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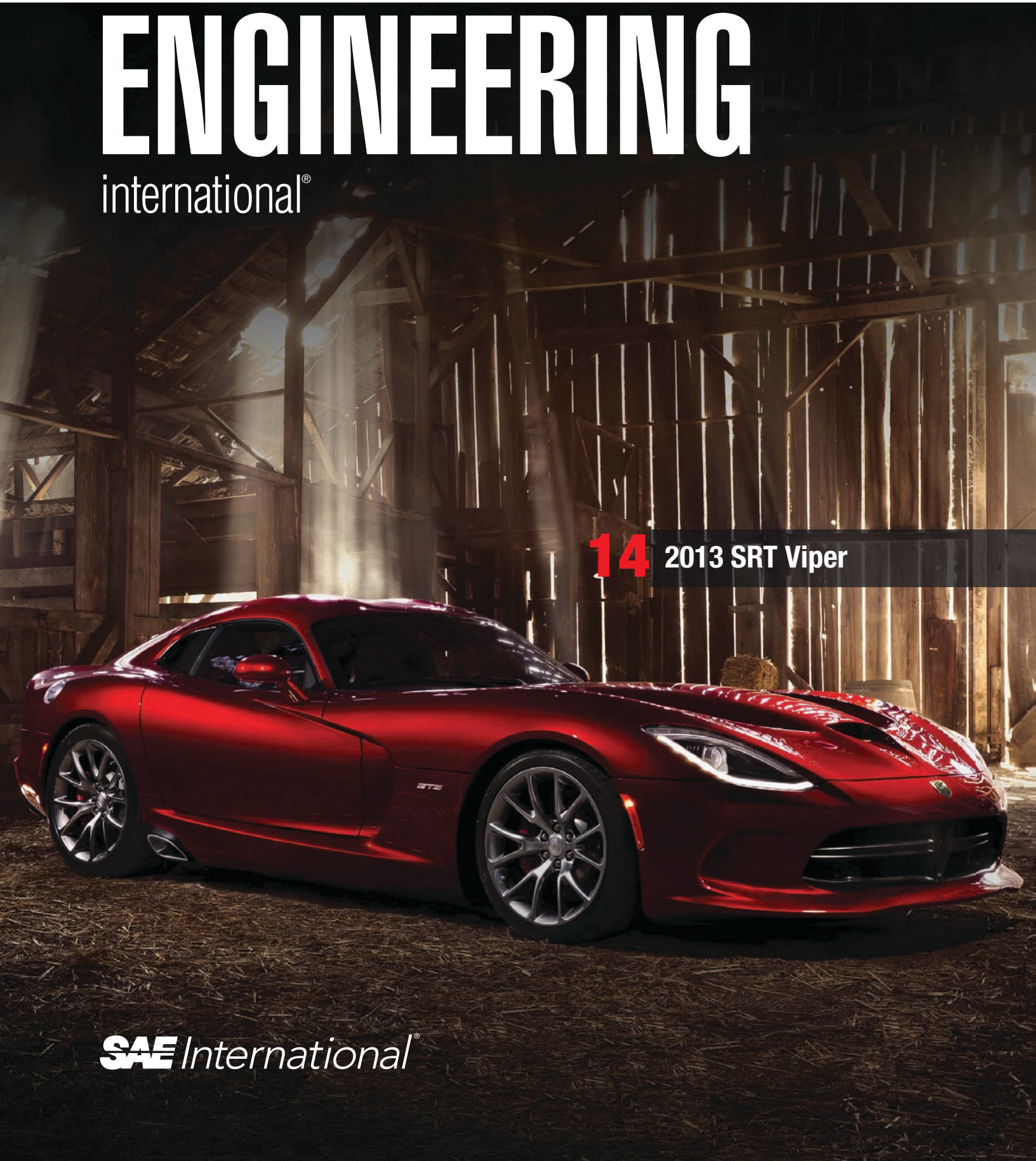
automotive ENGINEERING international®



SAE International®

CONTENTS

TOP PRODUCTS

Inline electric A/C compressor

Making its global debut on the **Ford** Focus Electric, **Denso**'s inline electric A/C compressor (e-compressor) is smaller, lighter, and quieter than previous generations, claims the company. Designed for EVs and hybrid vehicles, the slimmer compressor allows for easier under-the-hood packaging, yet maintains the cooling capacity of the previous generation. More detail at www.sae.org/mags/aei/10809.

Full-vehicle NVH simulation

Altair Engineering's NVH Director is the first commercial software tool that makes full-vehicle NVH simulation possible in the most advanced and streamlined form, according to the company. It uses Altair's HyperWorks suite of CAE tools in a fully integrated, user-friendly, customizable form. More detail at www.sae.org/mags/aei/10793.

PC/ABS resins

Styron expands the PULSE GX series of tailor-made solutions for automotive interiors to include the PULSE GX70 and GX90. They are made of a polycarbonate and acrylonitrile butadiene styrene blend. More detail at www.sae.org/mags/aei/10822.

Traction inverters

Arens' automotive-hardened traction inverters with power ranges from 30 to 500 kW (40 to 670 hp) are for applications ranging from large transit buses and medium-duty trucks to hybrid passenger cars. More detail at www.sae.org/mags/aei/10875.

TOP NEWS

PATAC engineers conduct wet-weather testing on a Buick LaCrosse at the climate wind tunnel in Shanghai.

GM-SAIC wind tunnel unique

A climate wind tunnel that the **PATAC** joint venture between **General Motors** and **SAIC** opened March 27 in Shanghai is the first climate wind tunnel in China that can provide rain and snow simulations and has the widest temperature simulation range. More detail at www.sae.org/aei/10813.

Innovation for e-motor/inverter

Mitsubishi Electric Corp. recently announced that it has developed a prototype electric vehicle (EV) motor system with a built-in silicon carbide inverter. It is the smallest of its kind, the company claims. More de-

FEV

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tail at www.sae.org/aei/10784.

Azure enters bankruptcy

Azure Dynamics, a developer and integrator of hybrid-electric and electric components and powertrain systems for commercial vehicles, has filed for bankruptcy. It plans to stay in business and reorganize. Azure supplies the electric drive system for several commercial vehicles, including the **Ford** Transit Connect Electric. More detail at www.sae.org/aei/10816.

Eaton gets DOE fuel-cell funds

In return for giving **Eaton** Corp. a $2 million grant, the **U.S. Department of Energy** is expecting the Southfield, MI, company to boost the performance and reduce the cost of fuel-cell systems. More detail at www.sae.org/aei/10820.

WEBCASTS

June 7: 'Advanced Reinforcement Materials'

"Advanced Reinforcement Materials for Engine and Vehicle Efficiency: Are you prepared to meet the new standards?" is a free webcast June 7, at 11:30 a.m. EDT. It will look at how integrated material science can be used to meet elevated performance requirements while delivering lower total cost solutions for the automotive industry. Four experts with **DuPont Protection Technologies** will discuss how advanced reinforcement materials can be used to design higher-performance components in charge-air-cooler systems, enabling advantages in engine and vehicle efficiency. They'll also explore how new materials can help designers reduce weight and overall cost for lower-rolling-resistance tires and higher-performance engine hoses and belts. The speakers are:

John Dottore

David Litchfield

Monty McNeil

Gianluigi Molteni

John Dottore, North America Product Manager; David Litchfield, New Product and Applications Development Engineer; Monty McNeil, Research Associate; and Gianluigi Molteni, Marketing Development. Webcast attendees will be invited to interact with the experts during the program's live Q&A segment. Sponsor: DuPont Protection Technologies. Registration: www.sae.org/webcasts.

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POWERTRAIN

Jatco's new CVT8 is key to 2013 Altima's 38-mpg efficiency

The new CVT8 uses two different internal drive systems, depending on engine application. A belt drive is used on all four-cylinder models (shown). CVTs designed for use with V6 engines feature a chain drive.

Nissan engineers focused on all areas of the 2013 Altima (L42L program) in their quest for greater efficiency. But they credit the car's new continuously variable transmission (CVT) for contributing a significant portion of Altima's estimated 38-mpg highway fuel economy.

"I'd say that 40% of the fuel economy is due to the CVT," said Vishnu Jayamohan, a product-planning executive with Nissan North America.

The new CVT is supplied by **Jatco**, which is 82% owned by Nissan. Jatco has been in the vanguard of CVT R&D for years, although the company's product portfolio also includes many planetary-type stepped-gear automatics for front- and rear-drive applications.

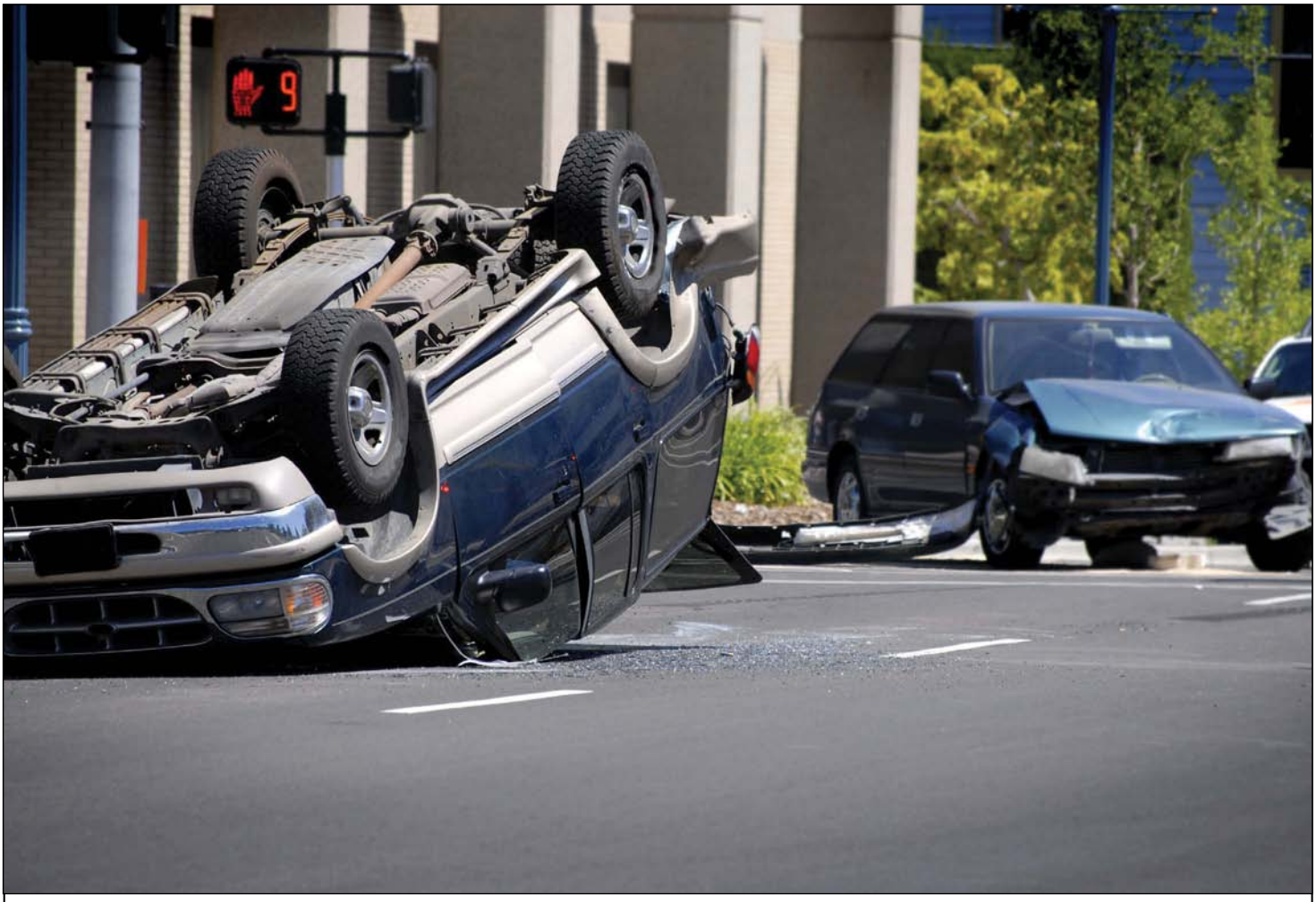
Jayamohan, an engineer, told *AEI* that the CVT features a ratio spread of "around seven—the largest ratio spread in the segment," he said. The new Altima's main competitors, including **Toyota** Camry, **Honda** Accord, **Ford** Fusion, and **Chevrolet** Malibu, use planetary six-speed automatics with ratio spreads near six.

The CVT8's controls are configured to give the unit the shifting "feel" of a seven-speed stepped automatic, when the transmission is actuated manually using paddles on the steering column.

The new CVT is branded "Xtronic" by Nissan. According to industry sources familiar with the unit, it is known as the CVT8 (despite its ratio spread) and by its APO internal code. They said its 40% greater operating efficiency and reduced parasitics are due to use of a more efficient pump design and reduced valve body leakage.

Jatco considers the CVT8 (also coded ARO) to be its "global strategic" CVT, designed to handle input torques up to 380 N·m (280 lb·ft). With this breadth of capability, the CVT8 will replace Jatco's CVT2 and CVT3. It will be used with both the 2.5-L I4 and 3.5-L V6 Altima engines for North America. (The two transmission applications differ in the size of their torque converters and number of clutch plates, engineers said.)

CVT8 joins another new model, the CVT7, in the company's portfolio. Known internally as APO, the CVT7 replaces the



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CVT-1 and is aimed at input torques below 180 N·m (133 lb·ft). CVT7 will be used in the next Nissan Versa, among other compact vehicles. Its technology trump card is a planetary gearset engineered into the CVT for improved efficiency. It also features a slimmer drive belt and new pulleys with a smaller internal diameter, which provides a tighter "wrap" at launch, according to engineers.

The new Jatco CVTs share approximately 85% of their bills of material. With the new Altima in final calibrations, Jatco has a team of engineers stationed at Nissan's Arizona proving ground to support the car's launch.

Lindsay Brooke

ENERGY

Envia Systems touts new high-energy-density Li-ion batteries for EVs

A Bay Area start-up firm with 35 employees has developed a new automotive-grade lithium-ion battery that delivers about twice as much energy per unit of mass as current EV batteries. The new rechargeable batteries from Newark-based **Envia Systems** were recently shown to store 400 W·h/kg, which compares favorably to the 120 to 250 W·h/kg provided by existing commercial counterparts. Technicians at the **U.S. Navy**'s Naval Surface Warfare Center in Crane,

Envia System chose a pouch design for its cell. Shown are samples of the company's new high-energy-density, 45-A·h lithium-ion cells.

IN, conducted the performance tests on the novel electrochemical device.

One of the principal barriers to widespread adoption of electric cars is "range anxiety"— potential customers' fears that the maximum ranges of today's EVs (only 80 to 100 mi/130 to 160 km) will leave them stranded with no power. Because energy density is the main determinant of EV range, Envia's new batteries could enable a doubling or tripling in range. And at a projected cost of only $125/kW·h when commercialized, the new batteries could cost less than half that of current batteries, cutting the price of an EV battery pack—now as much as $10,000—by half or more.

Envia's high capacity manganese-rich cathode material is stable at high voltages and handles high charge fluxes in long-term use.

To bring the new technology to market, however, the new battery's operational lifetime will have to be doubled. Tests have confirmed that the Envia cells can be recharged some 400 times and still retain 80% of their original storage capability, but to last for the entire lifetime of a vehicle they must withstand at least a thousand recharging cycles.

Targeting better EV batteries

"We founded the company in 2007 using venture capital funding from Silicon Valley sources with the mission to develop practical high-energy-density batteries for electric cars," said Sujeet Kumar, Co-founder, President, and CTO. "Right now, EV battery costs are too high and EV range too low for them to compete in the market."

The company has received a $4 million grant from the **U.S. Department of Energy**'s **Advanced Research Projects Agency-Energy** (ARPA-e), as well as a $7 million investment from **General Motors**.

Kumar pointed out that the untested firm gained credibility with potential investors and customers by building "coin cells" of 5 g (0.2 oz) mass that made it possible for others to test Envia's technology for themselves.

Electrode improvements

"At the beginning," Kumar recalled, "we focused on improving the cathode because it is the most expensive component in a cell—some 40% of the total cost." The cathode is the electrode to which the lithium ions travel.

Envia researchers modified a novel cathode material that the company licensed from the DOE's **Argonne National Laboratory**, where researchers several years ago had identified a material with a unique microscopic structure that could handle high charge fluxes. Argonne's patented "layered-layered" microstructures integrate an electrochemically inactive lithium-based compound with an active lithium-based component to provide improved structural and electrochemical stability at high potentials.

Starting with the Argonne material, company researchers systematically tried out some 300 chemical compositions during a total of 25 million test channel hours to find a formulation with a higher voltage capability that resisted the tendency of one of the components, manganese, from escaping the cathode and dissolving into the electrolyte—a deleterious process that cuts storage capacity.

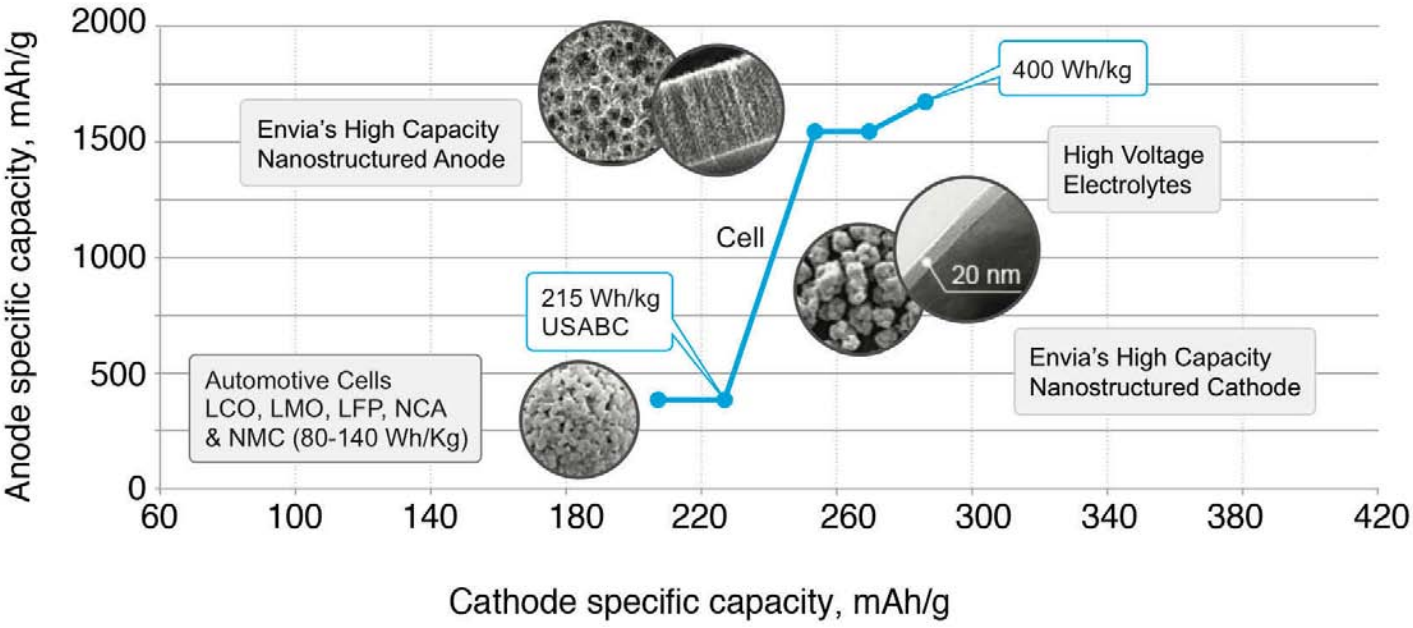
To achieve these goals, the specialists fine-tuned the original chemical composition of the layered-layered crystal (which contains nickel, cobalt, manganese, and

lithium manganese oxide) by adding several trace elements and by altering the morphology—size, shape, distribution, density, and porosity—of its component particles. A surface modification—a proprietary nanocoating process—helps to encase the inactive component within the layered active structure to stabilize the electrode and reduce oxygen activity at the surface of charged particles.

Envia researchers have developed a high-capacity anode material that offers promising cycle life performance.

Better anodes too

"Next we addressed the anode," Kumar continued. "Most battery makers use graphite, but we wanted to use silicon, which is widely touted as the next-generation electrode material" because of its high charge capacity per unit mass. But silicon electrodes have poor cyclability because of the large volume expansion and structural failure that occurs when



Envia's electrodes measure up well against common competing types.

lithium ions react with silicon. "Silicon electrodes typically last only ten cycles," he noted.

The research team tackled this challenge by employing a porous form of silicon that is better able to handle repeated expansion and contraction. They then combined the porous silicon with three types of carbon stabilizers: carbon fiber, graphite, and a graphene-like substance. The carbon supplies pathways for electrons to move through the silicon-carbon nanocomposite alloy even when the material is damaged from multiple charging cycles.

"Finally, we developed an electrolyte that is stable at high voltages," said Kumar. "We took an existing electrolyte formulation that was compatible with our electrodes and blended with it certain additives to make it more resistant to high voltages."

Straightforward fabrication

A major consideration in choosing the specific materials was that they had to be compatible with conventional production equipment so the batteries could be commercialized relatively easily, according to Kumar. For the same reason, the team chose a traditional large-format pouch cell type, which would be familiar to potential users. This work took place at Envia's cell prototyping and manufacturing plant in Jiaxing, China.

Researchers also had to deal with another key user concern: the possibility of thermal runaway whereby a Li-ion battery warms excessively from the exothermic heat associated with structural changes of the electrodes and the electrolyte, causing it to catch fire. Kumar said that Envia's pouch cells are substantially thinner than many similar cells, which promotes heat dissipation and lower temper-

atures. He added that the devices have also passed nail-puncture tests, a standard test of battery safety.

"We're happy with the overall safety of our materials and of our design. All that remains is to await the results of third-party qualification tests to confirm our beliefs," he said.

The solution to extending the cycle life of the cells will probably require substantial improvements to the electrodes, but Kumar is unfazed. "We feel that we have a lot more room to squeeze out improvements," he said.

The firm's management does not plan to produce batteries itself, said Chairman and CEO Atul Kapadia, but instead license the technology to battery manufacturers or enter into joint ventures. "We don't want to go the vertical route that some other battery start-ups have taken," he said. "It's a difficult path."

"Envia's new battery technology represents exactly the kind of innovation and breakthroughs that ARPA-e is looking for from the American research and development community," said ARPA-E Director Arun Majumdar at a recent energy innovation conference. "We hope that this low-cost and high-density battery technology enables widespread adoption of electric vehicles across the country and around the world."

Steven Ashley

Chrysler relaunches the Viper

The 2013 SRT Viper has a carbon-fiber hood, roof, and decklid with aluminum door panels and superplastic aluminum fenders.

Chrysler's **Street and Racing Technology** division returned its Viper sports car to enthusiasts at the 2012 New York International Auto Show following a brief hiatus. With more power, less weight, and more distinctive styling that hews more closely to that of the first-generation car, the 2013 SRT Viper addresses many of the issues that led to the previous models' discontinuation.

"This car's not going to make a lot of money for us," acknowledged SRT President and CEO Ralph Gilles. Building a cash cow wasn't the reason for returning the Viper to production; it was to "show we still have a soul," he said.

The car's fundamentals remain intact, with an enormous 8.4-L aluminum V10 engine and **Tremec** TR6060 six-speed manual transmission powering the front-engine, rear-drive two-seater, dismissing wild rumors of the car's switch to a **Ferrari**- or **Maserati**-based platform as a result of **Fiat** leadership.

However, the latest iteration of the engine is pumped up to 640 hp (477 kW) and 600 lb·ft (813 N·m)—the highest-torque naturally aspirated engine in the world, according to Gilles.

Optimization of the engine block for reduced mass, a switch to a composite intake manifold, and the installation of an aluminum flywheel trimmed 28 lb (13 kg) from the engine's weight. New carbon

The use of lightweight materials in the 2013 SRT Viper has reduced overall weight by 100 lb (45 kg) compared to the old car.

Underhood of the 2013 Viper is an 8.4-L aluminum V10 engine and an aluminum x-brace for stiffness. Torsional rigidity by 50% compared to the old car, Gilles reported.

fiber and aluminum body panels contribute to an overall weight reduction of 100 lb (45 kg) compared to the old car. The **Metalsa** S.A.-supplied frame employs additional high-strength steel and is reinforced with an aluminum x-brace under the hood and a cast magnesium beam in the dashboard to boost torsional rigidity by 50% compared to the old car, Gilles reported.

Tweaks to the engine include forged pistons, sodium-filled exhaust valves, and low-restriction catalysts for reduced exhaust backpressure. The transmission features an array of closer-spaced gear ratios in place of the previous six gears, of which fifth and sixth were primarily intended for fuel saving.

The 2013 Viper's ratios are more closely spaced and the final drive ratio has been reduced to 3.55:1 from 3.07:1. "Fifth and six gear are in play now," Gilles said, while before they were strictly for highway cruising. This is evidenced by the fact that the car now achieves top speed at redline in 6th gear rather than in 5th, which was the case before. Making these more useful ratios more accessible, the shifter is shorter and has shorter throw, so enthusiasts will be more interested in flicking among the gears now.

Similarly, the car's suspension has been redesigned to make it realistically possible to toss the car around casually with less fear of a catastrophic outcome. Until now the Viper has been notorious for its unwillingness to indulge such treatment, earning it a reputation as an easy car to crash.

The new car has revised suspension geometry to enhance stability, such as

Inside the car, the Viper borrows its 7-in instrument cluster display from the Dodge Dart. For the Viper it provides driver-selectable information about the car's performance.

having the rear toe links moved forward for better toe control. The **Bilstein** DampTronic Select shock absorbers, optional on the base car and standard on the GTS, have track and street settings to tune the damping curves to suit the conditions. Standard **Pirelli** P Zero tires also contribute, and along with the greater suspension compliance made possible by the stiffer frame, make the car both more forgiving and more comfortable than before, said Gilles.

The optional SRT Track Package includes Pirelli P Zero Corsa tires and trims away another 57 lb (26 kg) by deleting equipment and substituting carbon-fiber components for a curb mass of 3297 lb (1495 kg).

Four-piston aluminum **Brembo** brake calipers act on 355-mm (14.0-in) vented rotors, with **StopTech** two-piece slotted rotors available as part of the Track Package.

Inside the car, the Viper borrows the 7-in **Magnetti Marelli** instrument cluster display seen previously on the **Dodge** Dart. For the Viper, it provides driver-selectable information about the car's performance.

Sabelt provides Kevlar/fiberglass shell racing seats that mount 20 mm (0.8 in) lower than before and which provide an additional 90 mm (3.5 in) of seat travel. A power seat adjuster is available for the first time.

While the exhaust pipes have traditionally provided the Viper's sound track, the 2013 car features a 32-V **Harman Kardon** surround-sound audio system driving as many as 18 speakers through up to 11 channels. The speakers all use rare-earth metal magnets for reduced

SRT will campaign Vipers in the American Le Mans Series starting this summer, with a goal of qualifying to race in the Le Mans 24-hour race in 2013.

mass delivering the system's acoustic power, which is double that of the old car's stereo.

Outside, the Viper wears a carbon-fiber hood, roof, and decklid with aluminum door panels and superplastic aluminum fenders that combine for a 0.364 coefficient of drag. It includes functional vents for a differential cooler and brake cooling. The 70-mm (2.8-in) projector beam headlights are bi-xenon high-intensity discharge, while the running lights, turn signals, and taillights are LED.

Supporting the new car's introduction was the announcement of Viper's return to competition. The company will campaign cars in the American Le Mans Series starting this summer, with a goal of qualifying to race in the Le Mans 24-hour race in 2013.

Dan Carney

FAB CABS

While functionality cannot be compromised inside heavy trucks, their cabs increasingly mesh practicality with passenger-car sensibilities for comfort and ambience.

by Ryan Gehm

The Freightliner Revolution Innovation Truck is a full-size crossover cab concept that attempts to combine a warm, spacious environment with the day-to-day functionality that is so important inside heavy trucks.

"There's no storage!" a woman said rather incredulously to her husband, surveying an interior concept on display in a supplier's booth at the recent Mid-America Trucking Show (MATS) in Louisville, KY.

"It's a show truck, hon," he replied. "It's supposed to look pretty, not be functional."

This exchange captured perfectly the notion that a high-end interior is nice and all, but it still better work on a day-to-day—and night-to-night—basis for the vehicle operator.

Still, with advanced technology concepts, cab engineers and designers portend what the inside of trucks will look like in the years ahead. They also try to shape that vision around *who* will be inside those trucks in the future. "Overall with the interior, we're trying to look at attracting the younger generation," Justin Yee, Manager of Vehicle Concepts for **Daimler Trucks North America** (DTNA), said of the **Freightliner** Revolution Innovation Truck, a full-size crossover cab concept vehicle revealed at MATS.

Added Tracy Simpson-Meyer, Lead Interior Designer for the Revolution Innovation Truck, "The next generation of drivers is going to be a lot different from the ones that are retiring right now, the old-school drivers who really like the gauges and switches, who like the stick shift. These younger guys, they're gamers; they're growing up with all this multitasking and much more interactive [media]. So we really wanted to keep in line with that trend…of automating things a bit more."

In press materials for the Revolution, DTNA states that "thoughtfully placed LED lighting throughout the cabin creates a functional and relaxing atmosphere"—or what Simpson-Meyer described as an airliner-type ambience that evokes a "warm-and-fuzzy feeling." But just before that statement on atmosphere was this one: "Abundant storage is found throughout the cab."

Managing that balance between must-have functionality and nice-to-have ambience—regardless if the driver is old-school or next-gen—is a challenge that truck designers must constantly address.

FAB CABS

An automotive supplier helped Caterpillar achieve an upscale interior for its new CT660 vocational truck. The company also drew upon its expertise in designing off-highway equipment for ergonomics and human-machine interfaces that relay information quickly.

An automotive influence

During the development of **Caterpillar**'s new CT660 Class 8 vocational truck, extensive voice-of-customer (VOC) efforts were employed. What was one of the main takeaways? "Customers told us that they wanted premium interiors," said Gary Blood, Product Manager for Vocational Trucks at Caterpillar. "And part of the translation of that is they don't want fake components in the interiors—that fake wood and chrome-plated plastic."

Caterpillar worked closely with its interior supplier—a company with a "very heavy background in the automotive business"—from early in the development process to achieve a high-end interior. Blood refused to name the supplier, but noted that "they really understand the type of material selection [that is necessary], the kind of gaps that you control, what we call routing and clipping—what you do behind the dash to keep wires or tubes or anything from contacting surfaces."

A quiet environment was another focus for Cat's new truck. Use of a compacted graphite iron (CGI) cylinder block was a significant contributor to achieving that goal. "How can that improve your sound attenuation?" Blood asked. "It's the characteristic of that iron; it's very stiff and it does

not transmit noise like grey iron. It improves [by up to 30%] the reduction in interior noise."

Caterpillar's interior supplier also contributed, particularly by helping to limit buzz, squeak, and rattle (BSR)—"a real indicator of quality, whether you're buying a passenger car, a pickup, or a Class 8 vocational truck," Blood said. "It was really our suppliers that are in the automotive business that understood exactly what we were talking about—BSR, which is one level further down than NVH. This was a key focus of our endeavors in designing the interior."

For the development of its Revolution concept truck, DTNA exploited a technology partnership that its parent company, **Daimler** AG, has with **Toray Carbon Fibers America** for its passenger vehicles. Toray supplied carbon-fiber pre-preg material that was used in the construction of the Revolution's hood, roof cap, side walls, and back wall. A special sandwich structure of low-density honeycomb material and carbon fiber helped to simplify the truck's inner support structure and maximize interior space. The result, according to DTNA, is significantly more interior space and functionality than a day cab, at a lighter weight than a sleeper.

The Revolution is called a crossover cab because a convertible jump seat transforms the workspace into a sleeper for rest. (Click here to see video of the concept's development, including the jump seat in action.)

> ***"If we're headed on a path to [more car-like interiors] in the Class 8 vocational truck business, I'll be the first one to stand up and say, 'Yep, that's the way we'd like to take it.'"***
>
> ***—Gary Blood, Product Manager for Cat Vocational Trucks***

"One of the things we tried to do with this truck is focus on single-driver environment, being a day-cab operation," Yee explained. "We gave the driver a work area, a desk, which makes their lives easier. We extended the cab 12 inches and put in a regulation 24-in size bunk. That's the key—operationally it's a day cab, but it gives you that flexibility in logistics, if you get stuck in a snowstorm or your load is delayed, this allows you to reconfigure your interior."

Kenworth Chief Engineer Preston Feight made it a point in his MATS presentation revealing the new T680 that the heavy-duty truck "uses luxury automotive materials to create a [comfortable] driver environment." An example? The seats are available in Ultraleather, which is said to be softer than vinyl and more durable than leather.

Kenworth employed the help of several automotive suppliers in the development of the truck's interior, according to Jonathan Duncan, Design/Styling Manager, Research and Development Center. "**Continental** does our gauges. **Behr-Hella Thermocontrol** does the HVAC system. **Eaton** provides some switches, and **Inteva** does the door pads—they're a big automotive supplier," he said. **Gra-Mag**, a

joint venture between **Grammer** and **Magna Seating Systems**, provided the seats, as it does for **Paccar**'s **DAF** trucks in Europe as well, Duncan said.

Another Kenworth staffer stressed to *AEI* after the reveal of the T680 that "we did work with some suppliers that have automotive backgrounds, but one of our main goals was making sure that they were truck-worthy. You may hear someone throw around the term 'automotive.' It's automotive style, but it's still built to last 1.5 million miles that we've come to test all our vehicles to. We don't want to come across like we're doing just automotive; it's heavy duty."

LEDs light the way

LED (light-emitting diode) lighting solutions are enabling interior designers to create a warm, welcoming atmosphere inside vehicles by employing the technology in various locations such as the instrument panel, headliner, center console, and doors. While the

Jonathan Duncan, Design/ Styling Manager at Kenworth's Research and Development Center, shows off a red LED ambient light positioned in the center of the headliner of the new T680. At night, it provides "a nice red wash" over the dash, he said. (Ryan Gehm)

Connectivity is coming

Two advanced heavy-truck concepts revealed at this year's Mid-America Trucking Show—the **Freightliner** Revolution Innovation Truck and **Peterbilt**'s Model 587 Technology Truck—attempted to capture what the truck interior of the future will look and feel like. Personal connectivity is a big part of that future.

The Revolution is equipped with a conceptual Truck Operating System (Truck OS) that combines the intelligent onboard truck network with the portability, Internet connectivity, and entertainment options of a tablet device. "We wanted to take what exists today and add some things specific for trucking," said Justin Yee, Manager of Vehicle Concepts for **Daimler Trucks North America**.

Features include a Smart Navigation device, which combines route mapping, navigation tools, and Internet searches (click on video for more details); CB 2.0, which enables driver-to-driver chats; a Load Finder that searches online load boards for jobs; and Truck Health, which works with the truck's diagnostic system to provide automatic maintenance alerts and then directs the driver to the closest Freightliner dealer.

"This is our way of doing electronic integration, getting rid of having CBs, radios, iPads, and all this stuff, and consolidating to make it easier for the driver," said Yee.

The 587 Technology Truck expedites turnaround time of the truck between loads by wirelessly transmitting the status of the truck (mileage, tire pressure, diagnostics, etc.) using 5.9-GHz connectivity, for which Peterbilt partnered with **Qualnetics**.

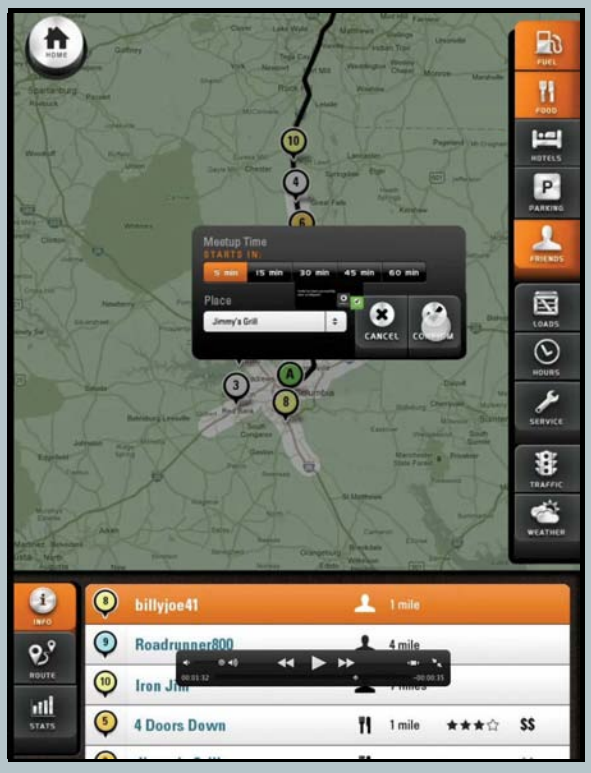
Connectivity can be established with the use of any wireless-enabled device, such as a tablet PC that is integrated into the dash but can be removed for use both inside and outside the truck. This interface gives the driver easy access for inspection, diagnostics, live video, tire pressure and temperature monitoring, and onboard scales.

"We're doing the same kind of functionality as with gauges, we're just doing it on a tablet PC," said Bill Kahn, Engineering Manager for Advanced Concepts at Peterbilt. "The key is that there's one source of all that information. Right now, we'll put a system up in

Storage, storage, and more storage. Inside heavy trucks, and especially for long-haul applications, plenty of storage for personal items is a must. Shown is overhead storage in the new Peterbilt 579 sleeper.

automotive industry has taken the lead in this area, particularly within luxury cars, that does not mean commercial vehicles cannot exploit the technology to the same end. In fact, many truck makers are already doing so.

"**Hella** is working very closely together with many of the OEMs, and what we have seen from a heavy-truck perspective—and that carries over into the mobile homes and RVs—is that people are looking



the headliner for one thing; we'll put a system over there for another thing, and you're looking and hearing all this stuff. The ability to put a tablet PC on the dash opens up a lot of opportunity…just by bringing connectivity into the vehicle."

The 587 Technology Truck also features a configurable display supplied by **Continental** that "allows you to personalize a vehicle from one person to another," Kahn said. "Right now, we have a dedicated cluster. You always get this and this and this; if you want to change it, you've got tooling that you have to pay for and stuff like that. If you can get people to accept a [configurable] display, then it only involves a software upgrade and the hardware never changes."

"You see the personalization trend in the automotive industry," Kahn added. "We really think that's going to be a serious trend in the future."

Ryan Gehm

The Smart Navigation feature of Daimler Trucks North America's conceptual Truck OS is detailed in this video.

An optional passenger 180° swivel seat and rotating table in the Kenworth T680 allow the occupant to face into the sleeper, better integrating the work and living environments.

more and more for ambient lighting," said Siegfried Tigges, Vice President of Canadian Aftermarket Sales/ Mining/Heavy-Duty U.S. at Hella Inc.

The lighting supplier has developed whole-cabin prototypes so executives at truck makers as well as attendees at truck shows can "physically sit inside and actually see what ambient lighting does to your behavior, because you react to different colors differently," Tigges said.

And LEDs offer practical benefits beyond just looking nice: they draw less power, last longer, and can be packaged more efficiently than conventional bulbs.

Peterbilt was one of several manufacturers at the recent MATS that touted the LED-lit insides of their new trucks. The company explains that the all-LED interior lighting system within its new 579 heavy-duty truck has "strategically placed lamps throughout the cab and sleeper, reducing fatigue and providing an updated, contemporary feel."

The 579's sleeper features what the company claims is the industry's widest use of LED lighting. The truck also employs a new amber, lower-door LED signature light.

Looking further out with its Model 587 Technology Truck, Peterbilt showed what is possible with blue LED light strips along the floor perimeter as well as other LEDs supplied by **Grote**. "It shows what's capable with lighting," Bill Kahn, the company's Engineering Manager for

Advanced Concepts, explained to *AEI*. "We want to go low power because the key to our vehicle is being able to do 10 hours of engine-off operation of the hotel loads while the driver's resting without having to start the engine. The best way to do that is the batteries, so you don't want to have a lot of power draw on them. LEDs are a very low-power solution, and they're very flexible and small, so you can do some very dramatic lighting schemes."

Another Paccar company, Kenworth, also boasts of all-LED interior lighting in its new T680 production truck. Explaining the extensive use of LEDs in the T680 to *AEI*, Duncan said: "They basically have a 15-year life cycle, at the least; you never have to service them. They're also low current draw, and they're a bright and warmer light—LEDs used to be only really cool lights, but now we've gotten them to where they don't turn you blue when you sit under them."

"We use them because they're compact; they're nice, slender light units that we can fit into a space and still have a lot of storage right above them," he continued. "We also have an LED ambient light [in the center of the headliner shining down]. At night, when the lights are on, that just gives you a nice red wash over this area so you can see what's in the cupholder, you can see some detail on the dash, and it's easier on your eyes. You see it in a lot of luxury vehicles, and it really makes a big difference."

Besides LEDs, glass fiber optics is another lighting technology that holds promise for truck interiors, according to Tigges. "The benefit with glass fiber optics is that you don't have big lighting elements any longer," he explained. "You put the lighting to where you actually need [it]; this is what cuts down the weight of the cable, and therefore the weight of the total vehicle itself."

A place to drive, work, live

Though the automotive industry is a definite influence on truck interior design, there are many unique

The seats in heavy trucks can be fairly complex, with plenty of controls to help ensure passenger comfort. The premium version of Peterbilt's new Evolution seat features two-chamber lumbar support, adjustable side bolsters, adjustable suspension damping, heating and ventilation options, a swivel option, and additional storage pockets.

considerations the engineers and designers of truck interiors must address that their lighter-duty counterparts do not.

For the most part, passenger vehicles must provide one function for its driver: a place to drive. As Kenworth's Feight noted when discussing the new T680 truck, commercial vehicles—particularly those in long-haul applications—must satisfy requirements for three different environments: a place to drive, a place to work, and a place to live.

"One of the things we hear a lot about from a driver standpoint is…they want a workspace and they want a sleep space, but converting it on a daily basis is kind of tedious. So we wanted to create an environment that allows them to have the best of both worlds," Feight said, referencing the T680's industry-first rotating passenger seat and table that can be used for eating meals, working on laptops, reading, or other tasks.

"The rotating seat integrates the cab and the sleeper into a single optimized working environment. It changes the way people will use the inside of the truck," he said.

Regarding that all-important characteristic—storage—Kenworth touts that its T680 cab and sleeper combined have 65% more storage than previous trucks. While storage is certainly important in passenger vehicles, the need is amplified within commercial vehicles where operators work and sometimes live.

"What we found from [numerous] driver counsels is that you need to be able to find stuff, you need a lot of places to put things," Duncan said. "So we brought in a whole pallet of stuff that some truckers had in their trucks and laid it all out, and we're like, 'Okay, where are we going to put it?'"

During research for the Caterpillar CT660, the development team discovered a similar sentiment from operators. "Because you're in a day-cab environment, obviously you've got to maximize the utilization of space in there," Blood said. "You'll notice that the top portion of our instrument panel has locations to put stuff. [We concentrated on offering] easy-to-reach compartments, whether it be storage up above in the headliner, map pockets down in the doors for good storage availability, the storage compartment in the back—that's the first step; we've got more things that we want to do to differentiate ourselves," he teased, not revealing any more details about future plans.

Blood also noted that the industrial design team devoted a lot of time optimizing the ergonomic dashboard and center stack, relying on its experience designing for machine operators. "Some of our expert operators will tell you about eight-tenths of a second is a quick scan that they can do to get that information, so you have to be very efficient at how you [display] that," he said. "Large, easy-to-read gauges—the design of those gauges started from the aircraft industry and carried over from Cat machines in terms of how we design the face, the font, the needles, so that you can attain that information very quickly."

Anti-idling regulations add another dimension to

the development of truck interiors: engineering for thermal efficiency. "Thermal is becoming a bigger issue in the industry because of the no-idle rules," said Dan Renn, Process Engineering Manager at **Commercial Vehicle Group**, an integrated-system supplier based in New Albany, OH. "[Truck makers] are becoming more conscious about the thermal characteristics of the truck than they were before; they've got to run these special low-power air-conditioning units [when the truck is powered off], so they've become very interested in how good the insulation is."

The flooring plays a critical part in both the thermal and acoustics package, Renn noted, adding that the more material the better when it comes to providing an effective barrier, which can work against lightweighting efforts. "Four or five extra pounds in the floor mat make a huge difference [thermally and acoustically]," he said of the trade-off. "From a selling perspective, I think the floor mat is one place they're willing to throw whatever they need to get those benefits."

One factor heavy-truck interior designers must consider that their automotive counterparts do not is under-dash finishing pieces. Also shown is the triple-sealed, stamped aluminum door of the Kenworth T680, which contributes to a 40% reduction of interior noise in the new truck.

Kenworth's Duncan offered a few other unique circumstances that automotive designers do not have to contend with, such as making sure the bins in the headliner can handle the load of someone pulling themselves up. "You don't have that in a car because people aren't standing up and walking around," he said. "Another thing you have to think about in trucks is closing off under the dash with finished pieces because you can see under there when entering the truck. In cars there's an ugly gap that only mechanics will see."

In current truck cabs and in those to come, ugly is definitely *not* an option. **AEI**

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