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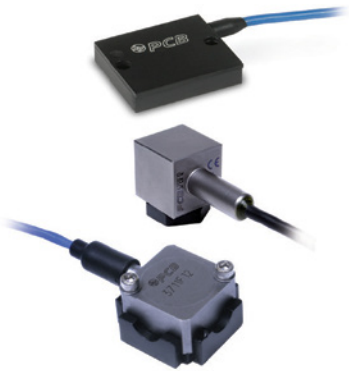

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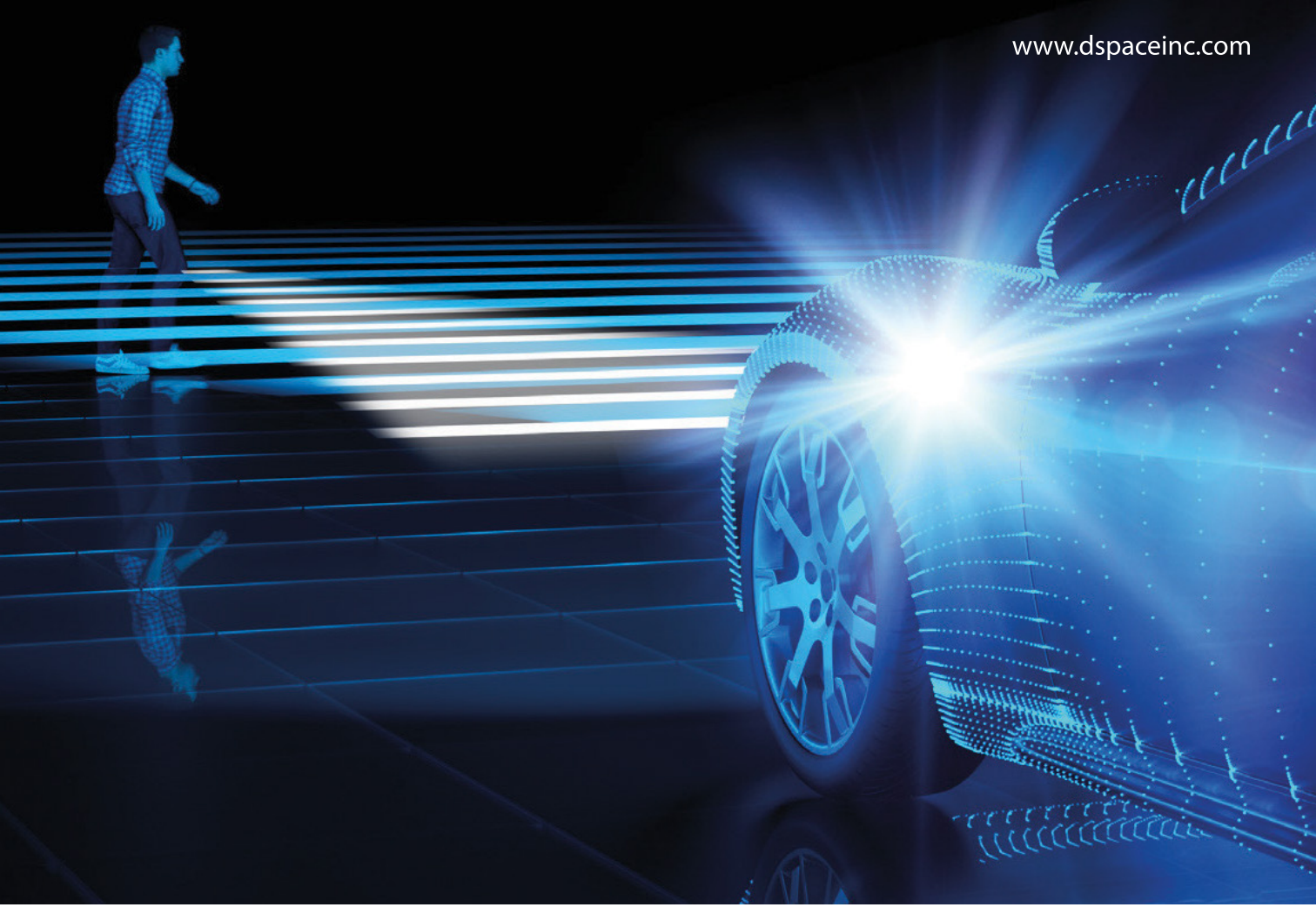

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FEATURES

ON THE COVER

There's more to the prototype safety jacket on our October cover than its blazing Hi-Viz Yellow exterior would indicate. Think electrification, illumination, thermal management—and an innovative culture within Continental. The feature begins on page 22. (Photo by Lindsay Brooke, background by best_vector/Shutterstock.com)

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EDITORIAL

Losing the plot of the Engineering story?

I think we all will agree that passenger vehicles are "technical" consumer products.

Why, then, do automakers seem to be progressively less interested in communicating this? With all the clever engineering and innovation that abounds within new cars and trucks, the auto companies are ignoring some of their own best stories.

I'm not basing this observation on the generally vapid state of consumer advertising and marketing, but on the inputs we in the automotive media receive from OEMs, mostly in the form of product launches and other informational programs.

Press kits prepared for media use were once packed with detailed cutaway images and technical drawings. These provide a window inside the products that you, the engineer-reader, and your competitors have devoted so much time and effort developing. But such graphics are increasingly being replaced with a tedious spectrum of vehicle exterior and interior "beauty shots" — and little else.

If there's a new engine, it's shown *in situ* and cloaked with the usual matte-black plastic engine cover. Many brands don't ever bother to lift the hood to offer a photo of what's underneath.

I recently groused to colleagues that the press kit for one all-new model included not a single photo, drawing or graphic of any component or sub-system — the stuff that shows engineers' creativity and innovation — only beauty shots. And this was uncategorically *not* a beautiful vehicle.

On the hard-information side, complex systems — let's say a completely new all-wheel-drive design — that used to merit deep description now may rate a couple lines of mention. At new-vehicle launch events, it used to be accepted that the chief engineer and others responsible for impactful new technology would be on hand to talk to the media about development highlights. These days, there is no guarantee engineers will be there.

Because every corporate culture is unique, it's difficult to pinpoint who makes the decision on whether or how to promote a company's technical advances. But after a quarter-century covering the auto industry, I can attest that the volume and scope of such communication has been significantly reduced. It's popular to say the auto industry is all about "the product." Unfortunately, the general product message has devolved into decidedly weak sauce.

Some say it's because non-technical people increasingly control the budgets that largely determine the broad go-to-market strategy. Others blame it on the explosion of social media, which will joyfully focus on nailing the perfect "selfie" rather than telling the engineering tale.

We who cover Autos need to look in the mirror, too. The field of reporters interested in and equipped to report technical subjects is diminishing; in the choice of where to direct promotional resources, auto companies are reacting to the prevailing environment.

Dumbed-down and disinterested media certainly plays a role. Peter DeLorenzo, a canny observer of automotive-industry hubris, recently wrote in his *Autoextremist* blog: "I believe the state of automotive journalism has never been as weak as it is right now. There are too few writers worth going out of your way to bother with today... automotive journalism (yes, of course there are notable exceptions) has devolved into a thinly disguised pay-to-play-for-access game."

With the pending deluge of electric vehicles rife with transformational technology, how will OEMs and suppliers distinguish their products if the story they're projecting is mostly about lifestyle? How will they convince investors of their engineering mastery — and of their legitimate standing as "tech" companies?

All the more reason to return engineering with a capital "E" to the lead role it deserves in the new-product narrative.

Bill Visnic, Editorial Director

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The Inside Story on Bringing Safe & Secure Autonomous Systems to Market

ANSYS is the global leader in engineering simulation technology. ANSYS' physics-accurate scenario and sensor simulation is uniquely differentiated by enabling ADAS and AV teams to move verification from physical miles driven to virtual miles driven. This results in faster, cost-effective, and more extensive training and verification of AI control systems by running 100's of thousands of scenarios in a fraction of the time using accurate sensor input data in open and closed-loop simulation.

What does it take to make safe secure autonomous vehicles? Bringing autonomous vehicles to market is very complicated and time consuming. It's a mix of time, money and many departments & companies working together to make it work. Very simply, to bring an autonomous system to market you have a combination of code generation (testing and certification), component level integration (sensors in vehicle context), perception algorithms, onboard software, cybersecurity analysis, increasing international standards to adhere to, varying conditions to factor in (scenario, environment, lighting, weather), HMI interactions and on-road testing. Some companies are doing this already and we've witnessed their on-road testing resulting in on-road errors.

ANSYS – Walt Hearn VP of America

What are the largest barriers to market currently for OEM's and suppliers? The largest barriers to market are the number of miles required to test and re-test with any small change in code, obstacle, placement, weather, etc. Some industry leaders have said it will take billions of on-road miles to safely test an autonomous system. Rand Worldwide published a survey stating that it will take hundreds of thousands of on-road miles to test an autonomous system. To be sure you have tested, re-tested and caught all variant cases, it is an unsurmountable amount of miles needed. And it can be dangerous to put an autonomous system on the road, even with a human fail safe, because they don't detect certain issues due to solar glare, changes in pavement and other variants. In addition, assisted and autonomous features require more safety critical lines of code in vehicles increasing from ~10M lines of code in 2010 to ~100M+ in 2019. The increase in lines of code require even more rigorous testing, plus a requirements traceability and data management strategy.

How do you accelerate your time to market while ensuring you are making safe secure autonomous vehicles? With the use of virtual validation. ANSYS' physics accurate scenario and sensor simulation is uniquely differentiated by enabling ADAS and AV teams to move verification from physical miles driven to virtual miles driven. This results in faster, cost-effective and more extensive training and verification of AI control systems by running 100's of thousands of scenarios overnight using accurate sensor input data in open and closed loop simulation. ANSYS has the only simulation platform addressing your autonomous vehicle simulation needs including: Sensor simulation - radar, camera, lidar and ultrasonic, safety critical software, code generation and certification, electronics reliability, embedded software, semiconductors, Socs, functional safety & driving scenario simulation. The largest benefit is that leading companies are already using ANSYS to simulate various parts of systems that are on the market today and will take some part in the autonomous system, so these companies are ahead of the game.

What are the main misconceptions currently on the market in simulation? Many companies have made the initial choice to go with limited physics engines or non-physics gaming engines for virtual testing. They are now realizing they are limited in what they can test & develop because these tools don't correlate to the real world. Therefore, the number of physical miles needed for development and test doesn't change and programs run the risk of delays due to catching errors late in the release process. We also see companies struggle to make the leap to trusting simulations, mainly because they don't recognize the paradigm shift in the automotive industry. There seems to be a lot of attention to AI, but AI only works with good data. The previous product development paradigm did not prioritize information external to the vehicle so automotive companies are at the beginning of learning how to generate and leverage good data for virtual vehicle testing. Lastly, the reality is that most testing, for example HiL or Hardware-In-The-Loop testing, are still very manual. Test automation and simulation must be more closely coupled to achieve the rigorous goals ahead in the auto industry.

What is ANSYS doing in the market today? ANSYS is the global leader in engineering simulation for the automotive industry, spanning the multitude of technologies that go into the modern car. For AD & AV, leading OEM's and suppliers are using ANSYS to speed their time to market and reduce their product development costs. Recently, a leading OEM used ANSYS safety certified code generation tools to automate their software development platform. This saved them months of time, saved millions on their overall project and enabled them to meet their deadline. Another supplier uses ANSYS simulations to simulate their camera sensors in context of the vehicle placement. This has allowed them to understand the behavior of their system under varying weather and lighting conditions, correlating it to real world conditions, subsequently winning a project with an OEM.

How are companies able to make money now with AD & AV systems?
Specifically, the automated testing and simulation worlds are coming together more than anywhere else. With new standards arriving aimed at L2 – L3 assisted systems, companies can leverage ANSYS simulation on the component level to prove out acceptance, win projects and speed time to market. Companies can test their L2+ systems in virtual settings today with ANSYS simulations.

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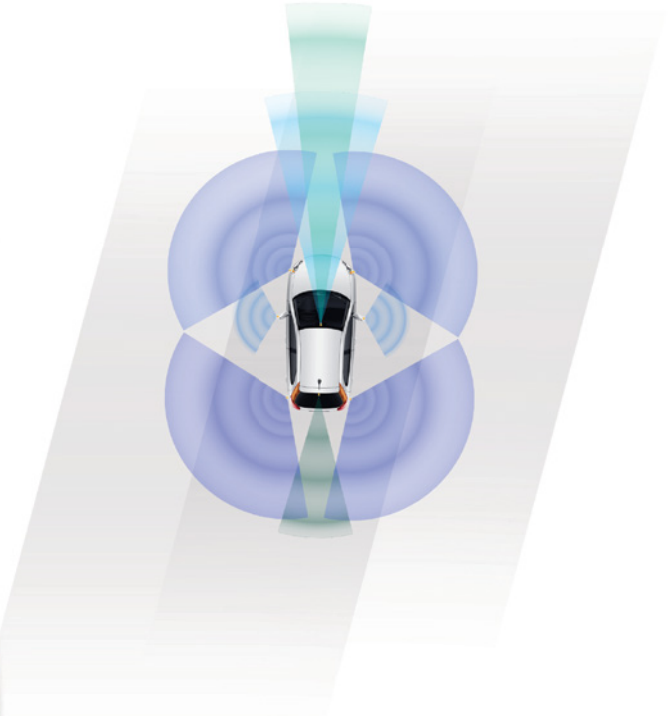

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SUPPLIER EYE

Critical decisions for the 2020s

Fourth quarter 2019 has arrived, and with it comes a fast-growing anxiety among suppliers. Many of them tell me they can't recall a period when they've faced so many critical decisions that will impact their competitiveness, profitability and strategic direction in the 2020s.

What's different in 4Q19 compared with 2018? There are more "moving parts" to the global automotive business equation that affect every tier of the supply chain. The list includes the myriad of trade disruptions; the chaotic global regulatory landscape; slowing Detroit Three production volumes, and the need to devote resources to develop connected-autonomous and electrification systems that promise almost no short-term return on investment.

And, did I mention the challenge of finding talent to staff all these initiatives? Demand for software engineers across the supply tiers, to give one example, is through the roof. Smaller sub-tier companies aren't the only ones with headaches related to finding, and retaining, the right people.

Deciding how best to tackle these significant challenges is important. The recent trade disruptions – U.S. Section 232 tariffs on steel and aluminum, U.S. tariffs imposed on China (and reciprocal tariffs from China) as well as the not yet fully ratified USCMA (US-Mexico-Canada) trade agreement, are giving all suppliers heartburn. How to react?

Should you shift sourcing to more trade-friendly countries, or reconfigure the supply chain to comply with a structure which may be temporary? Who will bear the cost of resourcing? Suppliers tell me that in many cases, their customers view potential adjustments as the cost of doing business. In the end, if a trade relationship becomes permanent, companies will need to adjust accordingly.

After nearly a decade of accelerating or stable North American production volumes (since early 2009), select OEMs are forecast to experience a third straight year of declining output into late 2019. FCA, Ford and General Motors reached a high of nearly 9.3 million units in 2015. In 2019, the current IHS Markit Light Vehicle Production Forecast for the Detroit Three is forecast to reach 8.3 million units, barring any impact from the UAW work stoppage (as I write this in mid-September). That volume is off nearly 11% from 2015.

Michael Robinet
Managing Director
IHS Markit
michael.robinet@ihsmarkit.com

Anxiety is building across every tier of the automotive supply chain.

Our current IHS forecast sees another 9% decline for the Detroit Three in 2020, versus 2019. Those suppliers primarily focused on the domestic-U.S. OEMs must decide how to adjust to shifting volumes to support the bottom line. In the face of talent shortages in several areas such decisions are critical.

Deciding what role your company will play in the burgeoning areas of electrified propulsion and connected/automated driving may be the riskiest for an industry that is classically risk averse. At the moment, these new-tech areas offer vague prospects for ROI. They're investment minefields even to the largest Tier 1s, regarding capital allocation, alliance building, organic and inorganic acquisitions and the subsequent tradeoffs.

Meantime, the OEMs are approaching emissions compliance in different ways. Some are taking a more measured approach – integrating higher levels of mild and plug-in hybrid technologies to meet regional regulations – and hedge their bets on battery development progress and the public's ambivalence to EVs. Others, including Volkswagen and General Motors, are committing to the battery-electric path, in order to seek scale advantages. In the meantime, incumbent technologies may prove more resilient, the ever-evolving internal combustion engine being one.

To best serve this strategic split, some suppliers must be prepared to offer everything to everyone. What route will your company take?

Choosing to be an early adopter/innovator may put your enterprise in a leadership position down the road. But how far down the road is the payoff? Larger suppliers may have expanded risk tolerance to investigate new capabilities. Smaller players must choose carefully. ■

2019 Ford GT

What first impresses about the GT is how easy it is to drive. Ingress is a little tricky over the wide sill, but once situated in the comfy driver's seat you use a strap to position the foot controls to your liking in a very cramped pedal box, and you have a few degrees of seatback angle to play with.

The 3.5-L EcoBoost twin-turbocharged V6 erupts to life from what feels like just behind your right earlobe, but settles quickly in a buzzing idle. Like many competition-focused machines, the V6 has a lightened-crank eagerness about it, but the "automatic" gearbox prevents any uneasiness about getting underway. Thanks to the rear-wheel-drive GT's low and centered mass, the engine can mutter away at low rpm while easily bringing the GT up to traffic speeds.

The Getrag-sourced 7DCL750 7-speed dual-clutch automated manual transmission operates as a precise instrument, snapping off up- or downshifts on command, and exhibiting distinct personalities depending on the driving mode you're in. The carbon-ceramic Brembo brakes engage RIGHT NOW, providing the sort of assurance that'd be required at a qualifying pace.

The GT has just enough technology ladled atop it to not feel like a rolling, high-strung carbon tub, and you'd have zero issue driving to a track day. A hilariously quick transportation device, few machines so vividly deliver Le Mans-winning fantasies on the street.

Paul Seredynski

2019 Suzuki Jimny

It may seem a conflict in terms, but the all-new, pint-sized 2019 Suzuki Jimny SUV, winner of the Urban Car category in the 2019 World Car Awards, not only has selectable all-wheel drive (called Allgrip Pro) but also a low-ratio transfer gearbox to complement its standard 5-speed manual transmission.

It could be argued this ostensible "capability overkill" would be useful for getting along city side streets that don't rate priority clearing in deep snowfalls, or tackling steep house driveways—and, well, probably something else.

But the Jimny really is more appropriate for offroad use. Its ladder-type body-on-frame chassis with stiffening cross-members is made for taming tough going and the three-link rear suspension is happy in mud, ruts and much worse. Ground clearance is 210 mm (8.3 in.)—and there's that low-speed transfer case, too. On-road, ride is just plain hard.

Power comes from a naturally-aspirated 1.5-L 4-cyl. gasoline engine that makes 100-hp (75-kW) and maximum 95 lb-ft (130 Nm) at 4000 rpm. This doesn't sound like much, but it actually delivers with "character," a bit like a 1970s/1980s noisy-but-enthusiastic powerplant—and it is impossible not to respond to its chirpy urgency.

Gearshift quality is satisfying in an agricultural way. Mechanically, the Jimny in some senses reminded me of my long-ago Series IIIA Land Rover, which had an immensely endearing character. The Jimny has great street cred with its square and functional yesteryear styling, delivering the sort of image in which some younger aspirants will bask.

Stuart Birch

2020 Corolla Hybrid

Will Americans purchase a small, affordable, normal-looking hybrid? That appears to be Toyota's mission with this new Corolla, which borrows liberally from its world-beating cousin.

The Corolla shares the Prius's architecture, wheelbase and propulsion system with a long-stroke 1.8-L 4-cylinder that employs the Atkinson combustion cycle. Boasting 40% brake thermal efficiency, the ICE and the two motor-generators make a total 121 hp, driving the front wheels through an electronically-controlled, planetary-type continuously variable transmission (CVT). The battery pack, borrowed from the Prius C, remains comprised of proven nickel-metal hydride cells.

Along with 'Normal' and 'Eco' drive modes, a CVT 'Sport' setting allows for stronger acceleration when desired. Corolla Hybrid also has EV mode, which allows the car to be operated as a pure EV for about .6 miles (.96 km) under certain conditions. And there's enhanced brake regeneration by sliding the hybrid PRNDB shift pattern into 'B'—quite handy.

On the road the Hybrid feels sporty and responsive. And what's not to love about the 53/52/52 city/highway/combined mpg? Ballparking the math, the $3,000 price difference between Corolla LE gasoline and LE hybrid models is paid back in about two years, based on the Hybrid's almost 20-mpg (combined) advantage, fuel at $4 per gallon and driving 12,000 miles annually.

Offered only in LE trim, the Corolla Hybrid may prove its mission accomplished.

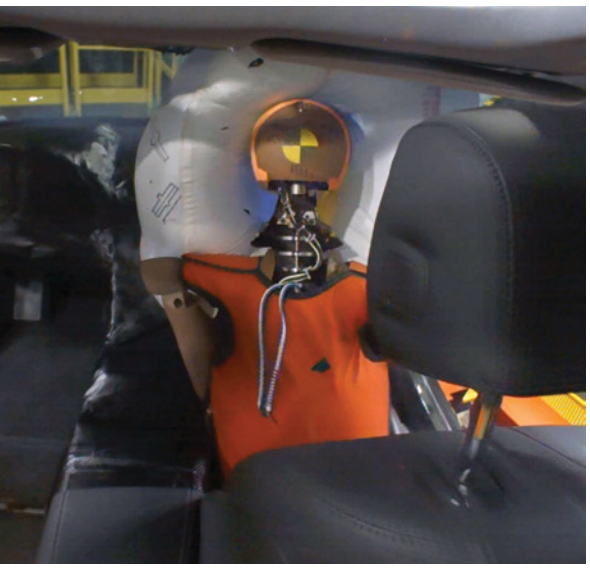
John Dinkel

SAFETY

Honda ready with new injury-reducing airbag

Engineers discuss the results of a crash simulation in front of a brilliant "powerwall" screen.

Starting next year, **Honda** will begin fitting vehicles with a new, advanced-design passenger-side front airbag that its engineers said is designed to mitigate brain and neck injuries by cradling the head like a baseball in a catcher's mitt. The design is particularly effective, Honda said, for angled impacts or when an occupant is not in optimal position when the crash occurs, reducing rotational acceleration of the head that can traumatize the brain.



Honda's advanced new passenger-side airbag is designed to reduce brain and neck injury caused by twisting acceleration of the head. The company will begin to fit the new airbag in 2020.

More than half of all impacts occur at some angle, said Eric Heitkamp, **Honda R&D Americas** technical leader/principal engineer, crashworthiness, at a media reveal of the new airbag at the company's safety research facility in Raymond, Ohio. Heitkamp said the airbag was developed by the facility's engineers in partnership with restraints supplier **Autoliv**.

The new airbag is comprised of three inflatable chambers, with the two outside portions angling across the dashboard. Connecting the outer chambers is a netlike "sail" panel that first catches the head and slows its forward momentum towards the inflated center chamber, while at the same time pulling in the bag's outer chambers to envelop the head to reduce twisting and prevent the head from sliding off the airbag, which can happen with conventional designs.

It's possible the design could be applied to the driver's-side airbag, Honda engineers said, but it is less-critical for the driver, as the act of

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BOTH IMAGES: HONDA

piloting the vehicle tends to have the driver more optimally positioned if the steering-wheel airbag inflates.

Beginning in 2014, Honda and many other automakers were rocked by the eventually massive recall of 56 million faulty airbag inflators manufactured by now-bankrupt **Takata**. Keitkamp said that Honda's safety labs now conduct more than 400 airbag tests annually, the majority testing for effectiveness on out-of-position occupants, as statistics indicate that of the 37,000 people killed in U.S. highway crashes in 2007, 47% were not wearing a seatbelt.

Physical research, simulations

At the Raymond safety research center, Honda is engaged in a wide spectrum of testing that includes full-scale physical crash tests and crash simulations, pedestrian-safety research and restraint-system testing and development. Currently, the facility conducts around 225 physical crash tests annually, said Bryan Hourt, Honda R&D Americas chief engineer - safety, strategy and planning, and a remarkable 30,000 crash simulations.

The facility's crash-dummy lab opened in 2000 and now boasts 48 dummies in a variety of sizes, as well as a specially-developed pedestrian-impact model. Another portion of the facility tests for pedestrian-friendly designs by simulating the impact of a head on a vehicle hood or the front of the vehicle with legs. In all, engineers gather data from some 2,400 crash-dummy "response evaluations" annually.

To help reduce crashes of all kind, Honda said it intends to make its "Honda Sensing" active-safety technology suite standard equipment on all Honda and Acura models by 2022. The system currently leverages a high-mounted mono-vision camera and millimetre-wave radar to provide safety features such as the collision-mitigation braking system (CMBS) that can automatically bring a vehicle to a stop from as fast as 40 km/h (25 mph) to avoid impact with a pedestrian or object, Honda claims.

Bill Visnic

CHASSIS

Continental Tire rolls towards a smart-and-connected future

It is difficult to become emotional about tires except when they—literally—let us down. But tires are set to get smarter, communicate more effectively and react to changing road conditions. Each of these will play a role in meeting the demands of autonomous- and electric-vehicle (AV/EV) development.

"They will be tires that take care of themselves and provide highly supported driving," said Dr. Philipp Struck, **Continental** Tire's head of tire line development. "Mobile data will be essential as we become more autonomous and drive more EVs."

Rims that automatically adjust width to achieve the optimum tire footprint for specific conditions are now the subject of extensive joint research between tire and road wheel manufacturers. Focus is also on AV systems that would recognize tire punctures, source nearby replacement/repair, vector to the required retailer for the necessary work and then recommence the programmed journey without involvement of the occupants.

Less resistance and carefree tires

Continental uses the acronym CASE (Connected Autonomous Shared Electric) to list divergent mobility needs in the tire business. Trends include maintenance-free ("carefree") tires, increased comfort requirements and the shift from ownership to usership fleets. EV tires will need to deliver advances in load capacity along with decreased rolling resistance to boost range. "EVs may weigh up to half-a-ton more than a regular ICE-propelled vehicle," Struck explained. "That means the need for higher inflation pressure, causing a potentially higher wear rate."

An EV's ability to produce maximum torque from step-off is particularly challenging for stop-and-go delivery use. "Of course a high, narrow wheel cannot be put on an electric vehicle as an afterthought," Struck said. He noted there are currently 139 tire sizes and specifications for EV and hybrid cars. "We are in constant interaction with manufacturers to figure out what is needed. And of course, top of our list of criteria is safety, always safety."

ContiSense incorporates electrically conductive rubber compounds.

Continental's latest EcoContact 6 spans fitments from the **Fiat** Panda to **BMW**'s X5, with diameters from 13- to 22-in., and section widths from 145 to 315 mm. Conti claims 15% less lowering rolling resistance, 20% better wear and 6/2% better wet/dry braking performance compared to the previous-gen EcoContact 5. It also claims its latest Green Chili compound (using vegetable-based oils vs. carbon-based) helps reduce CO_2 impact.

The next generation of Continental tires (it has 80 in development, using up to 40 rubber-compound variants) will include asymmetric ribs and sipes, with additional silica content and an optimized polymer network to enhance connection between the silica and rubber. Other goals include higher silicon content for reduced tire deformation and more precise groove-to-sipe ratios combined with lower rolling resistance. Confirmed OE applications in EVs include the **Mercedes-Benz** EQC, **Porsche** Taycan and fitments for **VW**, **Fiat**, **Ford**, **Mercedes-Benz**, Porsche and **Kia**.

CONTINENTAL

Adapting to road conditions

Two Continental technologies—ContiSense and ContiAdapt—provide continuous monitoring of tire condition and adapt performance characteristics to road conditions. ContiSense involves electrically conductive rubber compounds that permit tread depth and carcass temperature data to be sent from a sensor in the tire. Penetration of the tread by a foreign object will trigger a warning before pressure begins to be lost. Continental plans to further refine the system's ability to read road-surface conditions, including temperature and snow.

With ContiAdapt, micro compressors are integrated into the wheel to adjust not only the tire pressure within a variable-width rim, but the size of the contact patch. Four combinations are available: wet, uneven, slippery and normal. Low rolling resistance is achieved on smooth roads with the tire at high pressure, added grip on a slippery surface when pressure is lowered to increase the contact patch. For tackling snow or a stretch of black ice, pressure may be lowered to only 1.0 bar (14.5 psi).

Continental's R&D programs include adaptive footprint effects.

Complementing this technology is a Continental concept tire that has three differing tread zones for three distinct surface conditions: slippery, wet and dry. As tire pressure and rim width change, the tread zones and the tire footprint morph. Continental considers its technologies in R&D as "promising solutions" for EV and AV applications. Will there always be some element of compromise in tire design? "Yes," said Struck. "Otherwise, we would just have a single specification!"

Stuart Birch

CONTINENTAL

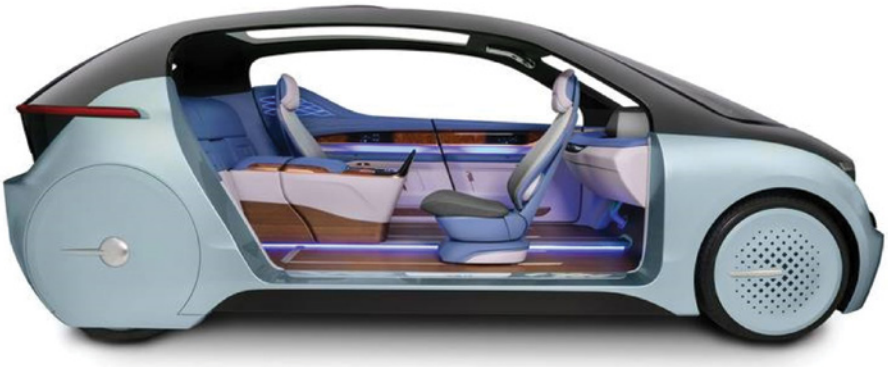
MATERIALS

Cutting weight seen as less vital for automated and shared vehicles

After long demonstrating lightweighting with steel for contemporary passenger vehicles, the **Steel Market Development Institute** (SMDI) is slightly changing the tune for a future of Autonomous, Connected, Electric and Shared (ACES) vehicles.

In a presentation to the **International Motor Press Association**, SMDI conceded that although weight on an isolated basis affects driving range and can't be ignored, the total effect on the viability of ACES designs is not necessarily the same—and other qualities may be even much more important. And the bottom line on range versus cost is likely to be a wash, said SMDI vice president Dr. Jody Hall.

When it comes to materials selection, weight can drop to second place when the vehicle's environment changes, and for ACES vehicles, the primary concern is safety, particularly for vehicles where the occupants may not necessarily be seated in ideal positions.



Shuttle-service ACES body with steel-ring easy-access side design and slide-together steel-frame doors can meet side-impact requirements.

Weight advisable for MaaS vehicles

Shuttle-service automated vehicles, for example, pose a variety of safety concerns. To accommodate easy entry of all types of passengers, a wide opening is desirable, and that raises vehicle B-pillar design concerns. The steel industry has been developing slide open/closed doors that when closed will latch into a bodyside ring, similar to an approach once used in utility vehicles, to meet regulatory side-impact requirements.

Inside (and without a driver) there is no practical way to ensure passengers are buckled up, so even if the vehicle is limited to low-speed operation, the extra strength of an all-steel structure improves its crashworthiness.

ACES vehicle operation relies on a wide range of inputs from external sources to its typically surface-mounted sensors and cameras, processed through electronic control units to onboard actuators. Although any input device that's mounted on or close to an external surface has exposure to damage, SMDI said the greater strength of a steel vehicle made it a safer choice in an accident.

Battery carriers scrutinized

SMDI also cited data from **ArcelorMittal**, a diversified steel company, in its presentation. Aluminum has become the material of choice for electric-vehicle (EV) battery packs in all premium models.

	Audi e-tron	Jaguar I-Pace
Curb weight (kg)	2611	2215
Construction	~70% steel body Aluminum closures	4% steel body Aluminum closures
Battery size (kWh)	95	90
Range (km)	420	430
Footprint (m²)	9.31	8.93
BIW mass adjusted for foot print[1]	430	259
Cost of Light weighting (assuming $5/kg)	-	$853
Cost of additional battery (assuming $170 /kWh 2020 prices[2])	$850	

Beyond 2020, light weighting with aluminum could become more expensive than additional batteries

Data from company website & A2Mac1
1. Don Malen, University of Michigan
2. Bloomberg New Energy Finance

ArcelorMittal comparison of Audi e-tron vs. Jaguar I-Pace indicates when footprints are mathematically equalized, the extra cost of batteries to match range with largely steel body is the same ($850-$853) as aluminum lightweighting.

However, SMDI pointed to ArcelorMittal's steel-based battery-pack carrier that weighs within 10% of the aluminum design and for which it projects a per-vehicle saving of $120. The modular design of the tray includes upper and lower crossmembers, with the lower one integrated with the bottom cover. The liquid cooling system is centrally located in the structure; all components incorporate various high-strength steels.

The modest weight penalty of the steel battery carrier will be overcome in the upcoming generation of lithium-ion batteries, Ram Ilyer of ArcelorMittal R&D said. He compared an **Audi** e-tron with its 70% steel body and aluminum doors and other panels with a **Jaguar** I-Pace and its primarily aluminum construction: the two vehicles are somewhat different size and the Audi has a 95-kWh battery pack, vs. a 90-kWh pack for the IPace, so calculation adjustments were made for the difference in footprint. Assuming an aluminum price premium of $5 kg, the cost of going aluminum on the e-tron was projected to be $853, whereas adding battery capacity to overcome the extra weight of steel in the Audi, based on a 2020 price of $170 kWh, would be $850, effectively the same.

However, assuming continued declines in battery pricing, SMDI asserted that adding battery should soon be less costly than an aluminum-intensive vehicle design.

Paul Weissler

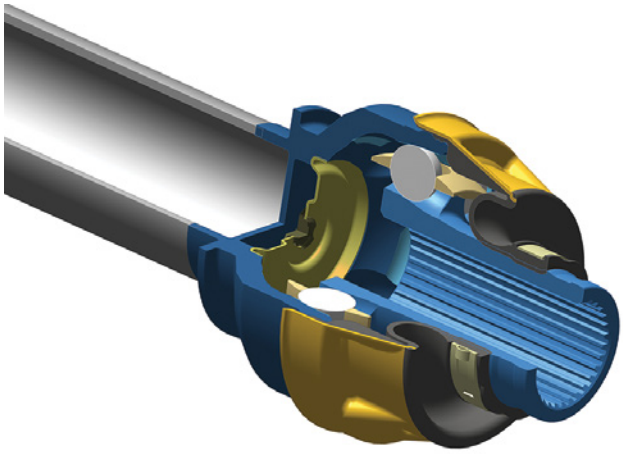
FROM TOP: SMDI; ARCELORMITTAL

NVH

GKN spreads premium propshaft tech to quiet pickup cabins

It may seem a long way in engineering and NVH terms from premium European cars such as **Audi**'s A5 and A7 to light duty trucks, but **GKN Automotive** has bridged that gap with its latest lightweight all-wheel drive (AWD) modular propshaft. Many pickups suffer a significant amount of unwanted NVH emanating from the front propshaft, with its two universal or CV joints and an interconnecting shaft positioned below and close to the passenger cabin. But now GKN Automotive has "re-characterized" its premium car driveline system to an entirely different vehicle category.

"With a traditional truck front propshaft, the level of noise entering the cabin is perceived as a drone," explained Michael Miller, GKN's propshaft product technology manager. "We've worked on applications of our new technology where the cabin NVH levels have been dramatically reduced. Positive results stem from the combination of joints used in our lightweight modular front propshaft."



Cutaway of GKN Automotive's latest one-piece modular propshaft.

Opposed track design

The GKN propshaft forgoes the traditional Rzeppa type layout where all joints face open in the same direction. Instead it uses an opposed track designed to better balance the joint's internal forces. Its flat, radial-offset construction allows weight reduction and increases articulation angles. "The counter-track principle allows the tracks to steer the balls," Miller said, "allowing the elimination of heat generating sphere surfaces of the cage to outer race, therefore allowing high speed CVJs to run more efficiently under higher angles typical of front propshafts."

The new propshaft also incorporates what Miller describes as advanced sealing methods developed to protect components in extreme conditions and "vastly extend" lifecycles. "This has been achieved using over-molded technology, which chemically bonds rubber to a steel substrate," Miller explained, "thus avoiding any additional sealing media or mechanically crimping of rubber to steel components." The sealing system uses a base polymer Hydrogenated Nitrile Butadiene Rubber (HSB5 HNBR) developed in collaboration with **Zeon Chemicals**.

Miller said the big development program challenge for GKN was significant performance improvement with reduced weight. "The aim was to apply relatively sophisticated technologies seen in other segments but never applied to the full-size truck and SUV segment, where high load and robustness are imperative," he said. "We had to ensure the CVJs remain lubricated throughout their lifespan despite the extreme uses of the vehicles. Both CVJs on the one-piece front propshaft utilize over molded boot designs which eliminate traditional sealing media components such as O-rings and gaskets by an integrated seal design in conjunction with the boot."

The difference between the truck and car applications? It comes down to required running angles. The Audi applications are "low" (< 3°) articulation angle applications. The PX1-41 countertrack geometry used for an **FCA** application required a higher (~12°) continuous joint running angle. The new countertrack is an optimization of interface, sealing system and component complexity reduction for these new application requirements. Several models that now incorporate the scalable system are based on **GM**'s 2019 T1XX platform and include Silverado, Sierra, Suburban, Yukon and Escalade. It is also used on FCA's DT platform for the Ram 1500.

Stuart Birch

According to GKN Automotive, its latest propshaft—which sees applications on GM's 2019 Chevy Silverado (above)—features "sophisticated technologies seen in other segments but never applied to the full-size truck and SUV segment, where high load and robustness are imperative."

BOTH IMAGES: GKN

TESTING | SIMULATION

Roush opens Advanced Durability Lab

Roush simulator 6DOF: The showpiece of the Roush Advanced Durability Lab is the MTS Systems six-degrees-of-freedom spindle-coupled road simulator.

The auto industry's steady march toward electrified and automated vehicles has many suppliers affixed to the digital-testing environment rather than using traditional hardware validation.

With a six-degrees of freedom road simulator as its centerpiece, the recently-opened **Roush** Advanced Durability Lab in Livonia, Michigan is a trend-buster. "If suppliers and vehicle manufacturers aren't going to reinvest in certain hardware solutions because their product-development focus is software solutions, there will be a gap. That's an opportunity for us," claimed Jeff Johnston, Roush's president of testing services.

In addition to the road simulator, Roush's $6-million lab also features bedplates for component and subsystem durability testing; isolated control rooms; a 450 gallons-per-minute hydraulic pump and a cooling tower. Mike Valko, director of business development for Roush, said global automakers have similar testing capabilities in-house. "But Roush can help with overflow, time-constraint and change-of-scope testing needs," said Valko.

The **MTS Systems** Corp. Model 329 six-degrees of freedom, spindle-coupled road simulator can be programmed with drive files that replicate cobblestone surfaces, potholes, curb-strikes and other proving-ground events, according to Gerald Roesser, advanced durability lab manager.

"A vehicle mule or prototype will accumulate miles faster and more aggressively during 24/7 testing time atop the road simulator than if all of the product development testing was done at a proving ground," said Roesser, adding, "We're really talking about early development work. This lab won't replace the proving ground, as that will remain the vehicle validation method for automakers."

With its 13,200-lb (5987-kg) peak payload, the road simulator can move forward/backward, up/down and left/right—in addition to pitch, yaw and roll rotation. "Whether done by Roush or our customer, you need a vehicle or mule on the proving ground for a few days to get vehicle-specific, real-world data," Roesser said. "But we are working on a concept where we'll use virtual roads and modeling with hardware-in-the-loop to get the road loads, then we'll play those loads through the road simulator."

Before Roush opened its latest lab, the supplier typically outsourced vehicle durability work, noted Johnston. "We have durability labs for engines and transmissions, but this is our first dedicated lab for vehicle and component-level durability testing," Johnston said, adding, "Over time, we will be known as the durability domain expert for component, subsystem and full-vehicle testing."

Kami Buchholz

ROUSH

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Frankfurt with an 'E'

Early September's Frankfurt Motor Show was all about production-ready or near-production electric vehicles (EVs), as Europe's propulsion transformation gains momentum. With European Union-wide carbon-dioxide (CO_2) emissions regulations closing in and societal pressure on the auto sector's contribution to climate change and sustainability, Europe's automakers—particularly those in Germany — are hastening their EV development timelines.

Whether there will be a market for the vehicles environmentally-concerned customers (and regulators) claim are necessary is another matter. **Porsche**'s formidable Taycan will start at $150,000 when it hits U.S. showrooms next year. The sublime **Honda** 3 city car, not coming to the U.S., has limited utility beyond city-car use but will cost nearly 30,000 euros. Such is the same for **Volkswagen**'s larger ID.3.

Porsche Taycan: Mighty performance—with a price to match

The 2020 Taycan, Porsche's first all-electric model, seems to be proof the company does not intend to let the transition to electric propulsion impact its high-performance reputation.

After four years of teasing and meticulously-metered release of technical details, Porsche unveiled the production version of its Taycan electric vehicle (EV) at the 2019 Frankfurt Motor Show. Porsche's fast and expensive 4-door competitor to the **Tesla** Model S is scheduled to be in European showrooms later this year and in the U.S. in early 2020.

Launching with two variants, the Turbo and Turbo S, the Taycan's curvaceous sheetmetal is satisfyingly loyal to the Mission E concept car that presaged the Taycan when it was unveiled at the Frankfurt show in 2015. Although it is based on an all-new EV platform, the Taycan's exterior dimensions—overall length of 195.4 in (4963 mm), wheelbase of 114.2 in (2900 mm) and width of 77.4 in (1966 mm)—are quite similar to Porsche's current 4-door sedan, the Panamera.

But with just over 94 kWh of capacity from the 396 pouch-type lithium-ion batteries of the Performance Battery Plus (insinuating lower-capacity battery packs for less-powerful models likely will follow) even a multi-material steel and aluminum body-in-white cannot disguise the Taycan's stupendous listed curb weight of 2,295 kg (5,060 lb).

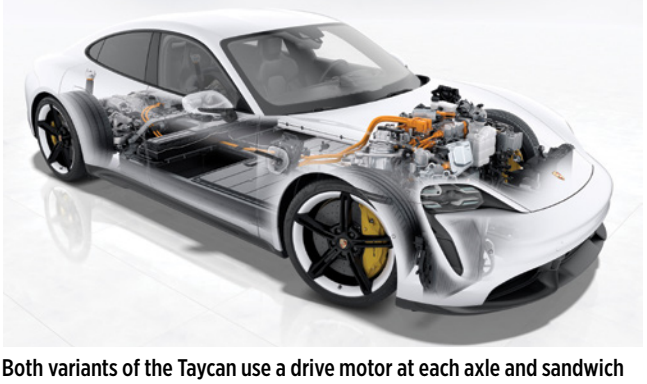
The primary difference between the Taycan Turbo and the Turbo S is total power output from the twin permanent-magnet electric motors, one for each axle. Porsche said the Turbo generates maximum power (in launch-control mode) of 500 kW (670 hp) and the Taycan Turbo S raises system output to 560 kW (751 hp) and 1050 Nm (774 lb-ft). Apart from delivering on the baseline EV goal of zero tailpipe emissions, the brand's brief is for the Taycan to uphold the performance credentials established by its internal-combustion history; thus even at two-and-a-half tons, the Taycan Turbo S can hammer from 0-to-62 mph (100 km/h) in a claimed 2.8 s. The Turbo variant needs just 3 s to accomplish the feat. Top speed for either model, said Porsche, is 260 km/h (161 mph).

The company confirmed less-powerful and rear-drive variants will follow.

Meanwhile, the company listed the power efficiency of the Taycan Turbo at 26 kWh/100 km and the Turbo S model at a slighter higher draw of 26.9 kWh/100 km. In the all-important metric of driving range, the Taycan Turbo's maximum—based on the European Worldwide Light-vehicle Test Procedure (WLTP)—is 450 km (279 miles) and 412 km (256 miles) for the Turbo S. When certified in the U.S., the Taycan's rated driving range is almost certain to be markedly reduced.

This comparatively abbreviated range is well short of the 370-mile (595-km) maximum for the long-range variant of Tesla's Model S and poses the likelihood of Porsche offering longer range in a future Taycan variant.

The traction motor for the Taycan's front axle drives



Both variants of the Taycan use a drive motor at each axle and sandwich the lithium-ion battery pack, per current EV norm, in the bodyshell's floor.

BOTH IMAGES: PORSCHE

through a single-speed reduction gear, while a two-speed transmission for the rear axle offers optimized acceleration, with the second ratio enabling maximized efficiency, Porsche said.

Electronic torque vectoring, adjustable air suspension and rear-wheel steering are chassis highlights, as well as *de rigeuer* oversized brakes (despite the fact Porsche said 90% of "everyday" braking can be accomplished with regenerative braking) including the option for Porsche's now-famous carbon-ceramic brake rotors.

Porsche had long promised the Taycan's industry-first 800-V electrical system and onboard capability for direct-current (DC) fast-charging at up to 350 kW would make for liquid-fuel-rivaling recharging times. But the Taycan is launching with a maximum recharging capability of 270 kW, which the company said offers a recharge time from 95% depleted to 80% charged in 22.5 minutes "under ideal conditions." Five minutes of such charging can bring 100 km (62 miles) of added range.

Sumptuously fitted with copious glass screenage and deliberately short on physical buttons and knobs, the Taycan cabin also offers the option of zero leather.

Volkswagen signals new EV era with launch of ID.3

The ID.3 is the first production vehicle to be based on Volkswagen's EV-specific MEB vehicle architecture, but it will not be sold in the U.S.

Multi-brand, multinational automotive powerhouse Volkswagen crossed a strategic inflection point when its all-new ID.3 electric vehicle (EV) was revealed at the 2019 Frankfurt auto show. There's no turning back, the company insists, from its intent to effectively eliminate use of internal-combustion propulsion for passenger vehicles—on a stated timeline that sees 10 million new EVs produced in the next decade and the entire Volkswagen Group "CO_2- neutral" by 2050.

With sales starting in Germany in mid-2020, the ID.3 small car is the first production vehicle based on the company's long-touted MEB architecture dedicated to underpinning a wide range of EV models. Sagely, the ID.3 is not intended to be sold in SUV-crazed America—an ID.4 crossover variant reportedly will be launched for the U.S. market early in 2021.

The 5-seat ID.3 essentially is the same general size as VW's iconic Golf, but shorter overhangs mean its wheelbase-to-overall-length ratio makes its interior roomier than many conventional vehicles in the class. The company said the ID.3's wheelbase is 2765 mm (108.9 in), overall length is 4261 mm (167.8 in) and perhaps most critically when it comes to EVs, base curb weight is 1719 kg (3790 lb).

Volkswagen said the new EVs turning circle is a compact 10.2 m (33.5 ft), "ideally-suited for urban environments." The company also claims a more-spacious perception for the cabin and organic shapes that emphasize the interior's openness.

In a driveline configuration that certainly wouldn't suit North American traction preferences for all-wheel drive (or at least front-wheel drive), the ID.3's single permanent-magnet drive motor

The ID.3 cabin promotes an enhanced perception of spaciousness, new ideas for instrument configuration and will be almost devoid of physical switches.

FROM TOP: PORSCHE; VOLKSWAGEN; VOLKSWAGEN

is integrated with a single-speed transmission and controlling power electronics and is situated at the rear axle. The motor develops 150 kW (201 hp) and a maximum of 310 Nm (229 lb-ft), Volkswagen said at the Frankfurt show. Top speed is 160 km/h (99 mph).

In another significant market-facing strategy, when the ID.3 begins series production, there will be a choice of three battery-pack capacities. A base 45-kWh lithium-ion battery pack will offer a maximum driving range — based on the European Union's Worldwide Light-vehicle Test Procedure (WLTP) driving cycle — of 330 km (205 mi). A 58-kWh pack, the capacity being used for all initially-produced ID.3 "1ST" models, delivers a maximum range of 420 km (261 mi) and a maximum-range battery pack has a capacity of 77 kW that provides range of 550 km (342 mi.).

Recharging capacity varies for the respective battery-pack sizes, with 7.2-kW alternating-current (AC) charging and 50-kW DC charging for the 45-kWh pack and 11-kW/125 kW for the largest 77-kWh battery. The company said the mid-range 58-kWh battery, using 100-kW DC fast-charging, can be replenished with 290 km (180 mi) of range in 30 minutes.

Mercedes-Benz EQS concept: the S-Class of electric vehicles?

The Mercedes-Benz S-Class for decades helped form the automotive definition for "flagship." With electric propulsion seemingly set to revolutionize the industry, the company could be ready to reframe the flagship definition, unveiling at the 2019 Frankfurt auto show the Vision EQS concept car, a vehicle that could signal the next direction for Mercedes' range-topping passenger car.

Mercedes already has discussed its intention to launch a full "EQ" lineup of electric vehicle (EV) models, but the Vision EQS concept could be particularly significant if the company intends for the longstanding S-Class to fully cast off its internal-combustion heritage. Another possibility is for a fully-electric model to represent the pinnacle of an S-Class lineup that also could encompass internal-combustion variants. Or, the EQS could simply become sedan flagship of the EQ lineup that also will feature several utility-vehicle bodystyles.

At the Vision EQS' unveiling at the Frankfurt show, Mercedes did not give direct insight into how a potential production version of the concept car would fit into the company's long-range strategy, but in a release did call the car "a milestone on the way to the future of Mercedes-Benz," adding that it is "a new outlook for future large, electric luxury sedans."

The Vision EQS is fitted with a battery pack of "approximately" 100 kWh capacity, Mercedes said. The lithium-ion battery pack is made by Accumotive, a subsidiary of Mercedes parent **Daimler** AG. The company took pains to add, "for the next vehicle generation of the product and technology brand EQ, some of the battery cells are ready to be wholly produced using power from renewable sources. In purchasing battery cells from CO_2-neutral production, Mercedes-Benz Cars is making a major contribution on the way to a CO_2-neutral new car fleet in twenty years."

The Vision EQS concept car presages a fullsize sedan that will be part of Mercedes-Benz's range of all-electric EQ models.

The Vision EQS promotes a variety of innovative cabin materials, including a roof liner created from "ocean waste" plastic.

Also added: "As a first result of the sustainability partnership [with a major battery-cell supplier], by purchasing CO_2-neutrally produced battery cells, Mercedes-Benz Cars will reduce the overall CO_2 footprint of all the batteries in future vehicle models by considerably more than 30%."

For the Vision EQS, this sizeable battery pack yields a "comfortable" driving range of up to 400 miles (700 km). With capability for recharging at up to 350 kW — such systems already in place for public use — the battery could be recharged to 80% capacity in less than 20 minutes, the company claimed.

An electric motor at each axle imparts all-wheel-drive capability with "fully-variable" torque distribution. Total output is 469 hp and a peak of 560 lb-ft (759 Nm). The 0-to-60 mph (97 km/h) run takes less than 4.5 s. A release mentions transmission "ratios," suggesting the transmission integrated with the traction motor and power electronics could be more than a single-speed unit; a handful of automakers and Tier 1 suppliers recently have shown 2-speed transmissions in conjunction with EV drive motors.

Bill Visnic

BOTH IMAGES: MERCEDES-BENZ

New-generation Nissan Versa breaks for higher ground

Subcompact cars hardly are spotlight-grabbers at the moment, but **Nissan**'s nonetheless delivered up an all-new 2020 Versa that notches higher fuel economy, quicker acceleration, tighter S-curve poise and a quieter cabin compared to the outgoing Versa.

"Nissan's third-generation Versa is well-balanced in terms of performance, handling, and ride comfort," Jose Romo, the car's marketability engineer, told *Automotive Engineering* during a recent media ride-and-drive program in Nashville, Tenn.

Versa's styling makeover extends the exterior dimensions, making the four-door 1.6-in. (41-mm) longer, 1.8-in. (46-mm) wider, and 2.3-in. (58-mm) lower. A refreshed interior provides best-in-class front legroom at 44.5 in. (1130 mm), a 2.7-in. (69-mm) increase versus the previous model. The competitive set includes the 2018-redesigned **Hyundai** Accent, **Toyota** Yaris and **Chevrolet** Sonic. It joins Nissan's Kicks compact crossover SUV on the company's global V-platform.

The third-generation 2020 Nissan Versa has a revised powertrain and larger dimensions and is assembled in the company's Aguascalientes, Mexico, plant.

More power, enhanced CVT

A Gen-3 version of the Versa's 1.6-L 4-cyl. produces 122 hp at 6300 rpm and 114 lb-ft (155 Nm) at 4000 rpm—12% more power and 7% greater torque versus the prior 1.6-L. Much of the new-found power can be attributed to an increase in the compression ratio, going from 9.8:1 to 10.4:1 for the Gen-3 engine. The powerplant mates to either a 5-speed manual or the Xtronic continuously variable transmission (CVT).

"Our next-generation Xtronic CVT achieves a 12% lower gear at 25 mph (40 km/h) with the addition of a belt reinforcement," Romo said. The CVT's revised D-step shift logic control enables quicker acceleration and better fuel economy with a 20% wider ratio spread. The car's Xtronic-equipped fuel economy is 32 mpg city/40 mpg highway, with the combined 35 mpg rating representing an approximate 2% increase over the prior model. Fuel economy with the five-speed manual transmission is rated at 27 mpg city/35 mpg highway/30 mpg combined.

Flatter cornering, better stability

Versa continues with an independent strut front suspension and a torsion beam rear axle—with twin-tube shock absorbers for each corner. Polyurethane bump stops replace the prior rubber stops to help provide a more rigid structure. The car's roll angle is reduced by 15% and crosswind stability improves with various changes, including larger tire widths and a 0.8-in. (20-mm) front chin-spoiler expansion. "The changes help to keep the car flatter during cornering," Romo explained.

Interior quietness improves with various noise-intrusion measures, including thicker dash insulation, thicker front side glass (from 3.5 mm to 4 mm), and 30% thicker carpet for driver and all passenger positions; the car's stiffer suspension components also help isolate road noise. "The noise-isolation improvements mean the driver can have a normal, low-voice conversation with passengers," Romo said.

The 2020 Versa, on sale now, is sold in three grades: S, SV, and SR. The SV and SR grades provide Nissan's Safety Shield 360 as standard fare; that safety package includes automatic emergency braking with pedestrian detection, rear automatic braking, lane-departure warning, rear cross-traffic alert and high-beam assist.

The Versa often was billed as the least-expensive new car in America. That's no longer the case, but the 2020 model remains one of the lowest-car new vehicles on the market, with a Versa S with 5-speed manual transmission carrying a base MSRP (before destination) of $14,730, while the top-trim Versa SR with the standard-equipment Xtronic transmission has an MSRP of $18,240.

Kami Buchholz

The 2020 Nissan Versa has 88.9 cubic feet of interior volume, with a 7-in. color display touchscreen and Bluetooth hands-free phone system and streaming audio among the subcompact's standard equipment.

BOTH IMAGES: NISSAN

CONTI SUITS UP

A team of young innovators aims to transform a critical piece of safety equipment – and create new business – through collaboration.

by Lindsay Brooke

Continental engineers Sebastian Dietz (at left) and Carsten Kellings with the prototype Schöffel safety jacket at Conti's Hannover proving ground.

Few colors shock the human brain into attention more than high-visibility Yellow. "Hi-viz" as it's known in the safety-apparel industry, is an on-the-job requirement for first responders, road workers, tow-truck drivers, linesmen, loggers, couriers, coast guard deck crews – any all-weather vocation for which being seen in low-visibility situations can make the difference between life and death. Included are overnight package-delivery drivers who must sprint across busy city streets – at night, in the fog and rain - to deliver the goods.

But hi-viz, even when combined with reflective fabrics, is often not sufficient for wearers to be seen.

The technology of so-called "technical garments" (including those rugged-fabric jackets, vests, trousers and boots that protect recreational wearers in skiing, cycling and off-road motorcycling) isn't a topic we typically cover in *Automotive Engineering*. In fact, this article is a first – and it's more about how Continental AG is leveraging its engineering depth and breadth across business sectors to engage new markets than it is about fabric denier (a unit of measurement that expresses fiber thickness of individual threads or filaments in textiles) and thread count.

And it could emerge as a significant revenue driver, as automated and connected driving systems enter the market in volume, the company's top engineers predict.

Co-pacing ideation

The retina-burning prototype jacket shown here "takes Continental's expertise in electronics, safety and quality and literally puts those things on people doing their jobs," explained Carsten Kellings, who was engineering leader in Conti's Intelligent Functional Materials, Systems and Technology group during the prototype development. The cross-divisional project, he noted, aims at taking safety-apparel visibility to the next level by integrating LED lighting into the garment.

The lighting – its battery to be charged inductively – complements the reflective fabric that is standard on many high-end professional and sporting garments.

The unique collaboration between Kellings' team (now led by Hans Schroth) and the Conti Innovations group brings high levels of start-up energy, and a degree of managed risk, to the project. They

LINDSAY BROOKE

The electrified/illuminated vest version of the garment concept includes eye-catching LED lights for safety, as well as a heating system that enables energy consumption for heating the vehicle cabin to be reduced by up to 90 percent. Could this be standard 'wearable' equipment for future UPS and Amazon Prime delivery personnel?

worked with Schöffel, a leading German manufacturer of premium outdoor technical apparel, that served as the OEM.

"We had the idea to do something outside the automotive business, looking toward the future - 2025, 2030," Kellings told *AE* last summer during an IAA tech preview at Conti's Hannover proving ground. "We began by asking first: Is this realistic? Can we provide the electronic stuff? Then we had to search for partners in the clothing industry.

"We thought to use our expertise in Electronics, something we're known for with high quality, to bring wireless power transfer to the technical safety jacket," he said.

Added Sebastian Dietz, an electrical engineer with Conti Innovations: "There is no real fixed schedule of meetings in this collaboration," he explained. "It all depends on when the ideas pop up. We then talk about the concept and what needs to be done. How much budget do we need? How many people? It starts out as a virtual engineering team, then as it gets more concrete we meet in person."

"It's a very flexible team approach using small teams and the many engineering and development synergies that Continental has," said Kellings. The supplier has steadily expanded the ways in which it encourages intrepreneurial and entrepreneurial ideas generated by the more than 50,000 engineers (about 15,000 in software development) out of about 243,000 total employees.

Engineers can present their ideas to management in sporting-like "pitch nights," with the most promising ideas then led to germinate in Conti's start-up "hub." Called Co-pace, it includes a tech incubator and a co-operation program that are closely allied with a corporate venture-capital arm that supports them financially when the ideas blossom into market-feasible products.

A recent start-up that was spun-off (in 2017) is PassiveBolt. Based in Ann Arbor, Michigan, this nascent company founded by a Conti engineer developed, through Co-pace, a turnkey "smart" mechatronic door-lock module that is already making waves among the smart-door-lock industry.

Unzipping the tech inside

The heated-and-illuminated prototype safety jackets unveiled by Continental in 2019 are among a wave of "smart wearables" that could "revolutionize the way we use technology in everyday situations and improve

CONTINENTAL AG

CONTI SUITS UP

safety on the road," according to the company.

At CES '19, Continental executives said the technology offers future opportunities, because it further expands the interaction with the vehicle electronics. They said sensors in the vehicle occupants' clothing could determine data such as humidity and temperature and, based on this, actuate the automatic climate control system.

Kellings and Dietz explain that the goal in developing electronics for an extreme-use safety jacket with LED illumination and an optional heating function is to activate those functions automatically when the driver exits the driver's seat.

A tubular plastic light bar snakes through the garment; it has an LED on one end, and a mirror to reflect the light. A thin-form-factor lithium battery powers the LEDs through wiring incorporated into the garment's fabric. The battery plus its control electronics are sized so that they can be slipped into a pocket of the jacket. A coil within the driver's seat inductively charges the batteries for the LEDs and the integral heating system.

This arrangement maintains an adequate state of charge in the jacket, Kellings said. A flexible second coil in the jacket absorbs the power from the seat coil.

Various material layers maintain the garment's integrity when it is laundered, while shielding the driver from the electro-magnetic field.

Power requirements "could be in the 5-watt range," noted Dietz. "It depends on what you want to charge. The LED lights only need a little amount of energy to flash it. From the measurements we've done so far, we don't see any issues with a magnetic field on the back of the jacket." He said the degree of illumination will be determined by use case. Some users may not want themselves lit up like a carnival ride, so as to not distract traffic, for example.

Kellings noted that the concept "could go beyond jackets into trousers, hats, shoes...it could also be used in cyclists' jackets," he said. "Raise your left hand to signal a left turn, and the left sleeve illuminates and flashes. We have so many ideas but the jackets are the first step. They're really cool and make it easy to understand the technology's potential." He and Dietz observed that electronics integrated into jackets is a new concept, "like airbag vests that came out a few years ago."

The optional heating function goes beyond the vital role of providing driver comfort. In delivery vehicles, which are

Continental future-think: AI, data, and drones

The term "mobility ecosystem" is grossly overused in the automotive space today, but it's impossible to ignore when speaking with technology leaders at Continental AG. The company's fast-paced emergence in electronics and connectivity puts it into the center of OEM discussions, as they plot future strategies on moving people and goods. *Automotive Engineering* recently sat down with Ralph Lauxmann, Conti's head of Systems and Technology (S&T) in the Chassis and Safety division, to talk about potential opportunities and challenges. Lauxmann, an ME, joined Continental in early 2014 from Knorr-Bremse SfN GmbH, maker of rail and commercial-vehicle braking systems, where he coordinated global development activities and was responsible for central engineering. He previously spent 17 years at Bosch.

Ralph Lauxmann talks future tech at Hannover 2019.

"It's important that we do not hire people based on the classical selection criteria."

Is Artificial Intelligence technology emerging as a greater focus within Continental than mechanical and electrical engineering?
No, I don't think so. If you don't have the basic understanding of mechanics, electronics, and programming, it's difficult to grasp how to incorporate AI into a given technology area. You need the AI understanding on top of understanding the traditional engineering.

I think it's important that, going forward, we do not hire people based on the classical selection criteria. We have to find a way to get the proper AI know-how within the company. That means making a qualification program for all of our engineers to increase their knowledge of AI based on the experience we've already gained in the company. Because AI as used for a radar sensor is totally different than AI used to teach a hybrid powertrain controller, for example.

What is your perspective regarding data management in the automotive space?
It is hard to talk about data in general, because there are several 'clusters' in our business that have data sources in them. In engineering, we need a lot of data to 'train' the systems, in order to create AI. And we need data to do predictive analysis and maintenance, homologation, algorithm development, and to update systems and provide security. Of course, it's all data – but the data sources and use cases are so different.

It's really a science, and it's a challenge for Continental, in the areas of data storage, data speed and processing, etc., because we offer a growing number of 'intelligent' systems. It's good that the universities are now developing curricula on data, how to understand it, to help provide new generations of engineers.

Some OEMs, and certainly many end users, are incorporating drone aircraft into their future mobility-tech plans. Does Conti see a future market in supplying drone technology, perhaps sensor arrays?
In general, the Aero market is not our market. The development speeds are much slower, the contracting, the regulatory framework, even components, are totally another world compared with Automotive. So, we're not targeting that market yet. But if it comes to the point where goods transportation and delivery-by-drones emerges become an integral part of the overall mobility scenario – if they communicate with the other vehicles - Continental could perhaps step into the game. Because then it's only an add-on to the picture of mobility we've already created.

So, if a FedEx or UPS would use delivery drones in conjunction with their other delivery modes in the future, that might be an opportunity for Conti to jump in?
Yes, because the difference is the Aerospace world today is totally separate from everything. But in the future, if drones communicate with the other elements of urban mobility, then the regulatory framework would change and opportunities start anew. By the way, the same goes for ground delivery robots.

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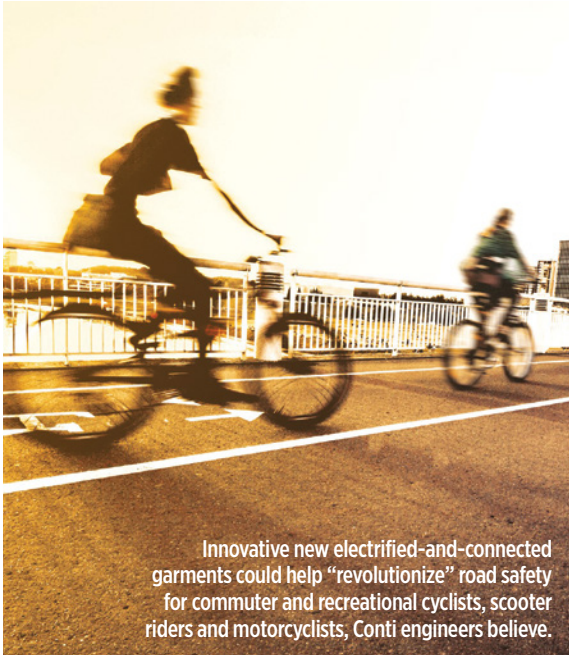


Innovative new electrified-and-connected garments could help "revolutionize" road safety for commuter and recreational cyclists, scooter riders and motorcyclists, Conti engineers believe.

increasingly battery-electric, the jacket heating system can help reduce the energy required to heat the cabin by up to 90%. That helps optimize vehicle range, by heating the driver rather than the cargo area, the engineers explained.

New electrically-conductive materials under development could replace the heating-filament wires that Conti currently employs in the Schöffel prototypes. These new materials feature a conductive, coatable polymer compound that would be printed into the textiles. Electricity flowing through the fabric would be directly converted to heat – rapidly warming the surface with relatively low power input.

"It's important to know if you need inductive charging or not," Kellings said. "The choice of materials and the level of electronics depends on the range of uses – daily use, for example, or for rough work outside, or for sports such as skiing. Will you be sitting in a vehicle? All of these determine design elements such as ease of access into the jacket. We knew nothing about jacket design and learned a lot from Schöffel in this project. And they learned some things about electronics from us."

Continental's unconventional electric safety jacket development project is not yet finalized. "We continue to develop new materials and technologies for it, and are looking for other partners to develop prototypes as a step toward really serious production," Kellings said with more than a hint of optimism. ■

CONTINENTAL

CASTING AROUND FOR lightweight solutions

The United Kingdom's Grainger & Worrall is introducing and perfecting "new and imaginative" casting-technologies.

by Stuart Birch

A large and complex mold for the innovative sand casting techniques that are a Grainger & Worrall forte.

"Get more [efficiency] from less [weight, time, cost]," is a mantra that will be chanted *sotto voce* by many an automotive designer and engineer facing the latest list of a new vehicle's "requirements."

Many propulsion solutions are possible, some of them evolutionary, that bring new opportunities for application within a rapidly-changing industry. But not all are focused on the design of pure EVs. Experts forecast that the internal combustion engine (ICE) will remain a mainstay of production vehicles—the majority used in hybrid configurations—for many years to come.

Keith Denholm, technical director of **Grainger & Worrall**, U.K.-based specialists in the design and manufacture of complex castings, is confident that major developments in aluminum casting technology are leading to what he calls "new and imaginative solutions," facilitating more-efficient vehicles to be brought to market faster, with reduced technical risk.

"The days of producing a prototype component which had little in common with the final part except its dimensions, are firmly over," Denholm told *Automotive Engineering*. "We are now able to achieve production-quality structural castings during the prototype and ramp-up stages of production which closely mimic the intended production part in all essential characteristics."

Denholm is a believer in the "Make Like Production" concept (pioneered by the Warwick Manufacturing Group, based at the U.K.'s University of Warwick) in which the finished part behaves like a production component. This enables useful validation to be carried out—even though the manufacturing process and materials used may be quite different. It is underpinned by using quality systems more akin to production than prototypes, enabling verification and traceability of all parts.

Cost effectiveness

The battery pack for an EV typically forms an integral part of the vehicle structure and requires very effective sealing to optimize battery cooling. While a production part may be made from extrusions, or hydroformed using expensive tooling, precision sand casting can quickly produce cost-effective prototype volumes with representative functional performance, argues Denholm.

"In the case of a battery pack, structural requirements necessitate wall thicknesses of at least 2.5 mm (0.1 inch) which is comfortably within the casting process capability. Satisfactory crashworthiness may require elongation properties of up to 15 percent, so we have developed a number of material specifications and heat-treatment procedures to achieve this."

Noting the crossover of ICE and EV technologies, he said Grainger & Worrall has developed 30 in-house specifications—mostly for aluminum/silicon and aluminum/copper alloys—tailored to suit specific applications. As ICE temperatures have increased, the company has developed alloy grades that it claims outperform the commercial grades, retaining their mechanical properties in temperature-critical applications.

'Digital sand'

For vehicle body structures such as crumple zones, temperature is not the concern, Denholm explained. So his team has prioritized ductility over strength to achieve the required elongation properties.

"It's through extending the performance of sand castings in this way that we are able to supply prototype components which behave just like production parts," he said.

In 2016, Grainger and Worrall acquired **Coscast**, home of the famous Cosworth Casting Process known

GRAINGER & WORRALL

for high-precision, high-quality sand castings. While still in demand globally for ICE engine components, Grainger & Worrall Coscast is increasingly supplying the EDU (Electric Drive Unit) market for hybrids and EVs. The process is equally valuable as a means of producing complex-shape vehicle structural components such as subframes, because it yields sand-cast parts that resemble the shapes and behavior of production pieces.

The relentless need to reduce the time-to-market for new products also has meant adopting innovative new techniques to speed up prototype production, such as digital sand manufacture. This is an additive manufacturing process where sand grains are fused together using a binder jet printing system that is quicker and more flexible than traditional processes.

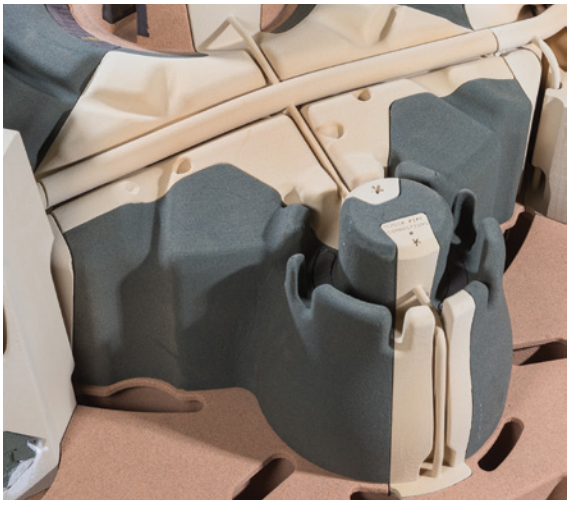
Grainger & Worrall regards the process as vital for the timely development of new structural components and major castings for EDUs, now a significant growth area for the company.

"Often, OEMs and Tier 1 suppliers are less familiar with major casting design than their opposite numbers in the ICE engine field," Denholm observed. "Plus, there is massive potential for design integration and optimization by incorporating the motor, transmission, cooling and control elements. By working with us from the initial concept design stage, we can help them take maximum advantage in terms of packaging and weight reduction."

CT validation

Grainger & Worrall has invested in computer-simulation methods for casting design, including Magma software packages for various materials. Aimed at producing right-first-time castings without extensive and time-consuming practical trials, more than 500 simulation projects have been completed—validated by X-ray, CT (computerized tomography), micro examination and tensile testing.

Other in-house capabilities include engineering (providing design support through to product launch), a materials lab, metrology lab and extensive machining facilities such as a flexible manufacturing system (FMS) cell comprising three **Mazak** 5-axis machining centers and a fully integrated pallet loading system.



A complex multi-process casting recently created by Grainger & Worrall.

GRAINGER & WORRALL

The company is set to expand into engineering analysis and joining technologies, but has no plans to become a high-volume supplier. Added Denholm: "By supplying components which speed-up development, we can help our customers begin meaningful testing earlier and shorten their time-to-market for new products. For fledgling companies, of which there are many in the EV sector, this reduces the financial burden prior to revenues coming on stream." ■

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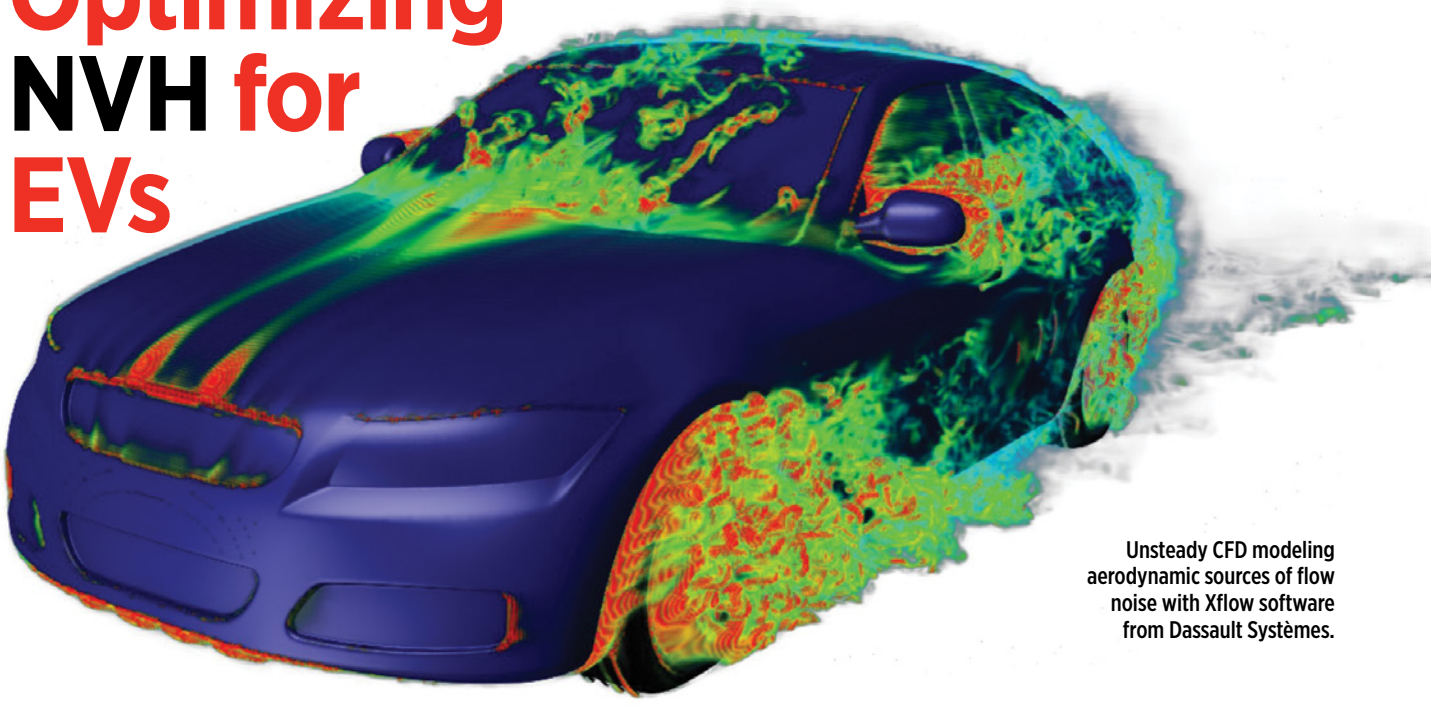


Unsteady CFD modeling aerodynamic sources of flow noise with Xflow software from Dassault Systèmes.

Unique acoustic and harmonic challenges require an integrated approach to simulation and analysis. An expert at Adaptive Corp. explains.

by Lindsay Brooke

Despite global sales market share stuck at single-digit levels, electric vehicles (EVs) are steadily filling the development pipelines at major OEMs. And as engineers are acutely aware, EVs bring a paradigm shift in the noise, vibration and harshness (NVH) arena. Their harmonic spectra are dramatically different than those of even the smoothest, most refined combustion-engine vehicles and hybrids.

EVs are anything but silent, however. They've got their own acoustic challenges, experts assert. Traction motors can be relatively quiet (in terms of tonal harmonic noise) in the low and mid frequencies, but unmasked gear whine and various sounds in the propulsion system are far more noticeable and potentially annoying. There's also the relative cacophony of tire noise, HVAC fans and compressor cycling. Even electrical switching and the muffled gurgle of battery coolant can be heard in some EVs while at rest.

While the industry is likely years away from customers complaining of EV cabin noise, leading practitioners in the NVH-reduction field are already working on up-front solutions. One of them is **Adaptive Corp.**, a specialist in simulation, structural analysis and product lifecycle management for automotive, aerospace and other industries. Optimizing designs for improved performance (including NVH, weight, cost, durability) is Adaptive's specialty, according to customers with whom *Automotive Engineering* spoke. The NVH science behind EVs and hybrids is increasingly a focus of Adaptive's services, explained Wayne Tanner, the company's chief operating officer.

"It's true that we have to 'up our game' with EVs," Tanner told *AE*. "We're hearing this from all our customers who are in the EV supply chain, such as those who make tires and suppliers of motors. We're looking at components and subsystems that were never before considered to make the vehicle quieter."

Easing the development crunch

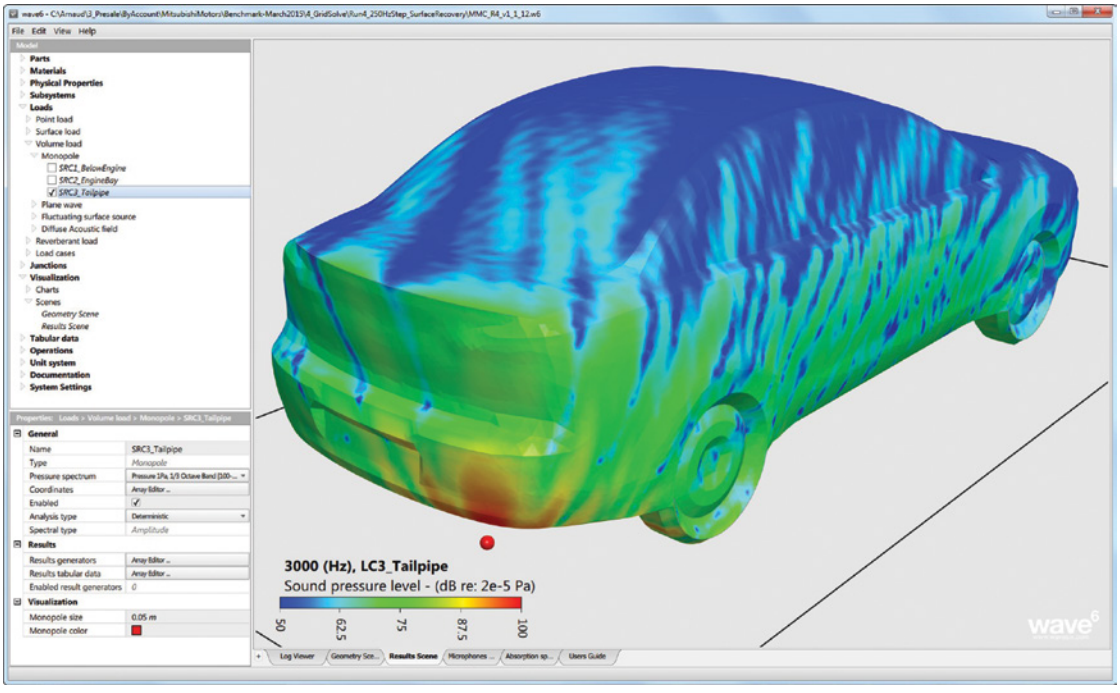
The industry's move to electric propulsion is driving new business across the engineering-solutions sector. Tanner, who is responsible for all his company's activities related to simulation and analysis, notes that the industry trend is toward clean-sheet vehicle platforms dedicated to battery-electric propulsion. OEMs such as Tesla and Volkswagen – the latter's dedicated and modular MEB platform to be shared by Ford on some models – are committed to this strategy that optimizes structural stiffness (with its related NVH benefits) and other attributes.

"The time-to-market is increasingly short, which is why product-development teams need simulation to do their fast, quick iterations," Tanner said, "and to make accurate predictions before they build prototypes and test vehicles."

The aim is to avoid the dramatic and often eleventh-hour 'band-aiding' of vehicle structures. Such activities include costly material replacements and noise-path mitigation by adding heavy NVH countermeasures, in order to meet production deadlines. "That's certainly something that we can help with if we're brought into the development process sooner, farther upstream," Tanner noted. Engineers sometimes don't think of components and subsystems as a system until they're actually put together, he observed.

"Some customers, because they're moving so fast, can't find time to do a simulation up front — then they discover the need for add-on countermeasures at a late hour," he said.

BOTH IMAGES: ADAPTIVE CORP.



Vibroacoustics and flow-noise full-spectrum analysis methods in Dassault's Wave6 software.

The aim is to avoid the dramatic and often 11th-hour 'band-aiding' of vehicle structures to mitigate NVH.

Tanner has worked in simulation for over 20 years in various disciplines including design optimization, load development, weld fatigue and dynamics. He and other NVH experts assert that the sooner system-level and full-vehicle models can be developed in any vehicle program, the more effectively predictions can actually improve those designs to reduce NVH, rather than being band-aids in the end.

Inside the toolbox

For its simulation platform, Adaptive partners with **Dassault Systèmes**, whose 3DExperience is rated by users as state of the art in comprehensive NVH simulation toolsets. "The advantage of [3DExperience] is, it gives us a single data model that can contain CAD and simulation data," Tanner said. "We connect that to systems engineering to drive requirements all the way from start to finish, to manage the workflow. Some of the tools we have at our disposal aren't fully integrated into the platform, but we're able to put everything together and manage that data. This allows our customers to access a single data source."

Tanner offered a peek inside Adaptive's extensive sim toolbox. On the aerodynamics/CFD side is PowerFLOW; on the acoustics side is another Dassault tool called Wave6 that's used to project an acoustic signature. On the mechanical side, Adaptive engineers use Simpack, which helps them develop all the mechanical vibrations needed for a given analysis. There are also electromagnetic tools.

"We connect all these tools into a single workflow — to drive mechanical and/or aerodynamic vibrations into the acoustic field, for example — on the 3DExperience platform," he said.. Once an OEM is ready to begin road and/or dynamometer testing, they employ Adaptive to validate and correlate from the company's virtual models into production models.

Another weapon in the arsenal is True-Load from **Wolfstar Technologies**. It leverages finite-element models to determine the optimum location for strain gauges on unmodified physical parts and then generates load-scaling functions. The company claims typical strain correlation within 2% of measured values. Output feeds directly into True-QSE events, described by Tanner as "a powerful post processing tool" that supports rapid virtual iteration.

"It allows us to take that test mule and put information-gathering tools on it, whether it be strain gauges or accelerometers, capture real-time load and vibration data from that system, and correlate it to our FE models," Tanner explained. "We use that to drive our simulation — and to predict more that may happen."

NVH simulation and analysis is "at the beginning of the power of what we can do," Tanner said. "The tools are becoming more interconnected and fully integrated, allowing us to run seamlessly from CAD to simulation to structural analysis to acoustics to vibration. The workflow is increasingly faster, enabling us to run multiple simulations in a single day. It used to take weeks." ■

The new gas tank:

Constellium readies its first OEM EV battery tray

Global Tier-1 aluminum specialist Constellium's first OEM EV battery enclosure is a far cry, engineering-wise, from the century-old fuel tank.

by Paul Seredynski

CAD illustration of the Constellium battery enclosure shows internal structure design details. Note the pack partitions, use of extrusions and sheet, and the joining solutions.

The "gas tank" is about to get a lot more sophisticated. Electric vehicle (EV) battery trays are highly-engineered components that barely existed a few years ago but play a wide role in an EV's safety, rigidity and weight – and therefore efficiency. They also need to be watertight. The enclosures typically reside within an EV's wheelbase and often serve double duty as the vehicle's underbelly, housing the complement of batteries, control and monitoring electronics along with cooling and high-voltage circuits.

Constellium, the Netherlands-based global Tier-1 supplier and aluminum specialist, recently invited *Automotive Engineering* to visit with the project lead on its first OEM battery tray, a 2.5 m x 1.4 m (8.2 ft x 4.6 ft) structure weighing approximately 70 kg (154 lb). Comprising aluminum castings, extrusions and sheet, the tray will house a 100 kWh battery pack for a soon-to-be-announced EV.

Known for its aluminum expertise in engineered extrusions for crash-management systems, as well as structural components for high-volume vehicles such as the **Ford** F-150 and **Tesla** Model 3, the project is Constellium's first fully engineered battery enclosure.

"We do currently supply certain components for battery enclosures," Alex Graf, director of development for automotive structures – electric vehicles, said during an interview at Constellium's offices in Livonia, Michigan. "But we have a full battery enclosure coming into production in the next six months with an OEM and the design was done by a team collocated at the OEM.

"Our task was to seriously and severely modify their existing design to make it manufacturable and come into target for pricing and performance."

Lightweighting, for volume

Constellium's long expertise with aluminum should see it involved in more EV projects, as the substance's strength-to-mass and stiffness-to-mass ratios factor well into the EV's efficiency equation.

"Now that we have exhausted most of the bumper reinforcements being in aluminum, we are going to more-complex structures that can save weight without having to go to a full-aluminum body," Graf explained. "Things that can be purchased outside at a significant mass reduction without having to retool a body shop. The figures for growth are quite staggering and I think the industry may be extrusion supply-constrained if we are not careful."

An EV battery enclosure is a prime, bolt-on lightweighting opportunity. In general, aluminum boxes will have a 30-to-40% advantage versus steel in terms of weight. "When you look at a battery enclosure, it's 70 to 80 kilos, and 30 to 40% makes a big difference," Graf said. "So battery enclosures are one chunk of a bolt-on structure that can be outsourced from the OEM to suppliers like us."

Mass reduction not only improves EV range and performance, it is also becoming part of the regulatory landscape.

"We are monitoring the Chinese regulatory system. They have an incentive for range, but there is [also] an incentive for kilowatt hours per kilometer. That is basically a button to push the technology, because you can just fill the trunk with batteries and you're going to get the range."

The kilowatt-hours-per-kilometer component "rewards the efficiency of the overall system, and mass plays a big role. And importantly, the battery pack contributes to the global stiffness of the car,"

CONSTELLIUM

Graf explained. "They're 120 millimeters tall and an expensive comodity compared to other materials. So you want to put every gram of it to work every moment." Beyond positioning batteries, another key functional aspect is safety.

"One function we need to take into account is intrusion, managing of damage from the bottom, which is purely penetration, a ballistic-type of approach," Graf said. "The other is side crash, which is a combination of what does the car structure do versus what is the battery box contribution to the overall crash deformation? The goal is to limit the damage to the battery box... not to cut the cooling line, not to cut the high voltage line and not, of course, intrude on a module itself."

Graf, whose education includes degrees in mechanical engineering and a Ph.D in materials, has worked for the Dutch concern for more than 20 years. He described his role on the OEM battery tray project as a "traffic director," with overview of the over-three-years project and directing or pulling resources from where they were most needed. He noted Constellium's extensive experience in aluminum as one of the real advantages for their OEM clients.

"It helps on the alloy selection. It helps on the shape selection. Because shape means how easy or complicated it will be to push an extrusion," Graf said. "How easy or complicated it will be to push means how tight or wide your manufacturing tolerances of that extrusion are going to be. There is always a balance between how complex you want to make a component to integrate the most functions, versus will you get someone to make it consistently the way you want it?"

Making it waterproof

Most design engineers come from the structural world and focus on making things strong, durable and stiff. "But then when you put the things together, they leak," Graf asserted. EV battery enclosures must be IP66 rated, which equates to submersing the enclosure in one meter of water for 30 minutes, with less than 3 cc of water incursion.

"We had to develop testing techniques for the leak-proofness of fasteners, of rivets, of rivnuts. Anything that has to do with leak-proofness, we manufacture," Graf said. "Even though it would be much easier to have a supplier put in that fastener – because it would save one station and two or three guys in our plant – we want to do it because we want to control all those things that contribute."

The new gas tank:

Constellium readies its first OEM EV battery tray

Technologies used by Constellium in its new EV battery enclosure projects include unique "CALD" ribbed thermal-management channels that can improve stiffness while hosting a phase-change cooling material.

Alex Graf, director of development for automotive structures – electric vehicles, details the battery tray construction at Constellium's Livonia facility.

A nice engineering problem

Graf noted that the world of EVs and the creation of new components such as battery trays was an opportunity and new challenge to apply expertise.

"We got to a point that we could engineer a crash-management system in under two weeks," he explained. "The OEM gives us the design package – location of the rails, barrier heights – and two weeks after, we have a design. Weight, cost, everything."

"On a battery enclosure, you really have to work at engineering to solve all the little problems, because not all the boxes are the same," Graf said. "We needed a lot of CAE, a lot of material design, a lot of local simulations and a lot of testing to optimize material performance.

"This is one of the most advanced pieces of engineering that I've ever worked on for the company," he noted with satisfaction. "It's a very nice engineering problem." ■

FROM TOP: CONSTELLIUM; PAUL SEREDYNSKI

SAE Eye on Engineering: Scooter trash

Personal-mobility electric scooters have appeared seemingly everywhere—and are dumped just about anywhere when their riders are finished with the journey. The situation has become an at-times comical allegory for some of the unintended consequences new-age mobility may bring, and in this episode of *Eye on Engineering*, Editor-in-Chief Lindsay Brooke looks at electric-scooter clutter—and who is—or should be—responsible for the cleanup.

This segment of *SAE Eye on Engineering* can be viewed at: **www.sae.org/news/video/content/12454/**. The series also airs Monday mornings on radio WJR 760 AM Detroit's Paul W. Smith Show. Access other episodes of *SAE Eye on Engineering* at **www.sae.org/news/video**.

Fuel-cell nanoparticle clusters may cut fuel-cell costs

Fuel-cell technology is a big subject with some small-but-vital aspects, one of which is the size of atomic platinum clusters. Reduce these and the required amount of platinum (one of the major cost drawbacks of current transportation-market fuel-cell systems) would also fall. An interdisciplinary research team at the Technical University of Munich (TUM) has just detailed in a report of successfully modeling size-optimized catalysts that are twice as good as the best pure-platinum catalysts commercially available today.

"In fuel cells, hydrogen reacts with oxygen to create water, generating electricity in the process," explained TUM's Roland Fischer, professor of inforganic and organometallic chemistry. "Sophisticated catalysts at the electrodes are required in order to optimize this conversion and platinum plays a central role in the oxygen-reduction reaction." The TUM team members were looking to answer how small a cluster of platinum atoms can be and still have a highly active catalytic effect.

Read the full story at: **www.sae.org/news/2019/09/fuel-cell-nanocatalysts-boosting-efficiency**.

AB Dynamics supports PEGASUS test of multiple autonomous-vehicle control

Test systems supplier AB Dynamics announced it will support PEGASUS, Germany's new testing procedure for automated vehicles (AV). PEGASUS has been established to standardize complex and synchronized AV testing scenarios, and involves OEMs/suppliers including BMW, Daimler, Opel, VW, Bosch and Continental. TÜV SÜD, a global technical-services supplier, will be responsible for the physical proving-ground tests.

AB Dynamics will provide technology to repeatably and accurately control multiple vehicles to ensure consistent and actionable test results. Specifically, it is applying its Flex-O by-wire control-path following for active guidance, and its synchronization system for targets and test vehicles. Additionally, AB Dynamics' driving robots, guided soft targets (GST) and LaunchPad platform will be used to create realistic testing scenarios.

These tools "bring test scenarios to life," said Andrew Pick, the company's track test systems business director. "Testing autonomous functionality necessitates highly complex traffic scenarios involving multiple vehicles that are positioned accurately," Pick explained, "the movements of which must be perfectly synchronized, otherwise the significance of data from repeated tests is severely diminished."

Read the full story at: **www.sae.org/news/2019/08/ab-dynamics-joins-germany's-pegasus-av-testing-project**.

PRODUCT BRIEFS

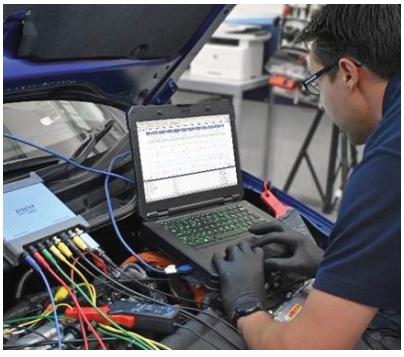
SPOTLIGHT: DATA-ACQUISITION TOOLS

DAQ module with CAN FD

HBM's (Marlborough, Mass.) new MX471C module with CAN FD (CAN with flexible data-rate) protocol expands its range of data-acquisition modules. The MX471 CAN FD module is part of the industry standard's QuantumX family, providing engineers with universal and flexible solutions for integrating data-acquisition systems into CANbus networks. CAN FD solves the bandwidth limitation problem of classical CAN networks by allowing bit-rates higher than 1 Mbit/s. In addition, it supports payloads in CAN FD messages up to 64 bytes. Many automotive companies make use of this increased bandwidth at low cost, which is especially required in today's electric vehicles. The MX471 CAN FD module allows the synchronous integration of up to four CAN networks and can be expanded as required. The module, combined with a data recorder and analog measurement modules, is suitable for mobile vehicle tests and as a measurement gateway in test benches.

For more information, visit http://info.hotims.com/73009-400

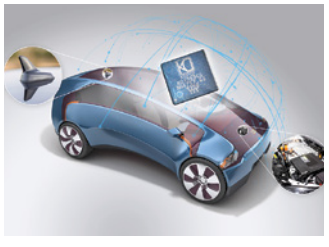
8-channel oscilloscope



An oscilloscope for the expert user with complex problems to diagnose, the PicoScope 4823 is **Pico Technology**'s (St. Neots, United Kingdom) first 8-channel oscilloscope for the automotive market. It is suitable for those involved in advanced diagnostics, training or vehicle design. The PicoScope 4823's 8 channels allow multiple sensors, actuators and CAN/CAN FD signals to be monitored at the same time at up to 80 MS/s. It is ready-configured for automotive probes and includes more than 150 guided tests, plus access to thousands of comparisons in the Pico waveform library. The 4823 inputs have common grounds protected by self-resetting fuses; this offers less input protection than the floating input design of the 2 and 4 channel 4225/4425 PicoScopes, but by sharing grounds it makes connecting its 8 channels quicker.

For more information, visit http://info.hotims.com/73009-401

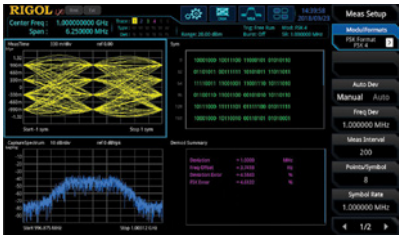
Optical connectivity with galvanic isolation



KDPOF's (Madrid, Spain) first application of a battery-management system (BMS) based on optical connectivity is slated for production. The company announced that by the end of 2019, the first carmaker will start assembly of a BMS with POF (plastic optical fibers) connectivity. Due to its inherent galvanic isolation, KDPOF says POF solves the electrical and interference challenges of new powertrain architectures for electric and autonomous driving. In BMS, galvanic isolation is necessary between primary and secondary systems due to hazardous high voltages and noise isolation. Further applications that rely on the inherent eclectromagnetic compatibility (EMC) of POF are Integrated Smart Antenna (ISA) modules. For ISA, KDPOF and ALPS have developed a concept for an LTE-A telematics control module with POF links to the central communications hub in order to avoid interference with the smart antenna receivers.

For more information, visit http://info.hotims.com/73009-402

Vector signal analysis



An addition to its UltraReal family of real-time spectrum analyzers, **RIGOL Technologies** (Beaverton, Ore.) offers the new integrated vector signal analyzer (VSA) application mode for complex signal analysis. The VSA measurement application allows radio frequency (RF) engineers to characterize most of today's complex RF modulation schemes including QAM (quadrature amplitude modulation) and QPSK (quadrature phase shift keying) as well as ASK (amplitude shift keying), MSK (minimum shift keying) and FSK (frequency shift keying) signals. The VSA application gives engineers ability to use up to 13 integrated measurement functions including I/Q waveform and RF envelope, constellation and vector diagrams, symbol level decode, time and frequency, and bit error analysis against known sequences, providing quick insight into signal behaviors.

For more information, visit http://info.hotims.com/73009-403

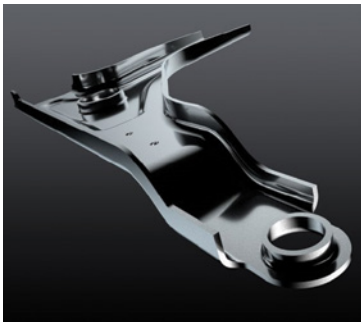
SPOTLIGHT: METALS

Amorphous metals

Zirconium-based and copper-based alloys for large-scale applications are currently available in the Amloy product line, with alloys based on titanium, iron and platinum also in the works. With this variety of materials, **Heraeus** (Yardley, Pa.) and **ENGEL** (Schwertberg, Austria) cover a range of new applications. The list includes portable electronic devices, durable instruments for minimally invasive surgery, stable suspension and wear-resistant drivetrain components for the aerospace industry, premium decor elements for vehicles and abrasion-resistant watch components. Based on its proven hydraulic and tie-bar-less victory range, ENGEL says it has developed a new injection molding machine for processing amorphous metals from Heraeus' Amloy product range. The ENGEL victory amorphous metal molding (AMM) delivers fit-for-purpose parts with a premium-quality surface finish within very short cycle times.

For more information, visit http://info.hotims.com/73009-404

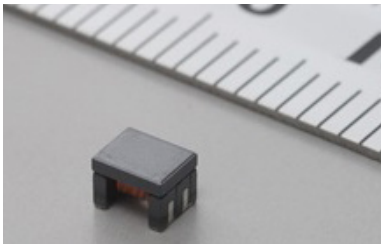
Certified AHSS range



SSAB's (Lisle, Ill.) hot and cold rolled range of Docol automotive steel has been approved for certification by the **Bureau of Indian Standards** (BIS). To support local industries in a fast-growing Indian economy, the national Standards Body of India created the BIS certification in 2016. For Indian OEMs and Tier 1 suppliers, this means easy access to steel grades needed for creating lighter and safer cars. Since many advanced high strength steel grades, including Docol, were subjected to the new regulations, SSAB applied for the BIS certification to ensure business continuity. Following audit by BIS inspectors and testing conducted to verify the composition, quality and consistency of both hot and cold rolled grades of Docol steel, SSAB was awarded a BIS certification for the entire Docol steel product portfolio for the Borlänge production facility.

For more information, visit http://info.hotims.com/73009-405

Common mode choke coil



Technologies that control basic automobile behavior are advancing rapidly, with the goal of providing safer and more comfortable driving. In keeping with this market demand, faster automotive networks are required for connecting ECUs, sensors and motors, with the result that conventional CAN is being replaced with the faster CAN FD. **Murata Manufacturing** Co., Ltd.'s (Nagaokakyo-shi, Japan) new wire-wound common mode choke coil (CMCC) DLW32SH101XF2 is the world's first CMCC to support DCMR 2 Class 3, according to the company. Murata Manufacturing claims DLW32SH101XF2 fulfills the IEC62228-3 requirement for use in CAN FD next-generation automotive networks. The device draws on Murata's CMCC design and manufacturing knowledge to deliver the high performance and reliability required for CMCCs used in CAN FD networks while realizing a small size, thanks to the company's unique wire-wound structure.

For more information, visit http://info.hotims.com/73009-406

2/2-way coolant valve

Pierburg GmbH (Neckarsulm, Germany), a part of **Rheinmetall Automotive** AG, has developed a 2/2-way coolant valve. The hallmark of these new coolant valves is that they will be used both in vehicles with conventional combustion engines and in battery-powered vehicles. The company has received its first major European order from a German premium car manufacturer. The valves developed and produced at Pierburg's Neuss site will go into series production in a customer's vehicles beginning in 2021. Pierburg will supply valves for a complete engine series of this OEM including 3-, 4- and 6-cylinder gasoline engines where the valve will control the coolant flow to the degas bottle and to the transmission. With the development of the new valve, Pierburg has a comprehensive modular coolant valve system that includes both 3/2-way and 2/2-way valves with various flow rates in both currentless open or closed design.

For more information, visit http://info.hotims.com/73009-407

WEBINARS

LEVERAGING ADVANCED MANUFACTURING TECHNOLOGIES FOR AUTOMOTIVE LIGHTWEIGHTING

Tuesday, October 22, 2019 at 11:00 am U.S. EDT

Advanced manufacturing technologies have unlocked new levels of performance and personalization in the automotive industry. In this Webinar, an application expert will demonstrate how geometry can be leveraged for competitive advantage and highlight two key automotive case studies live: lightweighting of structural components, and rapid design iterations for the personalization of aesthetic components.

Speaker:

Jonathan Harris, Ph.D.
Lead Application Engineer, nTopology

Sponsored by: nTopology

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For additional details and to register visit: www.sae.org/webcasts

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HOW TO MAKE SURE MORE ELECTRONICS IN AUTONOMOUS VEHICLES WON'T MEAN MORE PROBLEMS

Wednesday, October 23, 2019 at 12:00 pm U.S. EDT

It's expected that self-driving cars will see a massive increase in the amount of electronics used. As a result, virtual testing of the components' electro-magnetic interference and compliance (EMI/EMC) and signal and power integrity is increasingly critical to ensure the safe operations of these autonomous systems. In this Webinar, you will learn how simulation software with embedded CST technology helps solve these challenges.

Speakers:

Matthias Troescher
Business Development Executive, DS SIMULIA, Dassault Systèmes

Fabien Letailleur
Director, SIMULIA Transportation & Mobility Strategic Initiatives, Dassault Systèmes

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WEBINARS

NVH SIMULATION FOR ELECTRIC/ CONNECTED-VEHICLE DEVELOPMENT AND ANALYSIS

Thursday, October 24, 2019 at 12:00 pm U.S. EDT

With vehicle electrification expanding, there is less noise coming from the driveline. Electrification creates quieter vehicles, and quieter vehicles require more attention to noise, vibration, and harshness (NVH) attenuation. This Technical Webinar from the editors of SAE International focuses on the latest trends in simulation to reduce NVH for vehicles with advanced propulsion.

Speakers:

Zouhair Lazreq
Director and Technical Fellow, Dana Inc.

Darshan Mehta
Product Manager, Automotive Solutions Group, Tektronix

Sponsored by: PCB PIEZOTRONICS, MTS SYSTEMS CORPORATION; Tektronix; CRYSTAL — A clear advantage.

Hosted by: SAE INTERNATIONAL

For additional details and to register visit: www.sae.org/webcasts

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EFFECTIVE EV THERMAL MANAGEMENT FOR DRIVE RANGE PERFORMANCE

Available On Demand

We continue to see an increase in the electrification of vehicles, with nearly all OEMs pledging to release either an electric or partially electric vehicle in the next few years. In this presentation we will be evaluating thermal and e-powertrain systems and their effect on electric vehicle drive range.

Speakers:

John Wanjiku
Mentor Infolytica, A Siemens Business

Doug Kolak
Simcenter Flomaster Product Specialist, Mentor, A Siemens Business

Sponsored by: Mentor, A Siemens Business

Hosted by: SAE INTERNATIONAL

For additional details and to register visit: www.sae.org/webcasts

READER FEEDBACK

Inside the 2020 Corvette

Good coverage of the all-new mid-engine 2020 Corvette in the September *Automotive Engineering*. Don Sherman probably knows more about GM's sports car than anyone covering the performance-car scene today. More, more, more, please!

Mike Taylor
Waterloo, Ontario

Very cool cover shot of the new Vette and thanks to the SAE for an informative article on this "Everyman's Supercar." I've got mine ordered!

Adi Gilbert
Los Angeles

The ICE's Not Dead Yet

RE: "Extending the ICE Age" (August 2019): It was heartening to read about a *future* for the internal combustion engine in a media world dominated in recent months by talk of electric and hydrogen-powered vehicles.

There are many potential routes to improved ICE efficiency, including architecture changes like the Achates opposed-piston system, as well as various kinds of pre-mixed, compression ignition combustion systems. The fact that new combustion systems may well offer processes that reduce radiant and convective heat transfer to the cylinder walls while accelerating energy release and reducing emissions, combined with the potential for use of biofuels, encourage us to continue to develop ICEs.

As technical director of a small venture developing a diesel-fueled stratified-charge-compression-ignition concept, I know that there are many potential combustion systems likely to come down the pike. These will make the ICE much greener than we ever thought possible.

John Baxter
Advance Diesel Concepts
Berwyn, Pennsylvania

Scootermageddon!

Regarding SAE's work in micromobility, I was recently in San Diego's Gas Lamp District and I tried out both Bird and Lime scooters. I learned a lot about them, by observing and riding. The best info came from a guy who I saw loading up scooters very selectively. He explained that the scooter companies pay people like him to repair the scooters if needed, charge them, and return them to specific locations. He can only take ones that need a charge, and his version of the app located them for him.

He returns them to specific staging areas. That's why, at night, they are scattered all over but in the morning, they were lined up on neat rows every few blocks. This particular guy was really making out because he was charging the bikes at his grandma's apartment where she does not pay the electric bill. Not a sustainable business model!

What is important is usage enforcement and safety. In San Diego, I observed violations of almost every rule as I was watching the app that outlined all the rules, including:

- Wear a helmet. Of the dozens of scooters in use in San Diego, not one rider I saw was wearing a helmet;
- Ride solo. Just as I read this rule, a guy rode by with his girlfriend on the same scooter;
- Use restricted to age 16 and older. I read this just after seeing a mom using her phone to unlock a scooter her kid was on;
- Obey local rules about street and sidewalk. People were riding on both the street and the sidewalk, while a police car sitting at the corner was yielding to both.

Maybe he didn't even know his own city's rules!

This is a case of consumer needs being met so quickly that government does not know how to react. Transportation is fascinating right now and it's great to observe everything going on.

Neil Hannemann

The writer is an automotive forensics expert and former development engineer on the Dodge Viper, chief engineer on the 2005 Ford GT and executive director of engineering at McLaren Motorcars.

READERS: Let us know what you think about *Automotive Engineering* magazine. Email the Editor at Lindsay.Brooke@sae.org. We appreciate your comments and reserve the right to edit for brevity.

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Q&A

Magna prepared for AV "marathon"

Swamy Kotagiri is **Magna**'s chief technology officer and head of the company's Power & Vision segment. *Automotive Engineering* contributor Sebastian Blanco spoke with him at the 2019 opening of Magna Electronics' new manufacturing facility near Holly, Michigan. There, the company will be consolidating production lines to make and fully test around 12 million automotive-grade cameras a year. Some highlights of our conversation:

What are Magna engineers working on now that you can talk about?

The big play is on the [SAE] Level 1, 2, and 3 autonomous driving. We have a great foundation for the vision systems, whether it's surround view or front-facing or rear-facing cameras. Euro NCAP is kind of forcing a lot of features into the front-facing camera, like AEB [automatic emergency braking]. We have lidar, which we publicly talked about going into production with BMW. So, if you look at different levels of cameras, the digital-imaging Icon radar and lidar and the software associated with it, we have what it takes to provide all the features from Levels 1, 2 and 3.

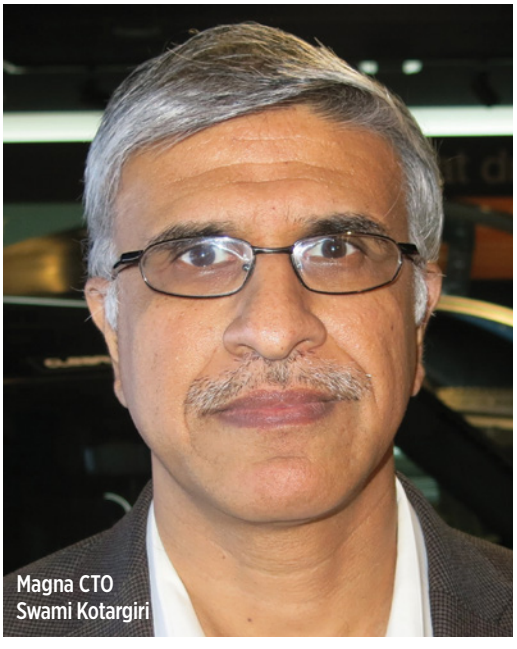
We have the partnership with Lyft and continue to work with them on a Level 4 and Level 5 AV stack. We jointly own the IP and we could use that to proliferate in the auto industry or for the uses that we see fit. With that, I think we broadly cover all the necessary building blocks for AVs. What is more important right now is to see how you can play a role and be sustainable for a long period of time. It's a marathon, not a sprint.

As you look at what to focus on, are you talking with regulators?

When we did the rear-view visibility system, which is kind of important to this facility and our history, we participated in all the discussions, whether it's with regulators or SAE panels or others. And we continue to do that today. What's different compared to 20 years ago with airbags or restraint systems is that safety drove things then. In this case, I think consumers are starting to "pull," based on comfort and convenience.

Do customers have realistic expectations for what AVs can do today?

Like any other technology, once you start having it in commercial scale, it's an iterative process. When we started having lane-departure warning systems, people got used to the vibrations in the seat or the haptic feedback. For example, I'm still used to looking in the mirror when I reverse the car, but the next generation won't. They're comfortable with the camera because that's what they started with. I think that transition is going to be extremely important for AVs.



Magna CTO Swami Kotargiri

If you look at different levels of cameras, the digital-imaging Icon radar and lidar and the software associated with it, we have what it takes to provide all the features from [SAE driving] Levels 1, 2 and 3.

How far ahead does Magna look when you come up with new products?

If you look back into the history of cell phones, you used to have cross-channel interference. You could hear someone else talking on the line because the usage grew beyond a certain point that they hadn't expected. Today, radars might not be in that many vehicles, but imagine in the future when we're going to have hundreds of thousands of vehicles with radar in them — how can we have something that doesn't have this interference? So, we said we've got to get from analog to digital, and that's how we ended up with the Icon Radar.

What will it take to get from today's SAE Level 2 AV technology to something more futuristic?

When you talk of AVs that are completely autonomous, you're taking about a business model where there might not be personal ownership. With something that can get you from Point A to Point B, without a driver, the economics are very different. I think it will start in more constrained geofenced areas — where you can have a lot of miles driven but not as many vehicles, maybe. I think that's where you take the first step, going from there to full autonomy. I think full autonomy is still a long way off. ■

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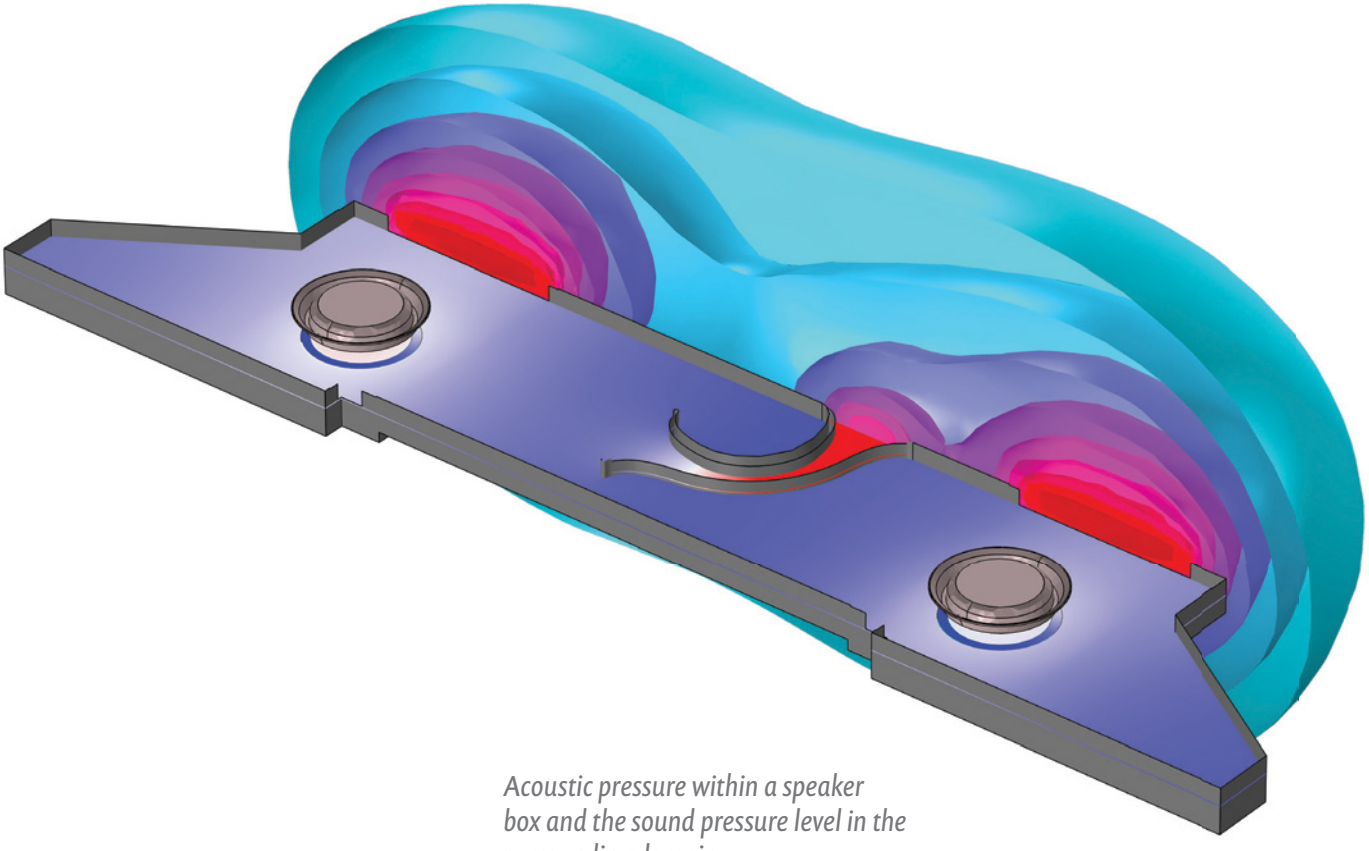

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