Co. Ford Mustang sports car



System Supplier:	MacLean-Fogg Co. / Ford Motor Co.
Material Processor:	MacLean-Fogg Co.
Material Supplier:	LyondellBasell
Tooling Supplier:	Industrial Automation LLC
Material / Process:	Hifax TYC 852X TPO / Injection molding

A flexible pedestrian-protection crash sensor bracket injection molded in plastic with an embedded metal stud is sonically welded directly to the fascia skin to decrease signal noise and improve response time of the deployable hood system. The flexibility of the design helps the bracket to conform to different fascia contours, allowing for a single bracket design to be used in multiple locations on the same vehicle, or across different vehicle lines. The final design saved 1 lb and \$5 USD/vehicle and allows the hood to deploy faster for greater pedestrian safety.



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Floor Rocker Reinforcement 2015 FCA US LLC Jeep Renegade SUV



System Supplier:	Proma Group
Material Processor:	Redstamp
Material Supplier:	SABIC
Tooling Supplier:	Redstamp
Material / Process:	Noryl GTX MPPE/PA 910 / Injection molding

An optimized MPPE/PA 6 honeycomb geometry in a plastic/metal hybrid proved to be a very efficient energy-absorbing crash-box structure in this floor rocker reinforcement. Not only is the component E-coat capable, but it is very easy to assemble into the vehicle's BIW. Since the plastic honeycomb is integrally attached to 2 steel flanges during injection molding, no structural adhesives are needed. The mixed-material solution took 1 kg of weight out of the BIW, saved approximately 10%, and contributed tooling savings vs. previous steel solutions.



### 2015 SPE Automotive Innovation Awards Competition & Gala

### Energy-Absorbing Armrest 2015 Ford Motor Co. Ford Explorer SUV



System Supplier:	Yanfeng USA Automotive Trim Systems Inc.
Material Processor:	Yanfeng USA Automotive Trim Systems Inc.
Material Supplier:	MRC Polymers
Tooling Supplier:	Yanfeng USA Automotive Trim Systems Inc.
Material / Process:	PP / Injection molding

An open design with a flexible, yet durable cover replaced conventional molded slots or honeycombs in this injection-molded armrest, improving vertical load performance and side-impact energy absorption. In addition to boosting performance, durability was also increased 3.5 times on this police special vehicle.

### Drop-in TPO Chute in Seamless Leather FIP IP 2016 Ford Motor Co. Ford Explorer SUV



System Supplier:	Eissmann Group Automotive
Material Processor:	Faurecia
Material Supplier:	Mitsubishi Chemical America
Tooling Supplier:	Reko International Group
Material / Process:	TT 860 TPO / Multiple

This is industry's first use of a drop-in TPO passenger airbag chute in a seamless leather, foam-in-place system. Door, hinge, and frame are all integrally molded into the same patented TPO chute, providing faster deployment and saving approximately 0.7 lb and \$1.25 USD direct and indirect costs per vehicle.

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> Unidirectional Inertial Lockout 2016 Ford Motor Co. Lincoln MKC luxury sedan





System Supplier:	International Automotive Components Group
Material Processor:	West Michigan Molding, Inc.
Material Supplier:	Celanese
Tooling Supplier:	Not available
Material / Process:	Celcon LW90-S2 POM / Injection molding

This console bin door has no latch in the closed position, but a undirectional inertial lockout feature was implemented to meet FMVSS 201. The lockout's inertial sensitivity is defined by part geometry, allowing it to be made of any material while maintaining the same inertial properties. A single injection-molded snap-in lever plus felt tape replaced multiple die-cast metal components, minimizing testing costs due to compliance the first time, increasing reliability, and saving 7.85 g and \$0.84 USD costs vs. the previous metal option.



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### SPE<sup>®</sup> Accepting Donations for Dr. Jackie Rehkopf Endowed Scholarship

The SPE® Automotive and Composites Divisions, in conjunction with The SPE Foundation, have formed an endowed scholarship to honor the memory of Dr. Jackie Rehkopf and are now accepting donations. The groups hope to raise funds for a sufficiently large endowment to allow an annual scholarship to a deserving undergraduate or graduate student studying engineering or science and with plans to work in the field of transportation composites.

Rehkopf spent her career doing research in the field of automotive plastics and composites. She was a long-time SPE ACCE committee member, session organizer, and two-times technical program co-chair. She also served on the SPE Automotive Division board as a director from 2005 through 2014, plus was intersociety chair for 2 years and treasurer for 2 years. She was active from the mid-1990s until 2014 with SAE International<sup>®</sup>, helping organize a large plastics session for over a decade for SAE Congress. Additionally, she wrote a book in 2011 entitled <u>Automotive Carbon Fiber Composites: From Evolution to Implementation</u> that was published by SAE. She was awarded an SAE Outstanding Technical Contribution Award for her work in co-developing and sponsoring the SAE Standard J2749 High Strain Rate Tensile Testing of Polymers. She authored many publications and presented at numerous technical conferences during her 20 year career.

In both academia and industry, Rehkopf's research interests were in mechanics of materials. After earning both B.S. and Ph.D. degrees in Civil Engineering from the University of Waterloo in Canada, she moved to the Detroit area and began work in 1994 as a materials engineer for Ford Motor Co. After 4 years, she became a technical specialist at Ford in the company's Research Lab Safety Department (from 1998-2003) and later in the Materials Engineering Department (from 2003-2006). She left the automaker in 2006 to join Exponent as a senior engineer and consultant in the areas of mechanics of materials, structural mechanics and dynamics, experimental testing, and failure analysis. Rehkopf's expertise was in high-strain-rate behavior of both metallic and polymeric materials, and fatigue and creep of reinforced and non-reinforced plastics. In 2010, she joined the R&D department of Plasan Carbon Composites as a senior researcher working on carbon fiber-reinforced composites. During her first 2 years at Plasan, she split her time between the company's Customer Development Center in Michigan and offices at Oak Ridge National Laboratory where she was principal investigator for a 3-year U.S. Department of Energy (DOE)-sponsored project that Plasan participated in on predictive modeling of carbon fiber composites in automotive crash. In 2013, Rehkopf became director of research at Plasan with a focus on developing new materials systems to facilitate the use of carbon fiber composites in mainstream automotive applications. She lost a year-long battle to cancer last summer.

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Year			
Recognized	OEM	Application	Material
2014	General Motors Co.	Blow-Molded CVJ Half-Shaft Drive-Axle Boot	TPE
2013	Ford Motor Co.	Integrated Front-End Module System	SMC
2012	General Motors Co.	First Publicly Accessible Airbag System	multiple
2011	General Motors Co.	Integrated Door Hardware Module	PC/PBT
2010	General Motors Co.	Front & Rear TPO Bumper Fascias	ТРО
2009	General Motors Co.	Thermoplastic Vertical Body Panel	MPPE/PA
2008	Chrysler LLC	Rear Seat Cushion	PUR Foam
2007	Ford Motor Co.	Radiator End Tank	PA 6/6
2006	General Motors Corp.	Thermoplastic Front Grille	ABS
2005	Porsche	Thermoplastic Intake Manifold	PA
2004	Ford Motor Co.	Box Beam Bumper	PC/PBT
2003	General Motors Corp.	Dual-Density Energy Absorbing Bumper System	PP
2002	General Motors Corp.	Mini-Wedge Latch and Door-Lock Actuator	РА
2002	General Motors Corp.	Wiper-System Transmission Housing	PA
2001	General Motors Corp.	Instrument-Panel Retainer	SMA
2000	Volkswagon AG	Fuel Tank	HDPE
1999	Ford Motor Co.	Hydraulic Clutch Actuator	PA
1998	Citroën	Fan Shroud	PA
1997	Ford Motor Co.	Transmission Seal	PPS
1996	General Motors Corp.	Front Fenders	RIM-PUR
1995	General Motors Corp.	Guide-Flex Energy Absorbers	EVA
1994	Ford Motor Co.	Headlamp Assembly	РС
1993	General Motors Corp.	Front/Rear Bumper Covers	RIM-PUR
1992	General Motors Corp.	Composite Exterior Body Panels	SMC
1991	General Motors Corp.	Tilt Steering-Wheel Centering Sphere	Acetal
1990	General Motors Corp.	Transverse Leaf Spring	Ероху
1989	American Motors Corp.	Battery Case	PP
1988	Ford Motor Co.	Windshield Interlayer	PVB
1987	General Motors Corp.	Grill-Opening Panel	SMC
1986	Chrysler Corp.	Heater Housing	PP
1985	Chrysler Corp.	Disc-Brake Piston	Phenolic
1984	General Motors Corp.	Front-Fender Wheel Liner	PP
1983	General Motors Corp.	Emissions Control Canister	PA

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#### Application

Active Glove Box All-Olefinic Liftgate All-Olefin, Soft Skin, Stitched Full IP System Microcellular-Foam Instrument Panel Diesel-Exhaust Fluid (DEF) System Shielded Plastic Case Radio Twin-Sheet Blow-Molded Fuel System Backlighting with Color-Converting Plastic Blow-Molded Front- & Rear-Bumper System Composite In-Bed Trunk Door Trim with Integrated Acoustic Chamber and Subwoofer Roof Module Extruded Polymer Film Fascia Nanocomposite TPO Controlled Energy Management Bumper Isolator Fan Shroud and Reservoir Assembly "I" Section Bumper Beam "Carpet to Car Parts" Structural Battery Tray Integrated Front-End System Thermoplastic Air-Intake Manifold Front-Suspension Stabilizer Link Instrument-Panel System Integrated Child's Seat and Top Impact Pad **Exterior Door Panel Composite Wheel** Front Fender Quarter-Panel Assembly – Sportside Quarter Window Windshield with Anti-Lacerative Layer Drive Shaft **Exterior Body Panels** Tailgate Assembly Radiator-Core End Caps Rear-Axle Leaf Spring Grille-Opening Panel Assembly **Bucket-Seat Frame** Instrument Panel Fender Aprons One-Piece Jeep Top Fascia and Rear Bumper Cover

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