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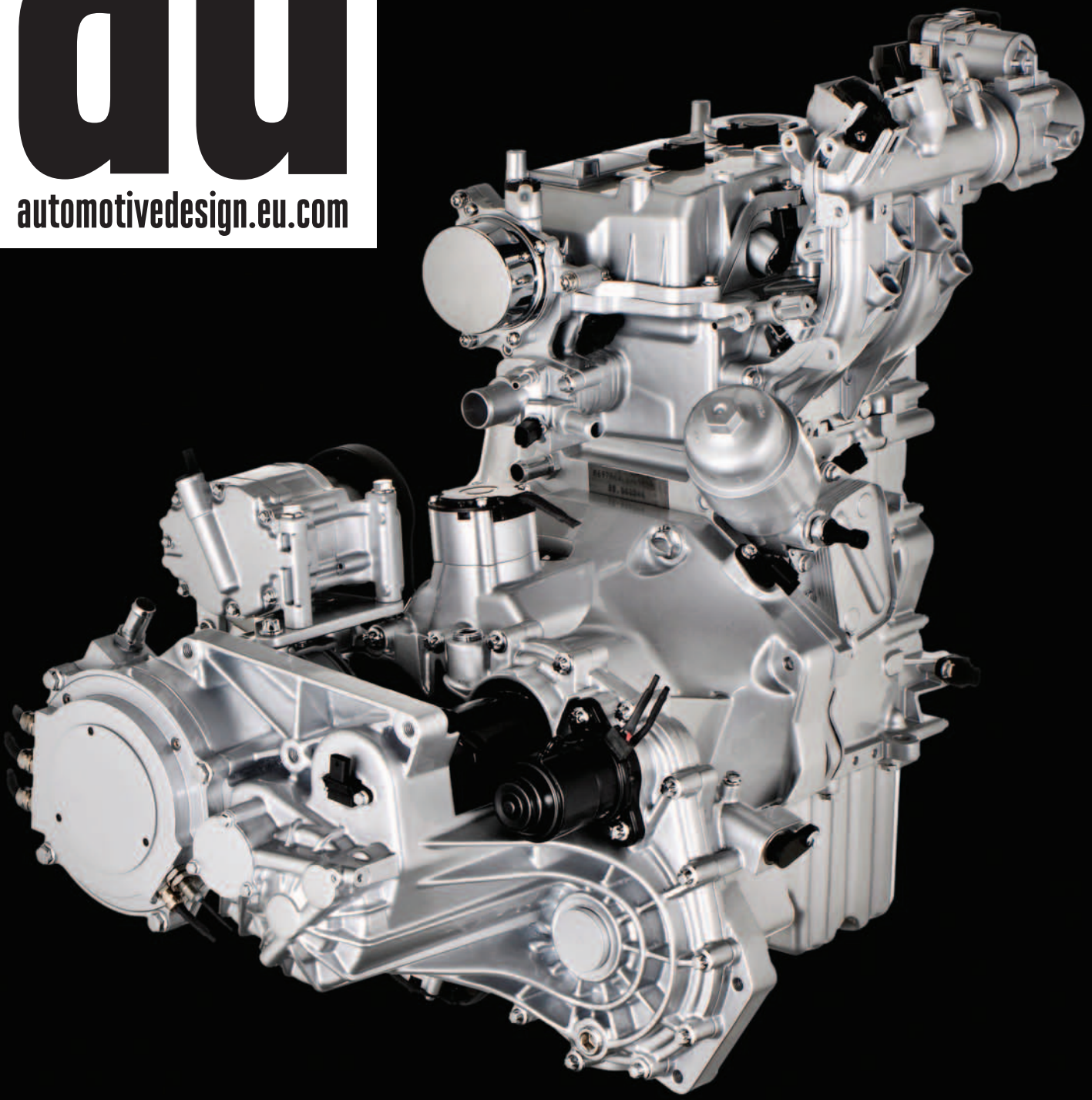
■ Embedded security

■ Plastic glazing

■ Concept car review



Transmissions transform quest for fuel economy

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Concept Cars

Concept cars serve many purposes. Vehicle manufacturers can use them to gauge public opinion of a new model or even unveil an entirely new design philosophy. At their most effective, they push forward the boundaries of manufacturing and production techniques. Here, we take a look at what makes a winner and where the concept car is likely to take us in the immediate future.

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American potential for Europe's suppliers

The Detroit Auto Show might have been awash with electric cars and hybrids, but what motor show isn't these days? However, it was Ford's press conference in Cobo arena that struck me as being one of the most potentially significant events of the show.

Ford uses this event as much as anything to rally the home troops, as well as showcase new products to the gathered media.

This year's conference was significant, in that all the products displayed were European, as it was the global launch of Ford's new C-car platform, underlining Alan Mulally's One Ford strategy.

In two decades of attending Detroit, it was the first time I can recall one of the Big Three not having some domestic product on show at its main press conference. Ford reserved its truck updates to a stand reveal on the second day.

European C-sized cars are now "very close" to domestic US product in size, Ford's global vice president marketing Jim Farley told me, adding that the C-sector will account for 30% of US sales in the coming year.

Ford's announcement, together with VW previewing its US-specification Passat, the first in a slew of new products that will push the marque to a million US sales annually by 2018, underlines two things: the global appeal and strength of European design, engineering and supply; and, secondly, how important the US market continues to be, in terms of sales for European OEMs and their supply chains.

China, in the long run, will turn out to be the dominant market. But, until then, the American Big Three, plus European, Japanese and, increasingly important, Korean transplants in North America will prove fertile grounds for the European supply sector.

Ian Adcock, Editor in Chief

Vehicle platooning demonstrated for first time

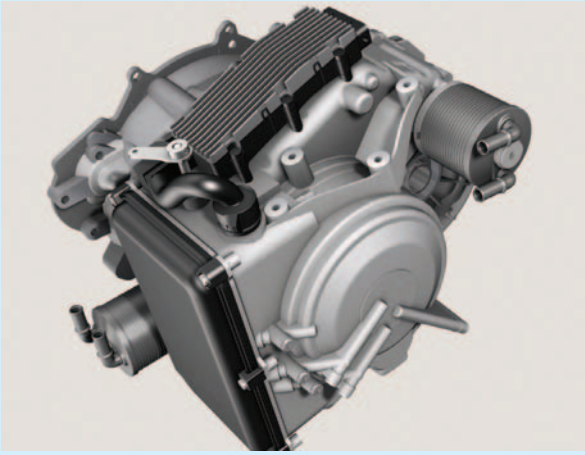
The first demonstration of the EU-funded Safe Road Trains for the Environment (SARTRE) project has taken place at Volvo's proving ground near Gothenburg, Sweden.

SARTRE is led by Ricardo UK, and comprises collaboration between Idiada and Robotiker-Tecnalia of Spain, Institut für Kraftfahrwesen Aachen (IKA) of Germany, and SP Technical Research Institute of Sweden, Volvo Car Corporation and Volvo Technology of Sweden.

Its aim is to develop technologies that will allow platoons of vehicles, led by a professional driver in a truck or bus, to convoy streams of other road users at a constant speed and distance between each vehicle. The vehicles would be automatically steered, braked and accelerated by the lead vehicle, and be able to stream in and out of the platoon at will.

Platooning is designed to improve road safety, as it minimises the human factor that is the cause of at least 80% of road accidents. Secondly, it saves fuel consumption and CO_2 emissions by up to 20%.

Gaining public acceptance, and the introduction of legislation across 25 EU governments, is likely to prove as big a stumbling block as developing the technology.



ZF has announced that its new nine-speed automatic transmission for transverse engines will be assembled at a new manufacturing facility in South Carolina, USA.

Compared to conventional 6-speed automatic transmissions for front-drive platforms, ZF's new 9-speed automatic transmission enhances driving performance and fuel economy. An advanced shock absorber system in the torque converter allows rapid lock-up of the converter clutch, enabling greater fuel economy and lower carbon dioxide emissions.

Similar to ZF's 8-speed automatic transmission used in rear-drive platforms, the new 9-speed delivers short response and shifting times that are below the threshold of perception. That means double shifts and direct multiple gearshifts occur without the driver or passenger noticing.

Sophisticated electronic controls select the right gear for the driving conditions, eliminating unnecessary 'stepping' – or constant shifting.

Rig hones steering 'feel'

Ford has used a new steering test rig at its Lommel test facility in Belgium to help hone the steering 'feel' of its new electronically assisted power steering system (EPAS), which debuts on the new Focus chassis. The rig, a Steering System Test Machine made by Anthony Best Dynamics of Bradford on Avon, Wiltshire, applies computer-controlled force and displacement inputs to the steering rack through the tie rods, and measures responses. Typical tests include steering feel, nibble, compliance, catch-up, self-centring, rack forces, on-centre loads and parking efforts.

It has been especially useful for Ford in developing its EPAS, which has been a decade in development, with early examples deemed "not mature enough" for introduction in the previous 2004 Focus update, according to Jürgen Puetzcschler, an engineering supervisor for the C-car chassis dynamics.

With 253 separately adjustable parameters to measure in the steering controller motor, setting the base line data for the rig has been an enormous task. "At first, we just changed stuff to see how the behaviour of the steering improved," says Norbert Kessing, engineering manager of vehicle dynamics. "At the same time, we were feeding data from the tuned steering in the car to see what worked."

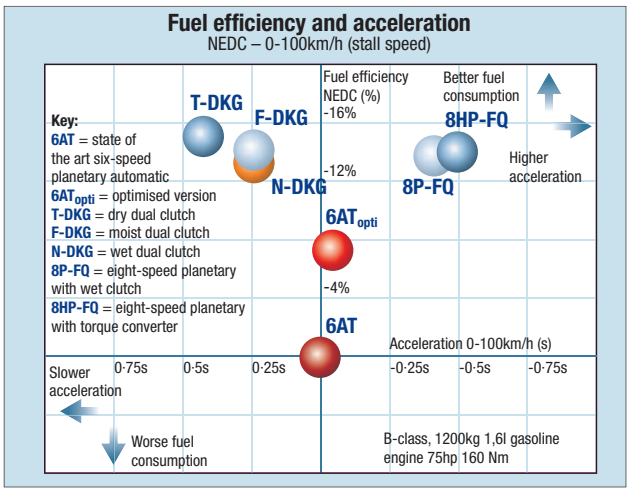
The painstaking build-up of knowledge has allowed Ford to develop its steering, while retaining that expertise for future projects. "With so many parameters, we could never have got to develop steering 'feel' without the rig," states Kessing.

The twin-pinion steering system is certainly impressive – able to calm high frequency road vibrations in real time, with pulses of counter torque. It will also impart torque to counter the steering effect of a heavily cambered road and steady side winds, so the car tracks straight ahead.

Symposium highlights energy efficiency

If there was a single theme that characterised the December 2010 CTI Symposium on Advanced Transmissions in Berlin, it was energy efficiency. Whether the talk was of gearboxes or axles, gasoline or diesel, batteries or range-extender hybrids, the discussion always boiled down to the fine detail of the efficiencies and inefficiencies at every stage of the process – each one seeking to minimise the cumulative CO_2 emissions and energy loss.

And this was exemplified nowhere more so than in the area of electric vehicles (EVs) where engineers are chasing even the tiniest improvements in efficiency, in order to extend vehicle range on the limited energy contained in the battery. The initial euphoria that the electric motor's strong torque delivery from near-zero rpm would allow a new generation of simple, clutchless single-speed transmissions has evaporated, as engineers realise the advantages of multi-speed transmissions to both speed and range. While production and near-production EVs, as exemplified by Tata Europe's Vista EV hatchback, are single speed, Adrian Huckstep of Tata's UK technical centre estimated that a next-generation two or three-speed could boost range by 10%. Meanwhile Graziano and Vocis, together with Zytek, are developing a two-speed version of their electric taxi, based on the Mercedes Vito. Aaccording to Stefano Bertolotto, significant gains are on the cards.



BMW's head of advanced engineering alternative drivetrains, Bernhard Marx, saw multispeed transmissions as a retreat from the essential simplicity of EVs, especially its planned Megacity vehicle. Instead, said Marx, the extra speeds would be used in larger, more luxurious electric vehicles where the additional costs are more easily absorbed.

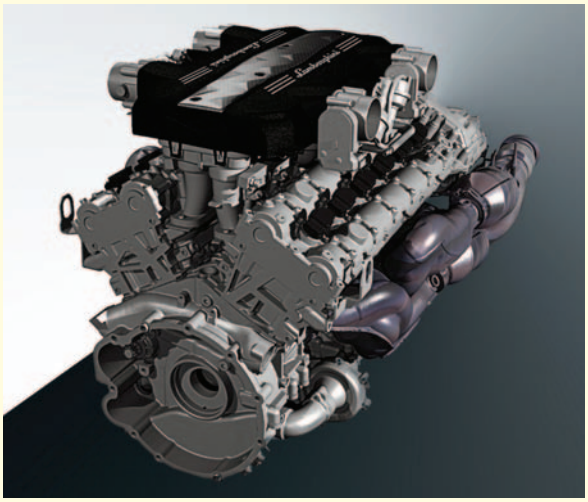
What the move to multispeed transmissions does mean, of course, is some form of clutching device to enable seamless shifting between ratios. Graziano-Vocis favours a one-way sprag clutch, while others – such as Adrian Moore, cto of Xtrac – are more secretive about their chosen solutions. Xtrac, which had chosen the format of a two-speed EV transmission to showcase its new IGS technology, was one of many organisations to present papers on EV drivelines.

The results of an intriguing simulation study for front-drive automatic transmissions were presented by ZF. Dr Gerhard Gumpoltsberger's team compared eight-speed planetary automatics with a variety of DCT solutions and came to some surprising conclusions: the planetary transmissions gave better acceleration and the power consumption of their optimised hydraulic systems was only slightly higher than that of the DCTs, though the dry DCT was still the most fuel efficient overall. The clear message from ZF is that planetary is still the most promising technology.

Cleaner Lamborghini V12

Lamborghini's all-new 6.5-litre V12 now emits 'only' 398g/ms CO_2, compared to the old engine's 500. Maurizio Reggiani, Lamborghini's vp of research and design and chief technical officer, described this as a 'significant' step towards the marque's goal of achieving a 35% reduction in CO_2 by 2015, despite the new engine developing 515kW – 44kW more than its predecessor and an extra 30Nm at 690Nm.

Weighing just 235Kgs, the 60° Vee-engine is lighter and more compact as well, and features an all-new, in-house developed engine management system capable of performing half a billion operations per second. The system consists of the main ECU, a secondary 'smart actuator' and two additional black boxes that function as 'smart sensors'. As speed is everything, some ECU control and connection functions are handled by the smart actuators, making the ECU faster. The two smart sensors are constantly monitoring combustion in real time – each ignition in every cylinder with the spark plugs, each powered by an individual ignition coil – functioning as knock and ionisation sensors. The two auxiliary control units monitor the power signal after every ignition, immediately identifying irregularities in the combustion process through ionisation.



A total of eight scavenger pumps suck oil out of the lower bedplate, reducing pressure and scavenging losses by around half, and allowing each of the paired pistons to act as air springs for each other, further improving efficiency and emissions.

News in brief

Award winner

Automotive Design's editor-in-chief Ian Adcock was voted the Guild of Motoring Writer's Automotive Technology writer of the year for 2010. He was presented with the Market Engineering-sponsored award at the guild's annual dinner in December.

Recycled oil boom for Chevrolet Volt EC

General Motors is to make use of around 100 miles' worth of used oil boom – utilised to contain the oil in the recent BP Gulf of Mexico oil spill – in its Chevrolet Volt electric car. Recycled oil absorbing polypropylene material from the boom will comprise 25% of the plastic GM will use in the production of a component that deflects heat from the engine and radiator. A further 25% will come from recycled tyres from GM's Milford Proving Ground vehicle test facility, and the rest from recycled plastics and other polymers.

Breakthrough paint stripper

Atotech has broadened its paint stripping processes with Recover, a part reclamation technology for the effective removal of organic coatings from high-value parts such as aluminium wheels, aluminium roof rails, window guides or galvanised door pillars, when 100% paint removal is required prior to reprocessing.

Recover is a sustainable paint stripping process, providing consistent etch-free performance, even with the most delicate components. It effectively removes fully cured powder, wet applied paints, e-coat, and multi-layered coating systems from all metal surfaces and has been specifically designed for processing aluminium and zinc. It provides undamaged, fully stripped surfaces that are ready for rework after just one application. Since polished areas remain undamaged after stripping, expensive re-polishing or machining is unnecessary.

Proreta 3 starts

Over the next three and a half years, Continental and Darmstadt Technical University intend to develop an integrated concept of an innovative system for driving safety and advanced driver assistance aimed at avoiding accidents and mitigating the consequences of accidents in city traffic. The system will be incorporated into a Continental research vehicle.

Inductive power breakthrough

An inductive power transfer (IPT) system for electric vehicles has been launched by HaloIPT, a joint venture between Arup and the University of Auckland's commercial arm.

It does away with the need for the charging cable. Instead, an energised mat buried in the road charges the vehicle by electromagnetic radiation.

According to the HaloIPT, EV users find it extremely irksome to have to plug in a heavy (and expensive) cable at the end of a journey, especially when it is cold and wet. With IPT, the driver merely needs to park approximately over the mat.

Charging begins automatically, with very low power loss. A wireless communication protocol with the vehicle ensures the charge continues at the right rate until the battery is charged. The same protocol enables payment on public IPT stations. HaloIPT is working with potential rivals to define standards.

IPT is already used to power up the autonomous electric trolleys in car assembly plants, but HaloIPT says its system can operate across a gap of 400mm, for high ground clearance vehicles.

As to price, HaloIPT also says that, because most EVs have both low and high voltage charging systems and cables, an IPT system could replace one of those and be cost neutral.

One long-term aim is energised highway lanes. By switching from one mat to the next at speed, cars would travel without depleting their batteries. There would be no need to run a cable under the carriageway; it could be in the central reservation itself and power the mats inductively.

Could a CVT revival by on its way?

A revival of interest in continuously variable transmissions could be on its way, in the wake of a key finding highlighted in a 2009 survey of vehicle speeds in Japan. The study, conducted by Nissan, judged that, where the speed variability factor of the traffic exceeded 48%, CVTs – despite their acknowledged drawbacks – are even more efficient than manual transmissions.

In parallel, Jatco has dramatically rewritten the CVT equation with its new-generation unit, using a secondary planetary transmission to allow a wider ratio spread, as well as significant downsizing and friction reductions. Also, Honda has reintroduced CVT to its compact Jazz/Fit, following the negative reception given to its AMT system.

Schaeffler, which supplies high-torque CVT pull-chains under its LuK brand to Audi and Subaru, is especially bullish. It expects that, by 2015, sales of CVT-equipped models – excluding hybrids, many of which also use forms of CVT – will exceed those fitted with DCT. Factored into this calculation is, of course, the continuing preference for CVT in Asia – in Japan, its market share is 45 % – and Schaeffler's own ambitious plans for a low-cost High Value CVT, with a broad market appeal.

Andreas Englisch, LuK's CVT director, believes that the HV CVT can achieve a fuel saving of 5% before the application of any electrification. LuK's concept envisages a 1,500 kg transverse front-drive application with a 150 Nm torque engine. Weighing less than 55 kg and with an axial length beneath 300 mm, the HV CVT would have a ratio spread greater than 7 and would be priced below a conventional AT offering inferior performance and economy. A novel torque-sensing system makes it possible to reduce the belt clamping pressure, the source of most of the CVT's efficiency drawbacks.

Figures from CSM, quoted by Englisch, show global CVT volume rising to almost 8 million units by 2014 – a substantial increase on 2010's total of just over 5 million. Given the familiarity with CVT of many millions of Asian drivers who were brought up on 'twist-and-go' motor scooters and mini-vehicles, LuK's bullishness could be well founded.

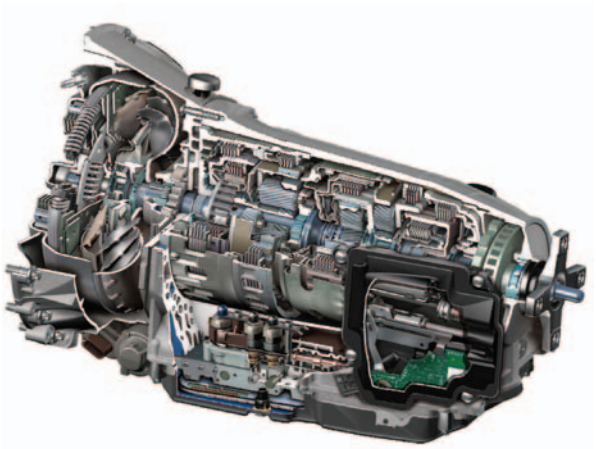
Are convertibles adding to noise-induced hearing loss?

Driving convertibles with the top open at speeds exceeding 88.5 Km/h may be putting drivers at increased risk of noise-induced hearing loss, according to new research recently published in the Journal of Laryngology and Otology, by Cambridge University Press, on behalf of JLO (1984) Ltd from the Saint Louis University School of Medicine, Missouri and The Ear Institute of Texas, San Antonio.

The research was carried out using five makes and models of car. Sound level measurements in 80% of the cars at 88.5 Km/h with the top down had maximum sound recordings greater than 85dB. Exposure of noise above 85dB for prolonged periods is not recommended, according to the US-based National Institute of Occupational Safety and Health. The higher the noise level, the shorter the recommended exposure time.

At 121 Km/h, the mean noise exposure inflicted on the driver of a convertible car driven with the top open was 89.9dB. Not only was the mean noise exposure excessive with the top open, but the driver was also exposed to extreme noise 'spikes' while driving on motorways and when driving alongside a motorcycle or lorry.

Drivers of convertibles may also be exposed to additional noise when listening to the car's audio. Even for comfortable listening, the volume levels required while driving under the conditions assessed in this study are likely to add significantly to the noise exposure level.



An object lesson in efficiency improvement: Mercedes' 7G-TRONIC PLUS automatic saves 3% through its fuel-efficient torque converter – 1.5%, thanks to new ultra low viscosity ATF; 1% through reduced drag losses; another 1% from optimisation of line pressure; and 0.5%, thanks to an optimised shifting programme. A further gain of 4% is realised through stop-start capability, using an electro-hydraulic pump. The cumulative CO_2 saving on a six-cylinder S Class diesel is 17 g/km.

Tesla goes aluminium intensive with new sedan

Californian EV manufacturer Tesla has given details of the aluminium body of its first volume car, the CY2012 Model S sedan.

Tesla's engineers, many ex-Lotus employees, agree that the construction actually bears a striking relationship to Lotus's Versatile Vehicle Architecture.

Extrusions are used for the main floor members, and also in more complex sections, such as for the arms of the rear multi-link air suspension. The front and rear crash members are double-octagon section extrusions. Large thin wall castings make up the front suspension turrets and rear suspension mounting areas. The front and rear subframes have large cast end sections and extruded laterals. The upper body and closures are mainly stampings.

About 97 % of the structure is aluminium; high-strength steels are used for B-post reinforcements, front and rear bumper cores, and the dashboard cross-car beam.

The packaging takes advantage of the EV powertrain. The motor, single-speed transmission and the power electronics are all bundled into a cylindrical shape that lies between the rear suspensions. The battery is a thin flat rectangle beneath the cabin floor.

All of this frees up space for both a front trunk and a pair of rearward-facing jump seats, making it a 5+2 seater.

The battery is demountable and is said to triple the body-in-white's torsional rigidity when bolted in place. It fills the area between the sills and Tesla claims that this contributes to crash safety, adding that the car is engineered for a five-star rating in the NHTSA ratings, which include a pole side-impact test.

The Model S has been engineered in-house and will be built at the company's own recently purchased plant in Northern California, US.

Volt range to grow

Tony Posawatz, GM's vehicle line director for global EVs and Volt, predicts that battery costs will at least halve by the middle of the decade. "GM's number one focus and challenge is to take this technology and drive the cost down, and to stay on the path of innovation. We're looking at greater efficiencies in our motors and systems, as well as enhancements in battery technology from a reliability and durability viewpoint, but also in energy density."

He said it was too early to predict what benefits GM's newly signed licensing agreement with the US Department of Energy's Argonne National Laboratory would bring, but was confident that its patented composite cathode material would result in advanced lithium-ion batteries that last longer between charges and can charge at higher voltages.

Posawatz also said that, if Volt is to be a growth segment, selling hundreds of thousands of cars, it needs to be more than a single model or brand. "In coming months, we will see the next extensions of the Volt family."

Daimler develops direct current motors

Daimler has reacted to China's export ban on rare-earth elements used in some electric motors by investigating the use of direct current motors for its battery electric and hybrid vehicles, based on the B-class. Professor Herbert Kohler, vice president of research and development at Mercedes-Benz, suggests that the Chinese restrictions will have similar effects to that of the concerns about a lack of platinum for exhaust catalysts in the 1980s or OPEC's attempts to restrict supplies of crude oil in the 1970s. "It just means that competitive materials get developed," he said at the Detroit Show in January.

Herbert Kohler, left, VP of research and development, Mercedes-Benz: competitive materials get developed. Hartmut Kristen, Porsche's motorsport director: criticised the supply chain.

"China is not the only country to supply these elements and it is not taking care of the environment in how it extracts them."

Kohler reveals that Mercedes is now developing DC synchronous motors that do not need the rare-earth magnets in them to operate. "We are close to getting the same kind of efficiency as the AC motors on a test bench," he says. "They are a little heavier and bulkier, but they are cheaper and the test results are much better than we expected. I have been pleasantly surprised."

Meanwhile Porsche's motorsport director Hartmut Kristen has criticised the supply chain's inability to develop small, lighter and more efficient electric motors for use in hybrids. Talking at the show, he told Automotive Design that Porsche had designed its own electric motors "by going back to school and thinking about the basic physics and using different materials.

"Proprietary electric motors are too heavy, with not enough performance and too big. No one realised that, because everyone has been focusing on batteries."

Lubricant achieves fuel economy benefits

Using the Gordon Murray Design's new T.25 city car as a test bed, Shell engineers have worked beyond industry specifications to formulate an ultra low viscosity 0W-10 motor oil capable of achieving a 6.5% improvement in fuel efficiency, compared to improvements of around 2.5% achieved in typical fuel economy lubricant development programmes. Selda Gunsel, vice president lubricants and B2B products technology at Shell Lubricants, says: "Blending low viscosity oil to improve fuel efficiency is actually relatively simple; the challenge comes when you look to balance it with engine protection and acceptable oil drain intervals. We believe that now is the time to start looking at lubricant technology that goes beyond current specifications to enhance the efficiency of tomorrow's cars." Although in the concept stage, this represents a major advancement. "What we have learnt feeds in to the products we are developing for use in the near future." Using the 0W-10 Shell concept motor oil, the 660 cc, 39kW T.25 achieved 2.9l/100Kms in the RAC Future Car Challenge.

In a separate development, the T.27 electric version passed its EEC 40% offset deformable barrier test, with zero cabin intrusion.

Bold claims from Scuderi Group

The Scuderi Group, which is developing the split-cycle engine featuring the unique combustion process of firing over top dead centre, has announced bold preliminary results from vehicle simulations conducted on the split cycle engine at Southwest Research Institute (SwRI).

Computer models showed that a base naturally aspirated Scuderi engine, operating in a 2004 Chevrolet Cavalier, consumes 25% less fuel, rising to 30-36% improvement for a naturally aspirated Scuderi Air-Hybrid under similar drive conditions.

These results are only going to get better," said Sal Scuderi, president of Scuderi Group. "The naturally aspirated Scuderi split-cycle engine will continue to improve when further optimised and the Air-Hybrid performance will increase with higher air tank pressures." We expect the efficiencies to continue to climb as modifications are made and new simulations are conducted, including computer modeling of the 2011 Nissan Sentra running with a Scuderi engine."

A report outlining the findings of the simulation program is expected to be available later this year.

Steve Henderson

CV

Steve Henderson was appointed president of Dow Automotive Systems in 2009 and is responsible for Dow Automotive Systems' global profit and loss, business strategy and organisational health. He is based in Tokyo, Japan.

Most recently, he served as president of the Americas, where he led the strategic oversight of all Dow Automotive Systems products, marketing and sales activities in North and South America. He has also held a variety of leadership positions at Dow Automotive Systems, including president, Diversified Products; vice president, New Business Development and Strategic Marketing; and vice president of Glass and Plastic Bonding.

Henderson joined Dow Automotive Systems from General Motors in 1987 as an associate engineer. He has a BA in Organisational Administration and an MA in Business Administration. He is a member of the Society of Automotive Engineers (SAE), Sales and Marketing Executives (SME), Adhesives Sealants Council (ASC) and Beta Gamma Sigma. Henderson is 50 and married, with two children.

Developing the right chemistry

Twelve years ago, the Dow Chemical Company formed Dow Automotive as its first 'business within a business'. Ian Adcock recently caught up with president Steve Henderson to discover what the company can offer today's automotive industry

Just as for every other company, the industrial collapse of the global motor industry hit Dow Automotive hard. However, it gave its then newly appointed president Steve Henderson the opportunity to reshape the business to focus on its core attributes. "During the downturn, we restructured the business, getting rid of certain parts of it, so we were left with a smaller, but much more meaningful portfolio, aligned to the motor industry.

"We're now in three specific areas and, when you get to a certain size, you need to start leveraging the organisation to maximise those specialities, which are: powertrain emissions, adhesives and what we call performance solutions from the traditional Dow assets of polymers, elastomers, fluids, etc. We're back to being specialists and a lot more agile."

Henderson believes there are three ways Dow can help its customers to reduce costs, solve technology problems – which, he says, is "very critical" to an innovation business like Dow – and finally, and most unusually, help OEMs and suppliers sell more of their products. "The first two are something we've done over a long period of time, but looking at ways to help OEMs sell more products is kind of a new activity for us. Generally, what we've done is more marketing. There are very specific reasons why we buy cars and we've translated those back through what Dow is offering."

Dow is focusing on four specific areas of vehicle development, he explains: "For a start, emissions will continue to be more regulated going forward and, whilst energy efficiency has a number of different aspects to it, the approach we're taking is by enabling mass reduction. Then there is safety. In the past, safety improvements were about increasing vehicle mass and that affects efficiency, and then there is quality appeal. Cars are getting smaller, but that doesn't mean people want vehicles that are decontented or stripped out.

"We have a very extensive sales and marketing organisation, which resides at our customers, so we have an intense knowledge of their operations. We feel their pain and bring that back into our business to develop solutions and simplify their manufacturing processes."

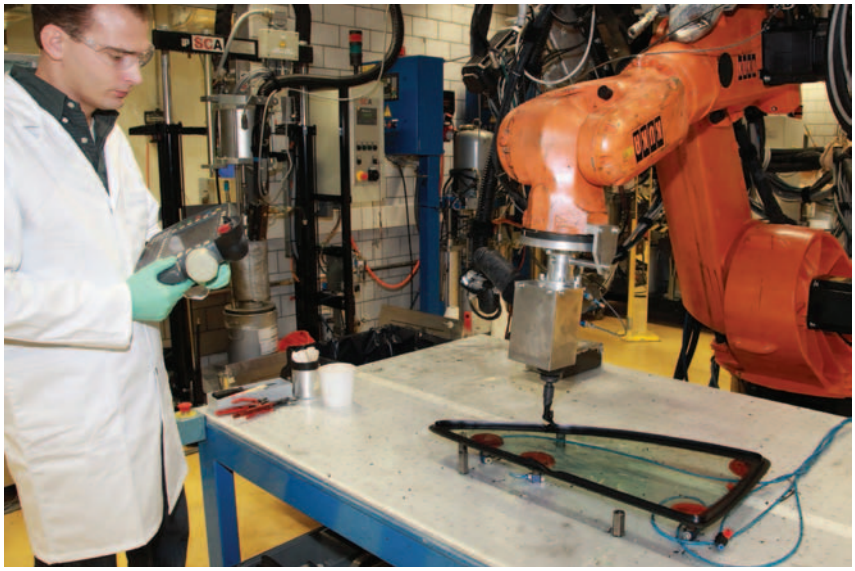
Success in the Le Mans 24 hour race has helped to promote Dow's AERIFY diesel particulate filters, which, he says, improve emissions without compromising efficiency. Currently, Dow is targeting medium- and heavy-truck applications that are coming under intense pressure from Euro 6 and Tier 4 legislation. According to Henderson, the system's unique structure significantly reduces back pressure, thereby improving efficiency.

"That allows the OEM to have a larger filter, with a significantly lower back pressure, or maintain the same back pressure and go to a significantly smaller filter. And that can help with packaging and cost, because it uses fewer precious metals. We're heading towards passenger cars, but the first step for the value proposition is better suited for medium and heavy duty applications."

He admits to working with partners on petrol particulate filters where the same characteristics of back pressure improvements and robustness with very high porosity make AERIFY attractive to GDI engines and could be available as early as 2013-14.

For Henderson, "materials science, the intersection of chemistry with automotive, is going to be one of the biggest influences on the industry going forward", which explains why Dow is developing Thermal Energy Storage (TES) systems that, following the delivery of the first prototypes to OEMs, are predicted to come to market in 2016.

"Dow has developed systems that



Bonding glass is quick and improves body rigidity

are 'heat batteries', using phase change materials that alternate from liquid to solid as heat is put in and out of them by taking waste heat from the engine and storing it, allowing the OEM to use it in any number of applications. Right now, we're targeting 24 hour heat retention that could be used in a number of ways – eg, to warm up the emissions system to operate more efficiently and faster with quicker light-off, which can then reduce the size of the system and the amount of precious metals," explains Henderson, adding: "They could be used to heat the passenger compartment for electric vehicles or hybrids or engine oil."

With the drive to reduce weight, Henderson rightly sees enormous potential, as manufacturers seek more ways of combining often incompatible lightweight materials. "Dow is the world leader in structural adhesives, bonding metal to metal, so that reduces welds and carbon footprint and down gauges steels for lower body-in-white mass.

Bonding allows a material mix: plastics, magnesium, carbon fibre, steel, aluminium can all be combined. And, in terms of mass, anywhere between 2 and 10 Kilos can be saved, just by down gauging materials and, potentially, avoiding costly high strength steels, of which there's a limited amount.

"Multi material bodies have got to happen [witness the Audi quattro Concept seen at Paris – IA] and we believe that adhesives will be the new welding, the enabler. We plan on extending our leadership in adhesives with the likes of Betamate Lesa and Betamate 2K." Henderson refers to these as "crash durable adhesives" that can be used to tune the deformation of crash structures by varying the amount of adhesives applied, helping to reduce vehicle mass, while maintaining impact performance. "You can use structural adhesives to stiffen the body to help with noise, vibration and harshness and dynamics. To reduce body-in-white by 50-60 Kilos requires new design technologies and we can enable that." While he concedes that bonding will never be as fast as welding for mass production, he predicts that within the next couple of years curing times will be drastically reduced, eliminating the need for mechanical fixings.

> **"Materials science, the intersection of chemistry with automotive, is going to be one of the biggest influences on the industry, going forward"**

The challenge of engineering small cars to meet stricter occupant safety legislation is one that Henderson believes Dow can help OEMs meet, especially with products like Impaxx energy absorbing foam. Already used to help protect NASCAR race drivers, it's particularly applicable in headliners and doors for hip and side impact protection, as well as 'A' pillars. "It's very light and could save 20-25% in an 'A' post, which means it can be made much slimmer for increased field of vision whilst still meeting HIC ratings and performance," he states.

The key factor is aligning the structural cells in the line of fire, so they compress in a very controlled manner. As well as being recyclable, Dow is exploring using Impaxx in bumper structures as well.

As new generations of downsized cars emerge, buyers are demanding the same levels of sophistication found in traditionally larger, more sophisticated products from which they have come. Dow, Henderson explains, can do the full range of sound analysis and leakage in its dedicated semi-anechoic chamber, targeting specific areas in the vehicle. "We look at the frequency of the body to target acoustic treatments in specific areas, rather than treating the whole body," he says, adding that this is another example of applying chemistry, rather than mechanical solutions, to achieve the optimum results. Are there other automotive applications beyond structural bonding and foams Dow is considering? Looking to the future, Dow is researching the feasibility of bonding seat frames, an application Henderson describes as interesting. "Beyond that, if it needs to come apart, then structural adhesives might not be the answer."

SAE International – All things electric(fication)… and then some

The terms and technologies are flying at consumers and industry professionals at breakneck speed: 'plug-in hybrid vehicles', 'hybrid-electric vehicles', 'electric vehicles' (EVs), 'hybrid powertrains', 'lithium batteries', 'Li-ion'… and the list goes on.

The need for knowledge to help understand these terms has never been greater.

Already a repository for such information, SAE International took things a step farther with the creation and launch of a new Vehicle Electrification (http://ev.sae.org) website. The new website showcases SAE International's portfolio of vehicle electrification intellectual property, including articles, books, technical papers, standards, research reports, events and training opportunities.

"We created this site with a 'one-stop shop' goal in mind," says Bill Cariello, manager of Web Strategies for SAE International. "The site serves as a resource for mobility engineers seeking the most up-to-date information on standards, technology advances, product solutions, supplier news, vehicle development trends and insights from the most plugged-in experts in the electrified-vehicles field."

Creation of the site was the natural next-step progression for SAE International, which already offered many relevant programmes, products, and services for vehicle electrification professionals. Earlier this year, in support of that one-stop-shop goal, SAE International created its SmartGrid (www.sae.org/smartgrid) Web page, which outlines SAE's involvement in the smart grid, along with relevant national information, and the latest smart grid and electrification news.

"While hybrid and electric technologies always have been an important part of our editorial coverage in our magazines [Aerospace Engineering & Manufacturing, Automotive Engineering International and SAE Off-Highway Engineering], we offer this new series as an innovative way for our members to really delve into these issues, and offer the information in an effective and convenient platform," states Kevin Jost, editorial director for SAE International.

Of course, serving as a foundation for all of this information are SAE International's industry-wide consensus technical standards. SAE International, with support from and thanks to its technical committee members, took the initiative of creating a document that provides a standard interface between plug-in hybrid and battery-electric vehicles, and electrical charging systems.

The volunteer committee members have also created a document that establishes requirements for EVs and the off-board electric vehicle supply equipment used to transfer electrical energy to an EV from an electric utility power system in North America, and are in the process of creating a document that defines some of the common terms associated with hybrids and hybrid-electric vehicles.

"The site serves as a resource for mobility engineers seeking the most up-to-date information"

The technology surrounding vehicle electrification is ever expanding. SAE International and its members are, in many cases, on the leading edge of that technology. Whether it's through technical standards, conferences and symposia, award-winning magazines or informational Web sites, SAE International's goal is to be the 'go-to' resource for the mobility engineering community. By achieving that goal, SAE International's members and the professionals of the mobility engineering community can be confident that they have access to the most relevant and timely technical content available.

focus@sae.org

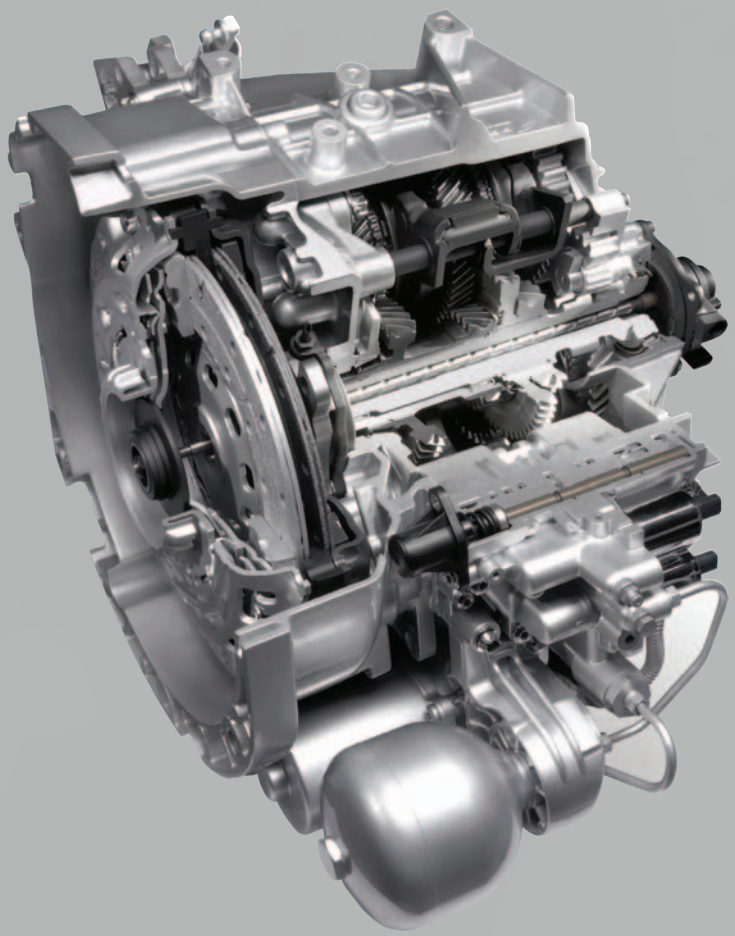
Shifting Times

Transmission systems are increasingly coming under the development spotlight as manufacturers strive to eke as much efficiency as possible from their products. Ian Adcock and Tony Lewin take a look at some of the latest offerings

When selecting a transmission, it used to be easy for both the vehicle manufacturer and their customers: it was down to a choice of manual or automatic. In many cases, there wasn't even a choice; it was manual.

But, as with everything, choice has extended as manufacturers seek different solutions, not just to attract customers, but also to differentiate themselves from rivals. And, of course, those great drivers that underline all powertrain development today – emissions and fuel economy – are putting even more emphasis on technologies that will improve an OEM's emissions rating.

That challenge is about to become even more difficult when new cars are labelled and bracketed for their CO2 efficiency, in the same manner that domestic white goods are. Although the parameters have yet to be set, it's clear that clever use of gear ratios and transmissions could prevent a car slipping from a low band to a higher one, penalising potential sales to more CO2 friendly rivals.



The biggest breakthrough in recent years has been the emergence of dual clutch transmissions (DCT). Although the concept predates the Second World War, it wasn't until Porsche developed one for its 956 endurance race cars in 1983 that the technology started to emerge. Even then it would be 20 years before VW introduced a mass-produced version in its Mark Four Golf.

Now Fiat Powertrain Technologies (FPT) has entered the fray with not one, but two new transmissions.

Fiat 500 DCT hybrid

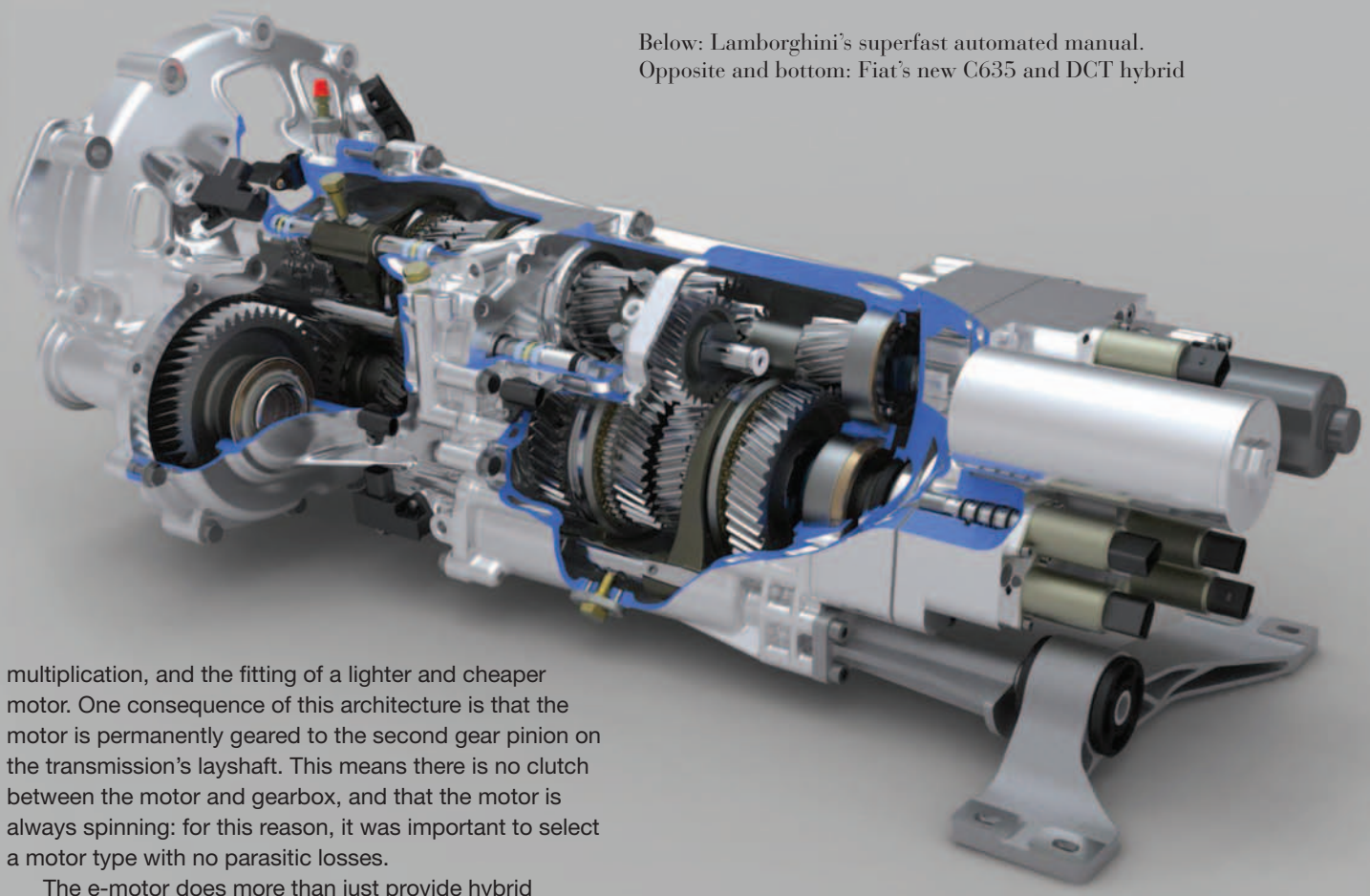
Fiat has important assets at its disposal in the tricky task of applying a hybrid drivetrain to the small 500 city car. The normally acute packaging constraints are less onerous, thanks to the company's novel two-cylinder Twin-air engine, half the length of a conventional four-cylinder unit. Additionally, Fiat Powertrain Technologies' (FPT) experience in dual clutch transmissions provides a versatile means of blending the torque flows from the two power sources.

The short two-cylinder engine has enabled a two-shaft gearbox layout that is not only more efficient in minimising mechanical losses, but also allows all the synchronisers to be on the same shaft and permits the use of a simpler electromagnetic drum-type sequential gear selector mechanism.

Five speeds suffice for the A-segment applications of the hybrid, reasons Dr-Ing Constantinos Vafidis, director of transmissions and hybrids at FPT. The model's primarily urban use pattern means that a high top speed (and thus a very tall cruising top gear ratio) is unimportant and the traction motor's torque assist at low speeds removes the need for a low first gear for launch.

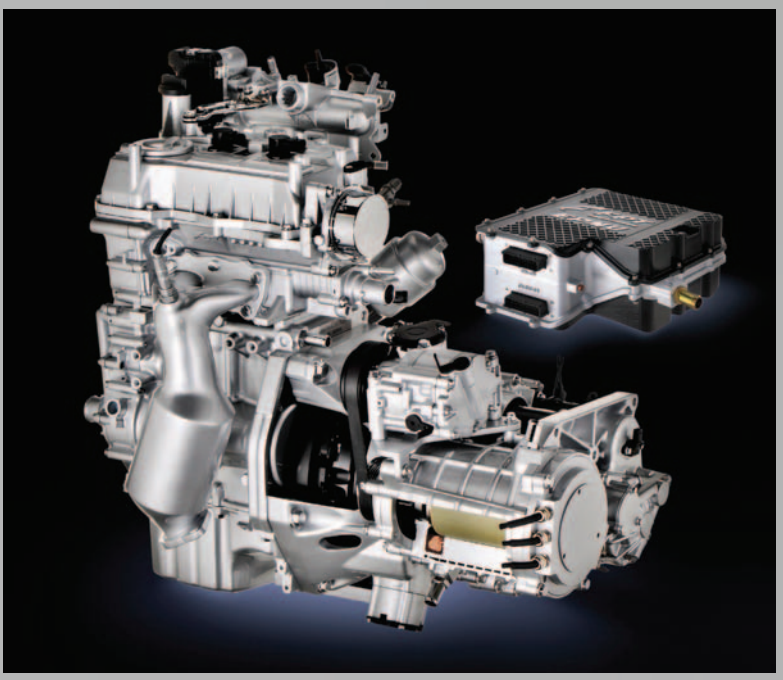
The 3 kW electric traction motor is mounted on a parallel axis, above the gearbox. This offers the major advantage of an idler gear, permitting torque

Below: Lamborghini's superfast automated manual.
Opposite and bottom: Fiat's new C635 and DCT hybrid



multiplication, and the fitting of a lighter and cheaper motor. One consequence of this architecture is that the motor is permanently geared to the second gear pinion on the transmission's layshaft. This means there is no clutch between the motor and gearbox, and that the motor is always spinning: for this reason, it was important to select a motor type with no parasitic losses.

The e-motor does more than just provide hybrid operation: it has an important role in improving driveability and smoothing out the responses of the drivetrain. The motor cranks the engine at each restart and adds extra torque, if it has to restart the engine, while also powering the vehicle – so the driver does not feel any reduction in tractive effort. The motor even spins up or slows down the gearbox layshaft, so that its inertia does not affect the smoothness or speed of the gearshifts.

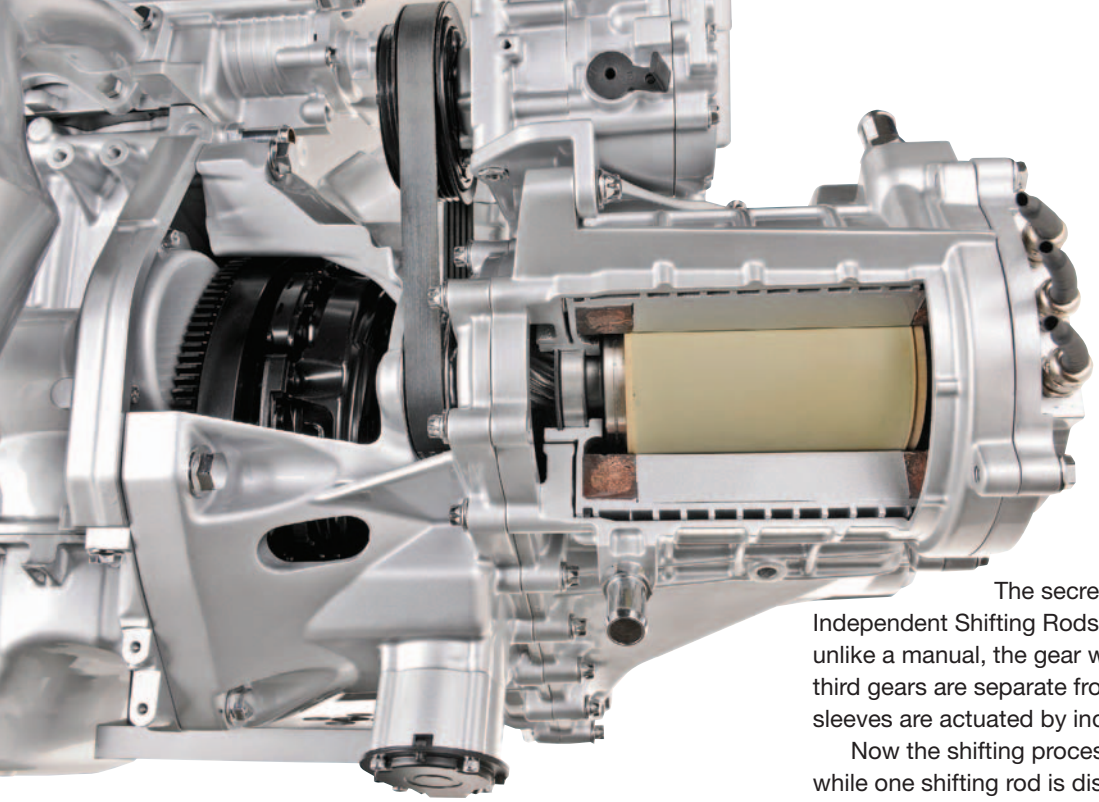


The mechanical air conditioning compressor is driven through an electromagnetic clutch off the traction motor, maintaining climate control during engine stop; this, says FPT, avoids the need for a costly electric compressor.

The development team is confident that the targeted CO2 reductions are feasible. The base vehicle, with its naturally aspirated twin-cylinder engine, already has low overall CO2 emissions of 95 g/km on the European cycle: the team is aiming for a 12 % reduction in this figure – to just 85 g/km – in the combined cycle, with an even bigger cut of 24 % in the urban portion of the cycle.

C635 Dual Clutch

According to chief engineer Vittorio Doria, the C635 Dual Dry Clutch Transmission (DDCT) has benefited from technological advances since 2003 that have allowed FPT



Fiat's novel hybrid DCT box

to increase its torque input capacity to 350Nm and output torque to 4200Nm. The latter is particularly important, as it future protects the transmission for all-wheel drive applications from both Fiat and Chrysler, although that will demand a new clutch housing to accommodate the PTU, as well as transverse installations.

FPT claims that its new 'box – weighing only 81Kgs – is lighter than comparable wet DCTs from VAG, as it doesn't require two kilos for the oil.

FPT has been particularly adept at engineering 30% commonality between this transmission and its six-speed manual, including synchronisers, meaning both transmissions can be assembled on a common assembly line at Verrone, northern Italy. Annual capacity is 400,000.

Likewise, the micro controller belongs to the same family as those used in the recent Multijet and Multiair FPT developments. In effect, all these applications share the same chipset and Base.

Application Software

As well as weight saving, there is also improved packaging, as a result of the three-shaft transmission architecture being housed in a two-piece aluminium housing, with an intermediate support plate for the shaft bearings. This has allowed the positioning of the differential group to be closer to the engine Rear Face Of Block, making the transmission compatible with the packaging requirements in the B-segment vehicles.

Doria has also made it clear that FPT will make the transmission and its controllers available to other manufacturers.

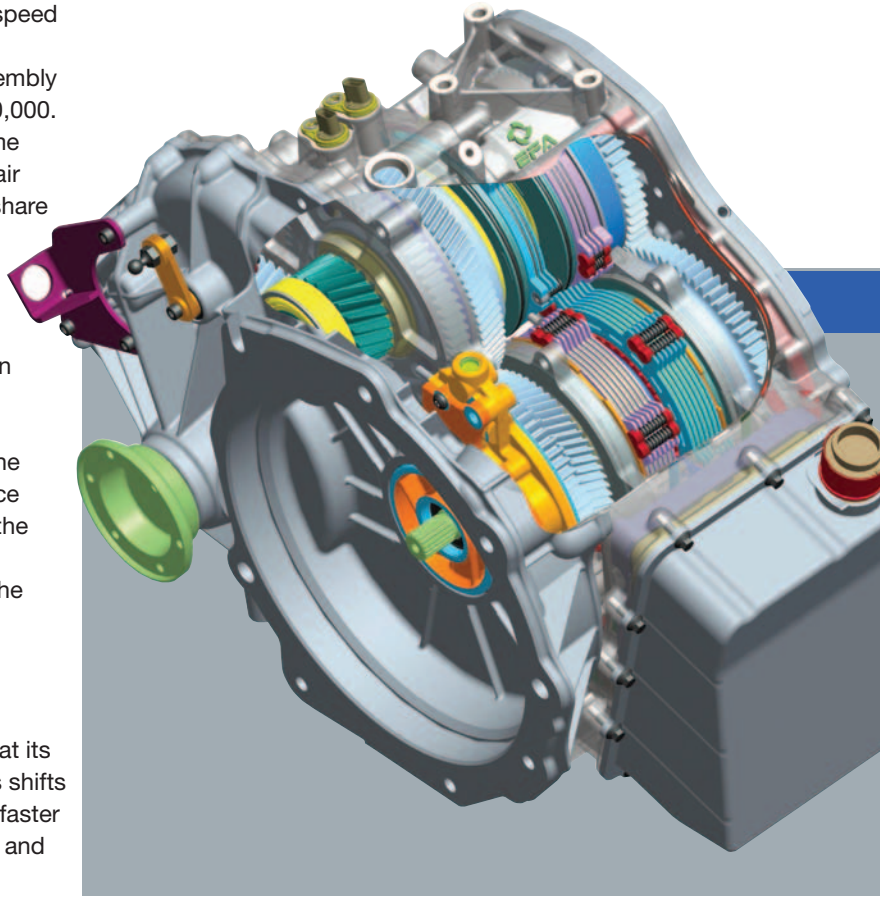
Fastest shift times

Italian supercar manufacturer Lamborghini claims that its new in-house developed robotised transmission has shifts speeds of less than 80 milliseconds, making it 50% faster than a DCT, according to VP of research and design and chief technical officer Maurizio Reggiani.

The secret to the seven-speed Independent Shifting Rods (ISR) transmission is that, unlike a manual, the gear wheels from the second and third gears are separate from each other and the shifting sleeves are actuated by independent shifting rods.

Now the shifting process can run virtually in parallel: while one shifting rod is disengaging one gear, the second shifting rod can already engage the next gear. As these movements partially overlap and the mechanical distances are considerably shorter, this facilitates a significant saving in shift time. Overall, the Lamborghini ISR transmission shifts around 40% faster than the e.gear transmission in the Gallardo, which is one of the world's fastest automated manual gearboxes.

The new transmission, assembled in co-operation with Graziano, has four of these independent shifting rods, with sensors constantly monitoring their exact positions.



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They are operated via hydraulic actuators, with a system pressure of 60 bar ensuring the necessary operating speed. The system incorporates seven hydraulic valves, with pressure supplied by an electric pump. The double-plate clutch is also hydraulically actuated. All system components are contained within one casing, with no external piping. The total weight of the transmission is only 70Kgs, due to advanced CAD work, resulting in reduced casting thicknesses and the use of carbon fibre synchroniser rings.

Xtrac offers instant shift

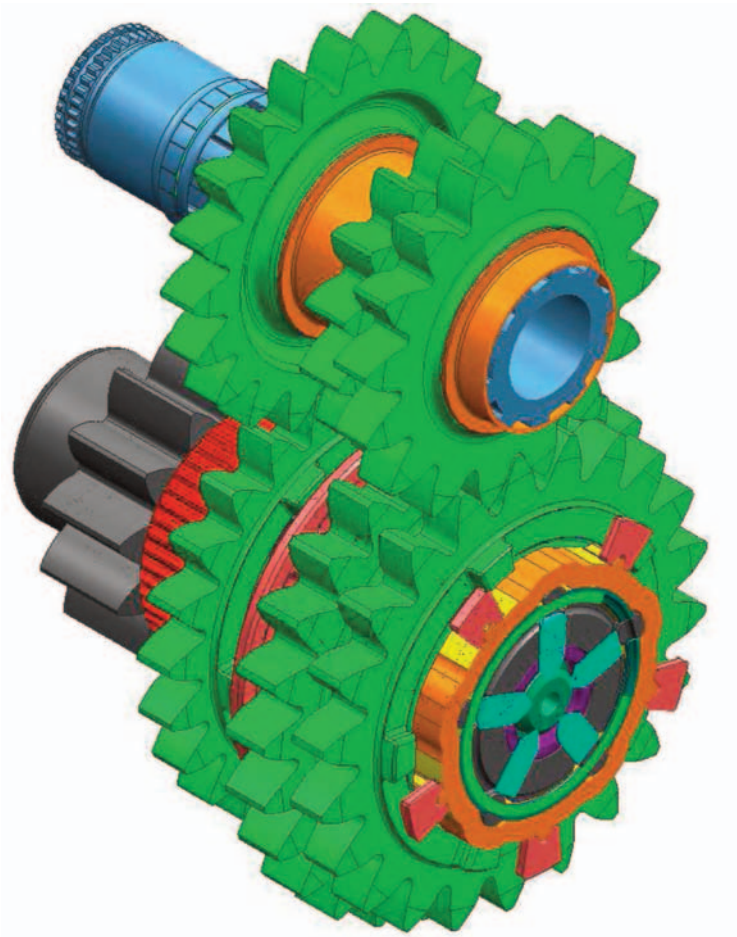
Competition transmission manufacturer Xtrac has developed its Instantaneous Gearshift System (IGS), a race car-like automated manual using dog rings and gear-face dogs, instead of synchromesh. The mechanism achieves seamless, torque-interrupt free gearshifts by engaging the next gear an instant before the current one disengages.

This is enabled by pawls fitted between each gear and its shaft, the ratcheting effect taking care of any overspeeding between gear pairs. As soon as the first gear is disengaged, the pawl on the second ratio re-engages, taking up the drive and enabling the shift to be as near instantaneous as possible.

The system has been tested in several race series with some success and telemetry tests, comparing IGS with a conventional transmission cluster, show a spike in acceleration (as opposed to a drop) during each upshift. On the track, this corresponds to a speed advantage of 3 km/h over a 450-metre straight.

Xtrac technical director Adrian Moore says IGS has significant advantages over DCT for road vehicles, including lower weight and an architecture with much more in common with a conventional transmission. With suitable calibration of the engine and transmission, it could be as refined as DCT, too, he claims.

Xtrac's IGS box has production car potential



ANTONOV INTO PRODUCTION

Antonov's innovative six-speed TX6 transmission will go into series production in the last quarter of 2011 at a new factory being built by Chongqing Landai Industry Co Ltd, China, with a planned initial capacity of 200,000 units a year.

Eliminating the traditional torque converter from a planetary transmission results in a novel layout of epicyclic gear sets in two parallel shafts, instead of the usual single shaft arrangement found in conventional automatic transmissions. This helps keep the 'box to a compact 325mm, ideal for transverse engine installations.

Currently, the TX6 has a torque capacity of 150-180Nm, but Antonov is confident this can be progressively increased to more than 300Nm.

Antonov is targeting Chinese car makers, with Lifan already committed to taking 20,000 a year initially.

Lethal weapons

Does the increase in on-board electronic control systems, and the prospects of vehicle-to-vehicle and vehicle-to-infrastructure, make cars more vulnerable to criminal activity? A country's whole transport system could now be crippled by cyber criminals. Keith Howard investigates

As cars have become more dependent on microprocessors and vehicles' electronic sub-systems have increased in value, so it has become a temptation for miscreants to overcome their embedded security. To date, this activity has mostly been criminal: thieves will steal high-value car components and reprogram them for resale on the black market; others will charge owners to reprogram engine management systems to release more performance, without concern for emissions regulations or vehicle reliability. As car makers rely more and more on software enabling of hardware functions – to allow the customer to buy additional map coverage for the satnav system, for instance – so these wil become the subject of criminal attack, too.

"I roughly categorise the security issues that concern automotive designers into four groups," explains Benjamin Jun, (right) vice president of San Francisco-based Cryptography Research, a developer and licenser of technology to solve complex electronic security problems. "The first is authenticated access, which is essentially, 'Can I get into the car and start it?' Early electronic keying systems were quite crude; enough to solve the problem at the time. But then the criminals caught up and more sophisticated systems were required – this is how the game is played. Now that cars can access networks, the login credentials that the car presents to the network are also a concern.

"The second category, which is a major problem today, is component cloning – the selling of what appears to be a functionally OEM-equivalent part but doesn't come from them. Cloning of high-margin items is particularly attractive to criminals. There can be very serious implications, if you replace a critical component with a part that is not genuine, and it also removes an important revenue stream for the car

An even darker prospect now looms that goes far beyond the eternal battle against criminal activity: the possibility of a concerted cyber attack on a nation's transport system via the embedded systems within its cars

manufacturer. This issue affects everything from small mechanical components, like oil filters, to expensive electronic components, like HID headlight modules.

"The third category is very similar to cloning, which I call component diversion. A large part of auto theft these days is not necessarily stealing the car, but removing certain high value components from it. Airbag module theft is an example and still a big issue. Thieves will use pretty crude means to steal these components, causing substantially more damage to the car than the value they're extracting, and then reprogram them for use in another vehicle. If you look on eBay, you'll find hand-held devices on offer that are sold as diagnostic tools, but can be used to reprogram the anti-theft codes on an airbag module.

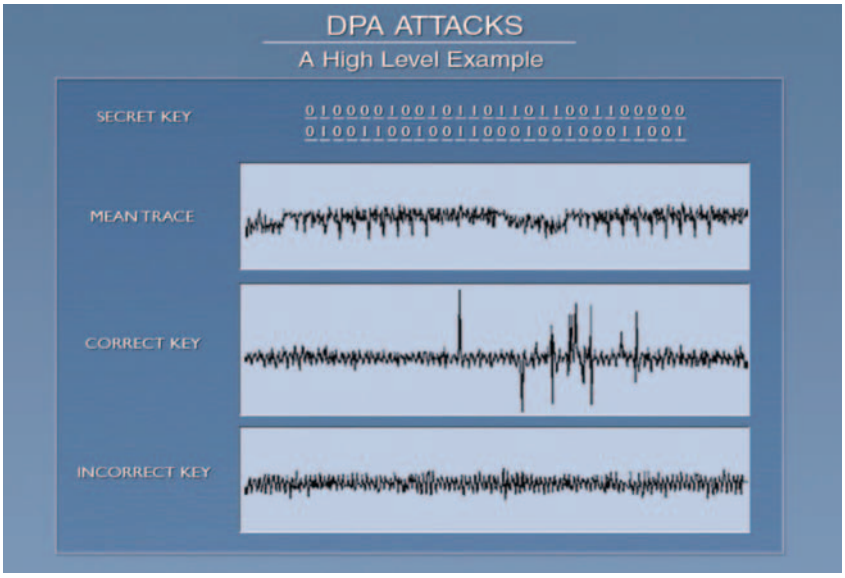
"The last category is configuration management. Of primary concern here are vehicle tuners who find ways to re-flash an ECU, so that it performs differently to how the OEM intended. It's possible to make changes that considerably alter the vehicle's performance, but can also do great damage. If the engine develops significantly more torque, for instance, then the drivetrain may not be able to handle it, without compromised reliability – and increased warranty claims."

Cryptography Research emphasises the benefits of combining hardware and software security solutions, rather than relying on one type alone. Delivering the keynote address to the recent eighth ESCAR (Embedded Security in Cars) conference, Jun explained the many benefits of hardware security, including securing states when the CPU is not active and offering enhanced resistance to sophisticated forms of attack, such as differential power analysis (DPA).

Although it is tempting to imagine that cryptographic processes take place within closed environments, hardware can 'leak' information in various ways. DPA – in which statistical techniques are used to help identify cryptographic keys non-invasively by analysing a component's process-dependent current draw from its power supply – demonstrates this, as does the US government's TEMPEST programme, to prevent sensitive information leaking via equipment's electromagnetic emissions.

The possibility of a concerted cyber attack on a nation's transport system via the embedded systems within its cars may sound like a Hollywood film script, but the recent news of the Stuxnet worm makes the prospect a real one. As cars become increasingly 'connected' – first through vehicle-to-infrastructure (V2I) and then vehicle-to-vehicle (V2V) communications – so the opportunities will grow for malware to be widely disseminated.

"Wherever we have a large percentage of the population using the same embedded system, that represents a vulnerability," says Jun. "Stuxnet is one of the first widely publicised examples of a deliberate attempt to cripple a country's infrastructure. When that story broke, my 'phone started ringing. A vehicle electronics system generally has an embedded computer, which, in many cases, has or is proposed to have an online connection. With such an infrastructure, if we have security problems, we could see widespread crippling of automobiles, quite possibly in ways that will target specific countries. The economic attacks were always there; political attacks could become another factor in the future."



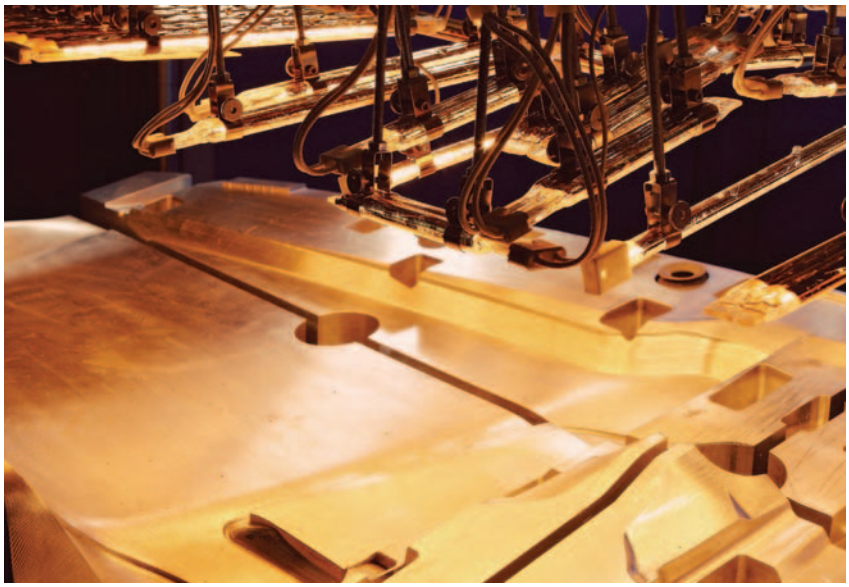
Frimo flaunts new production facility

Automakers and the supply chain are checking out the latest machinery for assembling instrument panels, door trim, headliners and other interior plastics at a new technical centre in Michigan, USA. Kami Buchholz reports

"No other tooling and equipment supplier in North America has a facility that serves as a one-stop shop for the prototyping and production of interior plastic components," says Jeff Daily, president and CEO of Frimo North America, referring to the company's new €3.7 million technical centre in Wixom.

The 1,400 m² facility features tooling and equipment for forming vehicle interior skins, producing and joining the substrates behind the touch surfaces, scoring airbags and completing other tasks.

"Before a company goes through the risk and cost of building a tool and/or machine based on an idea, Frimo's engineering and technical experts can work to build a low-cost prototype and do testing to see if the proposed solution validates the original concept. We can then take the next step, which is building that new tool and/or new machine," Daily states. In addition to customised equipment, the company offers a range of standard solutions, including an infrared (IR) welding machine for joining thermoplastics.



With a heating time of approximately 12 seconds, the IR welding machine can be paired with optional thermal imaging to compare heat profiles.

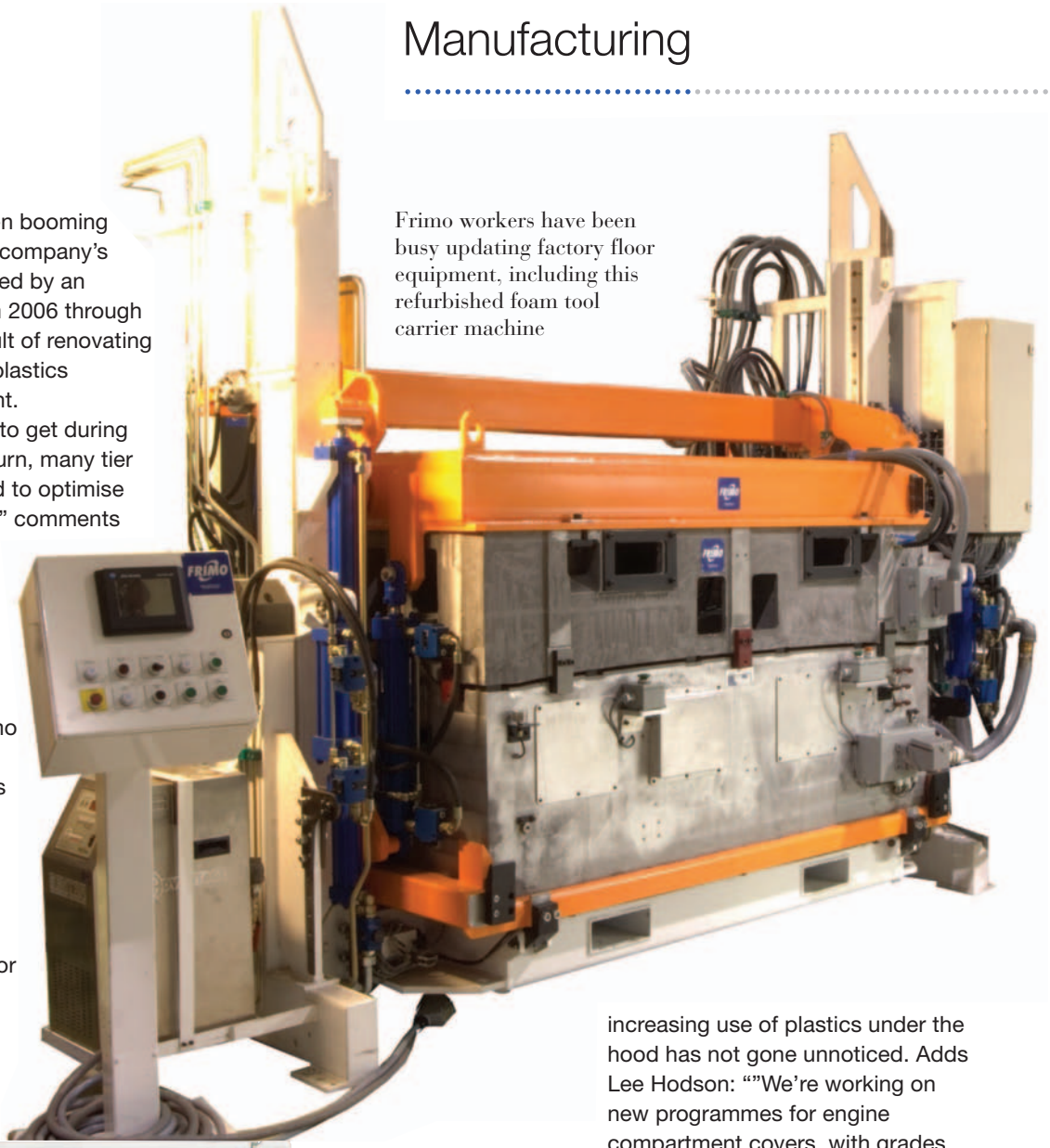
While specific European Audi and BMW interiors have been assembled using contact-free IR welding technology, the first vehicles with instrument panels assembled via IR welding for the North American market will arrive in the 2012 model year.

According to Lee Hodson, the tech centre's manager and director of advanced development, "IR welding is a much greener joining process than techniques that require solvent-based adhesives".

The airtight, particle-free IR welding machine, operated via intelligent drive and control systems, enables complex 3-D contours, as well as the ability to mate different material combinations.

US-based customers initially evaluated IR-welded part samples at Frimo's technical centre in Germany. However, with the Wixom facility's opening in October 2010, Michigan also serves as a comprehensive equipment showplace.

Frimo's Shanghai technical centre is on a fast track to put its capabilities on a par with facilities in the US and Germany, under the guidance of Hans Scholko, the company's US technical director for the past 10 years.



Frimo workers have been busy updating factory floor equipment, including this refurbished foam tool carrier machine

Business has been booming in the US, where the company's sales volume increased by an impressive 52% from 2006 through 2009, in part the result of renovating customers' existing plastics processing equipment.

"With credit hard to get during the economic downturn, many tier one suppliers needed to optimise their working capital," comments Daily. "That's why a strong part of our business over the last three to four years has been tied to upgrading machines—both Frimo and competitor machines—as well as upgrading computer controls to improve manufacturing efficiency."

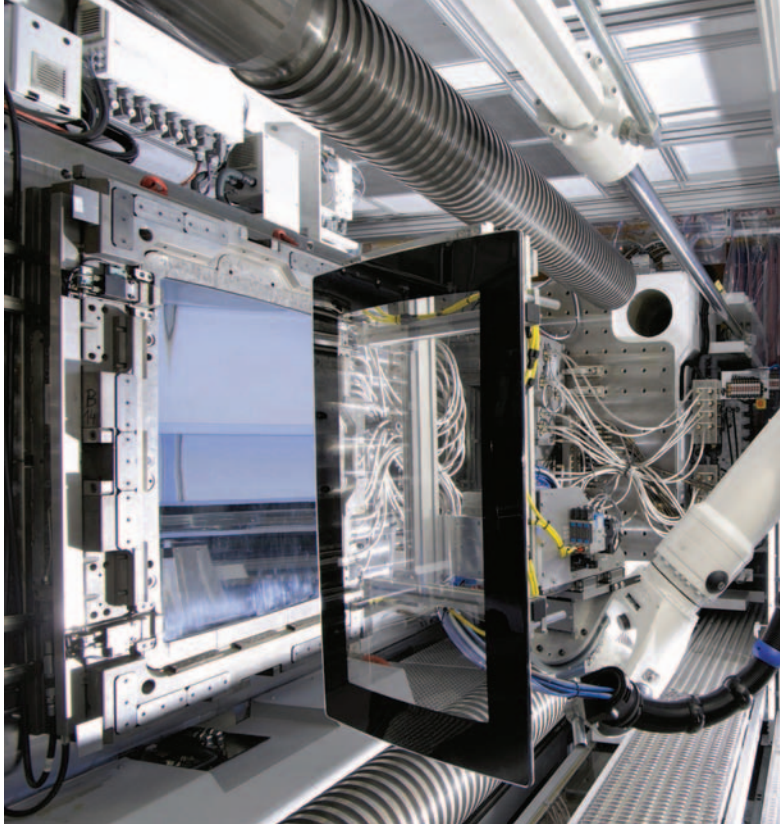
Although processing plastics for vehicle interiors is Frimo's automotive application stronghold, the ever-increasing use of plastics under the hood has not gone unnoticed. Adds Lee Hodson: ""We're working on new programmes for engine compartment covers, with grades and textures that rival interior surfaces. Our range of products is not limited to one industry or one application, which is why the engine compartment is a possible new growth area for us."

Frimo's Wixom technical centre, which includes two secured test bays, provides a framework for automakers, tier ones and material suppliers to optimise production processes.

"We're trying to bring OEMs, suppliers, and material providers together in a collaborative and productive way," Daily concludes, "to drive both innovation and manufacturing efficiency, so that we can be on the cutting edge of developing the technologies they want to sustain our business"

Frimo's IR welding machine is the newest member of the company's equipment portfolio for processing plastics. Other machines perform thermoforming, joining/gluing, pressing/forming, trimming and polyurethane processing.

CLEAR direction



Plastic windscreens are still a distant dream, as car manufacturers look to commercialise more promising glazing applications. Lou Reade reports

The uptake of plastics in cars continues to increase and one of the fastest growing areas is in automotive glazing. Just as designers inspect every metal component to see if it could be replaced with plastics, the same is true for glass.

Side windows, panoramic roofs and headlamps can all now be made in plastics – usually polycarbonate. A recent report from Chemical Market Associates Inc (CMAI) says that plastic glazing is the fastest growing area for polycarbonate.

When glass first began to be replaced by plastics more than 10 years ago, the industry had its sights firmly set on a plastic front windscreen – which would allow huge weight savings at a stroke. But this still remains a distant dream. The technical and legislative challenges of developing a plastic windscreen are huge: scratch-resistant coatings need further development; major chassis redesign may also be necessary, as the whole body of the car relies on the stiffness of the front windscreen; and the cost of glass is relatively low.

This means that other plastic glazing applications – such as rear window modules – will see commercialisation much sooner.

"Right now, people are working on these other areas of glazing," says Michael Fischer, sales manager technologies at injection moulding machinery manufacturer Engel. "Windscreens are a long-term option."

The major benefits of plastics are weight saving, design flexibility and the potential for component integration. All of these advantages are combined in 'rear window modules' – a new concept in which a conventional hatchback rear window is redesigned in plastic, so that it incorporates other parts, such as rear lights, registration plate and radio antenna. According to Fischer, this has huge potential to deliver savings in weight and cost, through parts integration. "For a front windscreen, that kind of integration would not be possible."

Polycarbonate supplier Bayer Material Science (BMS) – which has bought a large injection moulding machine from Engel to test out glazing concepts – showed a plastic rear window module at the recent K2010 plastics exhibition in Germany.

Joachim Simon, head of the automotive and transportation segment of BMS's polycarbonates business, says that the prototype tailgate offers new styling options for car manufacturers. Instead of a

Bayer has used Engel machines to mould a number of polycarbonate glazing components

conventional metal carrier with glass window, the part has an outer skin of coated polycarbonate that incorporates all rear lights, including one for the licence plate. "Everything is included in a single injection-moulded part," he says.

The company is expecting to move ahead with several development projects based on this concept, which explains why it has little interest in front windscreens. "I think that, as long as cars remain unchanged at the front end, there's not much emphasis on replacing glass in the windscreen," Simon comments.

"Maybe when things change – and you have an electric motor on each wheel and a different construction concept – then why not?"

For all its advantages, polycarbonate has one serious downside, in glazing terms: its scratch resistance. However, this can be overcome with the latest coatings. "The front windscreen is the most demanding, in terms of performance," says Stephen Shuler, chief technology officer of Exatec – the plastic glazing arm of polycarbonate supplier Sabic Innovative Plastics. "We're not particularly focused on it right now – we see greater opportunities elsewhere."

Exatec recently signed a deal with Ulvac to improve its offering in plasma coatings for plastics. Shuler explains that all plastic glazing needs a 'wet coat' – which gives around six years of weathering performance. "Adding a plasma coating on top will extend that to 10 years," he says.

"Plastic windscreens are a long-term option" says Michael Fischer

In common with other developers, he sees rear windscreens as a huge market. Sabic's Lexan polycarbonate has been specified in one of the few commercial applications – the Honda Civic in Europe. While this only uses a wet coat, he says that a plasma coating would be needed for applications in North America. "The challenge is to look at wiper performance," he points out. "We need to know how many cycles it can withstand."

Germany's Evonik comes to plastic glazing from a slightly different perspective: it supplies Poly(methyl methacrylate (PMMA), rather than polycarbonate, but says the material has some potential advantages.

"PMMA has excellent weatherability, and a naturally hard surface – but, for normal passenger cars, it would still need a scratch-resistant layer," says Rudolf Blass, director of business development for automotive and surface design.

The material is commonly used in external building applications and has also proved itself in demanding environments, such as aerospace. Evonik is developing glazing applications using both injection moulding and thermoformed sheet.

"Glass will be used for years to come, but the doors are open for alternative materials," states Blass. "Lightweight design is becoming so important that this will increase the use of plastics in glazing."

One potential area is in movable side windows. Again, these need scratch resistance – but probably less than for a front or back windscreen. And while there is a need for part redesign, this opens up the chance of part integration.

"Moving side windows are possible in principle, but some smart solutions will be needed in the construction of the door itself. You cannot just replace glass with plastic."

Possible roadmap for plastic glazing developments

Component	Why do it?	Challenges
Panoramic roofs	Aesthetics, lower centre of gravity	Increasing roof size
Rear windscreen module	Part integration/cost saving	Scratch resistance against rear wiper
Movable side windows	Part integration/cost saving	Design challenges
Front windscreen	Substantial weight saving	Major chassis redesign; scratch resistance

Are you sitting

Ryan Borroff discovers if there needs to be a fundamental rethink in seating design and materials

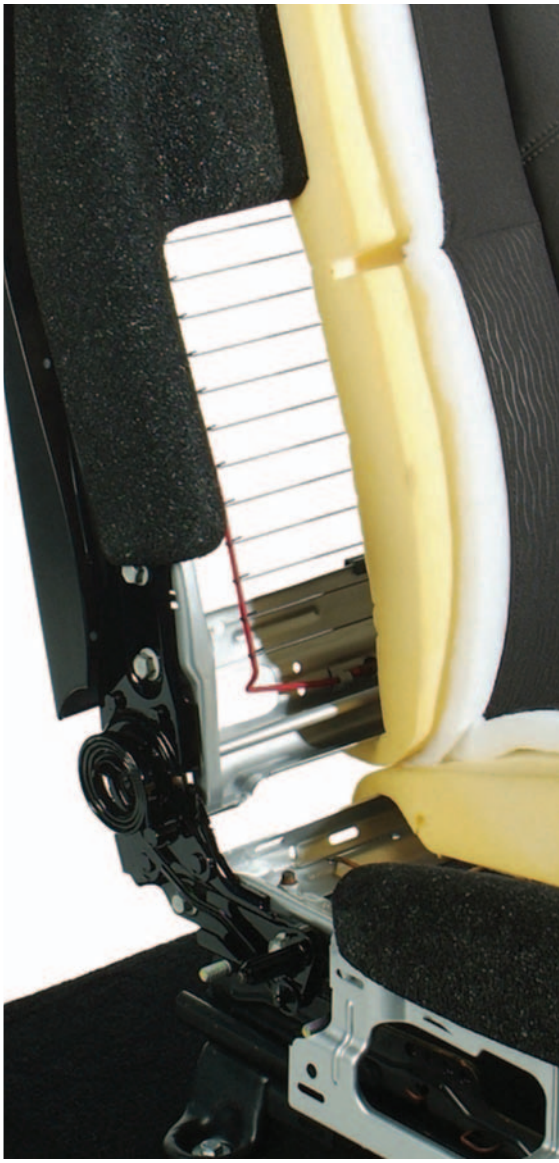
The worldwide trend is towards smaller, more fuel-efficient cars. Yet consumer expectations of space and comfort remain the same. The pressure is on automotive seating engineers to develop seats that are lighter, thinner and less complex, while offering similar comfort and safety levels.

It's a tough challenge made tougher, considering end-of-life recycling requirements and the need to use more eco-friendly materials. But, despite seats representing almost 40% of the weight of a vehicle interior, the evolution of seat design appears slow. Does there need to be a fundamental rethink in automotive seat engineering?

Not necessarily, says Karl Henn, engineering manager, global seating systems, Lear Corporation. "Lighter and thinner seats get a lot of press. This is because mass and thickness are easy to measure. Suppliers are being pushed hard to meet increasingly aggressive mass targets, but there is no sudden revolution – just a gradual trend to thinner and lighter seats. The real frontier is in what the end consumer experiences: in craftsmanship, seating comfort and feature usability, in being able to use seat functions intuitively."

These are not traditional areas of working for engineers, and the trend now is towards a closer collaboration between seat engineers and vehicle designers. If there is a revolution, says Henn, it is in the design engineering process: "From an engineering perspective, this fundamental rethink is beginning. Engineers like measurables, but the seats we need to be engineering now are craftsmanship and comfort focused, which are not easy to measure. The challenge is to find a way to objectively determine how comfortable a seat is and the same with craftsmanship or features usability; to get engineers cross-trained into these types of disciplines, so that we can confidently measure factors such as defining what comfort means.

"Better understanding of seat engineering means we can deal with these issues at the design stage, using robust processes to deal with integration challenges. By using anthropometric data, we have been able to develop comfort and safety features into parts that were serving other functions as well, while lowering mass and making the manufacturing process easier. Now we have to ensure that most of the major parts in a seat fulfil more than one role. For example, our Dynamic Environmental Comfort System (DECS) weighs up to 50% less than other systems. We couldn't do that ten years ago."



comfortably?

The focus is on removing foam and reducing components, either by design or in the manufacturing process. Johnson Controls has been focusing on the seat construction process. The company has adapted a high-frequency welding process to enable designs and imprints to be applied to seating trim covers.

"Usually, the cover of a car seat may comprise anything from a dozen to over 50 parts that are usually found in the central panels of the seat surface and in the backrests," explains Marc Van-Soolingen, senior design manager, seating, consumer & market research, Johnson Controls Automotive Experience. "The traditional method is to weave these designs into the material panels by a flat-bed or round-knit process, before they are filled with a layer of foam and backed with facing material into a complete seat cover. HF welding simplifies manufacturing, as the covers can be created in a single colour, since all of the design elements are applied at a later stage. This technology [means] new colours and designs [can be introduced] to the vehicles in a cost-effective way."

So what about the environment? Some suppliers are already using alternative eco materials in vehicle seats. Lear and Magna Seating have soy-based foam products in production vehicles, though their use has been questioned for competing with food supply resources. Suppliers are looking at developing foam materials from recycled product. Magna Seating is using a new technology to create renewed polyol – the key raw material used in polyurethane foam – from old car seat cushions. The material is now used in the seats of the 2011 Jeep Grand Cherokee.

Meanwhile, Faurecia may yet have shown a future direction for vehicle seating by eliminating foam altogether. Seen in its Light Attitude concept car, its Sustainable Comfort Seat uses two sheets of injection-moulded thermoplastic polyurethane, instead of foam. What would normally be the metal seat frame structure has been replaced by injection-moulded nylon and a long-glass-fibre structural frame. As the head restraints have also been injection moulded, there is no steel or foam used there either. The result is reduced weight and thinner seats.

For tomorrow's car seats, the evolution will continue by using new, non-ferrous materials for structural elements and by the gradual improvement of the seat design through materials commonisation and consolidation. The thin, sculpted seats seen in concept vehicles may yet begin to appear in production vehicles, but "tomorrow's seats will see much more focus on craftsmanship and brand differentiation in the interior", says Henn. "I am not convinced seats will look a great deal different over the next five years or so."

After all, this is an evolution, not a revolution.

Reality check

Anne Asensio, VP design & brand experience at Dassault Systèmes, talks to Mark Fletcher about, among other things, the evolving role of virtual reality (VR), both inside and outside the bounds of the design function.

As one of the leading vendors for CAD and PLM software in the automotive industry, Dassault Systèmes has an important role to play, not only in the introduction of its own new design technologies and methodologies, but also in catering for the needs of the ever-changing automotive design environment.

It's fair to say that, if you want to know what is on the automotive CAD horizon, then Dassault Systèmes' Anne Asensio is a good source to start with. Her infectious enthusiasm for all things car design is immediately obvious and is backed up by an impressive résumé.

After studying design methodology and industrial design at the Ecole Nationale Supérieure des Arts Appliqués in Paris, Asensio began her career at Renault, where she was responsible for driving the design of small- and mid-size cars, such as the Megane. She then moved to GM where she held senior design roles, including executive director of design, advanced design, at the GM's Design Center in the USA. In 2007, she joined Dassault Systèmes where she is currently vp Design & Brand Experience.

On being quizzed about the future evolution of virtual reality (VR), she explains: "In order to understand where virtual reality is going, you need to understand where it has been. It all began with digital mock-ups and designers who were coming from a fictitious representation angle. At Renault, we subsequently developed a combination of VR and real backgrounds before moving to a full CG environment. Although this was immensely powerful visually, it was still centred on the concept of post-design decision making. I knew at that stage that VR was capable of so much more.

"Thanks to advances in GPU power, coupled with ray tracing and global lighting, we are now able to generate really impressive real-time images in CATIA," she elaborates, "complementing one of our key messages – 'real time... anytime'. Not only does this shorten the iterative loop that designers face at the creative phase of the design, thanks to being able to leverage the power of VR earlier, but it also allows other non-designers to use high visual quality collateral and simulations earlier in the vehicle's development phase. This is the 'life-like' paradigm. As the capabilities evolve, VR will no longer just be a designer's tool; during the latter stages of a vehicle's design, it will be a tool for everyone to utilise, even at very early conceptual phases."

"Thanks to advances in GPU power, coupled with ray tracing and global lighting, we are now able to generate really impressive real-time images in CATIA,"

Another step Dassault Systèmes is taking is in the use of VR to simulate real materials and allowing them to behave how they are supposed to behave. "VR, in the future, will be beyond representation; it will be real life," Asensio claims confidently. "You will be driving knowledge with you and will reach your major stages a lot quicker, as long as VR is allowed to use the science of real life.

"In many instances, the rendering of a design is a two-step process," she elaborates. "Designers have to export their designs from CAD and into a rendering programme before generating the life-like images. In CATIA, however, designers can generate really impressive real-time rendered images in the same package – cutting time yet further. I like to think that, in CATIA, a designer will be closer to real life."

One of the more exciting developments, which really seems to have gripped Asensio's imagination, is the development of a new tool, soon to be part of Dassault Systèmes' offering – namely a concept that will allow designers to access 3D from freehand sketches.

Her face lights up and she is clearly excited when talking about this. With her background, it is easy to see why. "We are developing an algorithm that catches curve data," she explains. "Imagine a typical multiple-stroke sketched curve, drawn by a designer. What the algorithm does is pick a best fit from the multiple strokes and then work towards combining them." This concept of predictive curves is almost certainly going to be a very important tool for designers, especially in the very early phase where they might not yet have progressed from the freehand sketching phase.

According to Asensio, there are many other emerging solutions; the issue is how to integrate them into the bigger picture. "It is hard to convert people, especially if they are 10-year proficient on a particular software. It is complicated to manage skill levels and sometimes new solutions do not get adopted, due to skills gaps. Attitude to innovation also plays a very big part.

"My role is push, provoke and propose," she continues. "Look at the Renault Megane. That's a great example. You either loved it or hated it, but it was certainly not dull. We need adventure and alternatives. The car industry is very siloed; designers do get inspired by other industries, but they soon revert to being back in the car industry."

The big question on Asensio's lips is: "What is next? Ford gave us different colours, GM created the concept of obsolescence and Toyota perfected mass production. What will the next step change be?"

In the world of design, augmented reality is a hot favourite, as is customer customisation. Maybe even the car industry will soon be able to say: "There's an app for that."

Prof Dr Uwe Grebe, executive director, global advanced engineering GM

Powertrain developments will be at the core of General Motors global strategy

"When we're looking for greenhouse gas improvements, we look at the entire portfolio: the conventional and electrification, with hybridisation acting as the overlap," explains Prof Dr Uwe Grebe, adding that he sees a number of mega trends for petrol engines. "Downsizing, boosting, especially improvements in lean combustion, HCCI – and the third megatrend is variable valve train. Those all move the gasoline engine forward and there's a lot of potential in diesels as well to have a significant future.

GM, says Grebe, is among the leaders in HCCI technology that are predicting it will happen "in the next couple of years" and that it's one step towards achieving 2015 emission requirements. But he concedes that, for 2020, "there's still a lot of work to be done".

While electrification is going to play a role, he states, "it is not an option to say: 'Leave conventional technology where it is and only focus on electric applications to balance the overall fleet average emissions and fuel consumption'."

Although he does not dismiss diesel, he wants the supply chain to help develop technology that will keep costs in check. "It's all about improving the technology, so we can minimise complexity. If we can integrate NOX after treatment with the particulate filter, and get it in one can, then you can cut costs by eliminating flanges, etc. On the diesel side, there's room for improvement by working with the suppliers on ideas we have on the chemical and precious metal elements to optimise the design and costs involved."

Advances made by GM in developing control algorithms and increasing computing power mean technologies that were once theoretical, or impractical because of cost, are now potential game savers. However, Grebe adds: "Suppliers need to develop more sophisticated and capable injection systems, air delivery systems and after treatment systems – there's a lot of refinement needed.

> "It's all about improving the technology, so we can minimise complexity."

"To keep costs down, we need to look at the whole systems approach. There's definitely more complexity happening and we need to offset that in other areas by integrating more parts with a better understanding of the specifications."

When it comes to whole vehicle development, he says GM has a very clear understanding that this is 'team sport'. "Typically, I show, on the one side, engine downsizing and, on the vehicle side, they use the same chart. The synergies are really starting to happen. Take the weight out of the vehicle and you immediately require a smaller engine; all the technological solutions have the same applicability and effect. A lighter powertrain means lighter mounts; the brakes are smaller and lighter. It's an upward spiral in efficiency."

automotive design

CC

CONCEPT CARS

A mirror to the future

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Designed globally, tailored locally

As car manufacturers strive to improve their efficiencies by creating universal designs, Johnson Controls offers an interiors solution that seeks to suit all tastes and pockets. Ian Adcock reports

"We got the global design team here together in a room at Cobo Hall 12 months ago to thrash out some ideas for a new theme," recalls Johnson Controls' Michael Warsaw, vice president design and marketing, North America, as we stand alongside the ie:3 concept. "The whole model of the auto industry is changing, because of emerging nations like India and China. Currently, they don't want and can't afford the sophistication that European, American, Japanese, etc consumers expect and demand.

But the OEMs can't afford to deliver tailor-made products to individual markets. There has to be a way of customising cars, especially interiors, to individual regions – that's what ie:3 tries to address."

What Warsaw couldn't have known was that, a few hours earlier, I had been talking with Ford's Jim Farley, its global vice president of marketing, shortly after the new Focus range had been unveiled to the predominantly North American media. "The C-sized car is the fastest growing sector in the world. In the States, it accounts for 30% of sales. It's the new profit point and it's proving equally popular in China, India and South America. The challenge is we can develop a universal car, but then we have to hone it to local needs; and what Americans or Europeans expect as a matter of course, the first-time buyer in India or China doesn't. We have to address that."

The established motoring nations might consider themselves to be sophisticated, but, as Warsaw and his colleagues discovered, they, too, can learn and be inspired by the needs of people who are becoming motorised for the first time – more than a century after Europe and North America abandoned the horse.

Johnson Controls ie:3 concept is immediately recognisable as a Kia Soul, but nothing should be read into that, beyond the fact that its dimensions came closest to what the design team was looking for.

Dedicated plug-in facility for JCI's latest concept

"We looked at what typical small and tall vehicles were available and it just so happened that the Soul came closest to the interior dimensions we were looking for."

The ie:3 features the debut of

Interior features recyclable materials for the fascia (top) and stretch weave in the doors (below)

Johnson Controls-Saft's next-generation, low-profile lithium-ion battery pack. It is a unique, self-contained system that's integrated easily into the vehicle in a small space under the floor, giving the car a 160Kms range. The new prismatic format cell achieves greater packaging efficiency and uses less space in the vehicle.

"The cells are stacked like slices of bread," explains Warsaw. "With their rectangular shape, rather than cylindrical, it means we were able to stack all 216 cells very close together. Whilst it has a large footprint, it's only 152mm deep and, because of that, we can put them under the floor to create a flat area, freeing up much more space that we can utilise in the small environment and that helps to set up everything for the interior design.

"That means we can have some interesting things, like cantilevered seating for the rear and front passenger seats, which folds up like a theatre or cinema seat."

Theatre-style seating isn't new. Volvo showed it as long ago as 2004 in its Your Concept Car (YCC), although, in that case, the folding theatre-style seats only applied to the rear.

Safety and particularly cost have been cited as reasons why this seating system has never made it beyond the concept stage, but Warsaw says that all the technology previewed in the ie:3 is credible and could be in production by 2015.

"The seat is part of our overall core modular structure that is a well defined portfolio of mechanisms and tracks we've had for years. This is a new kinematic and configuration, but it's not totally new in the approach.

"There are some unique things, such as a one-piece metal stamping back frame, which is quite a trick to achieve. That means we can get all the strength, safety and lightweight out of it, but with interesting kinematics, so we can do the stadium fold flat."

Warsaw maintains the front seat's default setting would be in the folded up position. "Most of the time, cars carry just the driver. So, with the front seat folded, there's additional, easy access space for luggage, shopping or a briefcase. We've also freed up storage in the centre tunnel for a handbag or umbrella."

The base of the front passenger seat is also slimmer, and cantilevers up and down, so that, with the backrest folded flat, it converts into an Ottoman-style footrest.

"We found in emerging markets that the rear seating is often more important than the front, as a lot of people can't drive and have chauffeurs. We wanted to create something special, so the rear seat backs have a 45° recline. That, combined with the front Ottoman, transforms the interior into something quite special, especially in a car as compact as this that would appeal to owners in Europe or the States, as well as emerging markets," comments Warsaw.

"The other thing, too, is that, even if there's only three people in the car and you think of dad driving with mom in the back with the child, you can have the seat all the way down and you don't have the barrier of the front seat. That's an interesting way of thinking about the space available."

Johnson Controls, states Warsaw, has introduced a wide range of new materials in its latest concept, which, following current trends, are manufactured from bio materials for easy recycling. "Compression corn is used for parts

Kia-based concept displays versatility of theatre seating

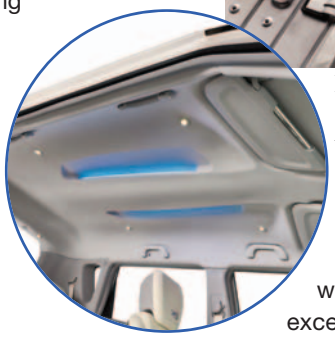
of the colour trim, with the upper parts of the instrument panel featuring natural fibres. It's an alternative to injection-moulded plastic parts and, in this case, the compression corn parties are covered by a polypropylene thin film that is extremely durable to create a great looking grain. PPthin film is used on production cars today where there is high wear rate, such as sills and rear three-quarter panels, and, because of its high durability, it won't scratch.

"The grain is in the mould, so you could put any tactile finish on it you want. On the lower part of the fascia, polypropylene wheat stock is used; we're taking part of wheat that isn't used commercially and putting it into the polypropylene, giving a rice paper-like effect. It has a very interesting appearance and it comes out of the tool that way, so it doesn't need any extra finishing material or paint."

But the most intriguing material used is an open mesh with a liquid repellent nano coating stretched over what would be a glove box lid and used in the door pockets where its backlit by light emitting diodes. The manufacturer could have this woven into any pattern or use it as a diffuser, in place of conventional air vents. "We've really tried to accentuate this and, as you open the lid, the fabric transforms, stretching over a bone line to create a beautiful image," adds Warsaw.

The floating centre stack screen and main instrument panel both use transflective liquid crystal display, with the pixels illuminated from both the front and the back, so they can be easily read, even in the brightest sunlight. The driver's instrument panel also features a neat flip-up glass screen that projects vital information to the driver via a head-up display, beamed two metres ahead of the car.

Weight is further reduced and storage improved by eliminating loudspeakers and replacing them with a quartet of transducers, mounted in the roof lining, that use digital signal processing that delivers a 'sound shower' to individual occupants. "As well as saving packaging and weight, the sound quality is excellent and the system could be developed so each passenger could tune the volume to their own taste or even switch it off altogether," says Warsaw.



Latest battery technology (top). Ceiling mounted transducers (below)

"We've pooled together great ideas from around the business, but ideas are only as good as its application. Looking at and understanding emerging markets will affect how we approach the established ones as well, because it makes us look and think differently. There are some things we wouldn't have thought of, like the recline in the back seat and using the front one as an Ottoman, if we were designing just for Europe or the States.

"That idea came from the emerging markets, but would be equally applicable to a car for a western customer, whilst the emerging market customer might not want the complication of an HUD or the DSP. But both of those could be left out in a much simpler interior that wouldn't require the OEM to have a separate production line," he comments.

And that's what the future is all about: maximising flexibility to satisfy customers on a global basis.

EV race gathers pace

Ryan Borroff finds out if the concepts electric vehicles for the 2010s are mere flights of fancy or will have a bearing on the future

Peugeot EX1 concept (above) and joystck steering (below left), with Poirel (below right) and Zytek smart (bottom left).

If 2010 showed us anything, it's that the race between car manufacturers to develop their own electric cars or even spin off their own electric vehicle (EV) brands is frenetic. Automakers are working quickly to develop their own EVs, with the help of the supply chain. However, except in a few cases, there is currently no clean slate from which to work, meaning the ultimate goal of designing an affordable electric vehicle, with comparable performance to an IC-powered vehicle, is compromised.

Concept cars, though once mere flights of fancy, are now more likely to be test prototypes for future products, particularly in the accelerated world of EV development. Commonly, suppliers are tasked with helping automakers incorporate electric drivetrains into existing vehicles or to use as many existing components as possible.

EV concept designs are moving rapidly into production, while legislation and regulations struggle to keep up; which means the opportunity to develop a fully optimised electric driveline – with little or no compromise – is elusive.

Peugeot's EX1 concept – first seen at last year's Paris Motor Show – is an advanced high-performance prototype that has notched up a number of EV performance records. Constructed of carbon fibre, the concept incorporates a lightweight, low-friction, single-pinion electric power steering (EPS) system from Nexteer Automotive.

The company had to work quickly – it had just one day – to install the system, a task that was not without some challenges.

"The steering geometry [on the EX1] was completely different to the production vehicle we are supplying, which meant it required different connection points," explains Paul Poirel, Nexteer Automotive's chief product engineer, Europe.

"The first consequence of this was that the steering ratio – the number of degrees that you turn the steering wheel to turn the wheels, was completely changed – from 17 degrees [at the steering wheel] on the production vehicle, to 12 degrees on the concept to achieve the same one degree wheel movement.

"There was a drastic increase on the required steering input from the driver, so we needed to increase the assist level of the concept's steering system. As there was no time to come up with a prototype motor with increased output, we had to use an existing motor, which meant we had to play with the different calibrations in the software to get the most out of it. This was a difficult balancing act, because you have to be careful not to add instability into the system and end up with undesirable steering wheel oscillation, which would have been the consequence."

For now, there seems little future for PSA's EX1 beyond more record breaking. But, as Neil Heslington, managing director of Zytek Automotive, explains, in the new frontier of EVs all lessons learned are valuable. "Developing an EV prototype has to give us some

genuine insight into, or a definite way forward for, a series vehicle," he points out. "That means you have to make the prototype reflect the work you have to do to get it into production. EVs have moved from being conceptual, as in 'what would an EV look like' or 'how would it perform', to 'how do we make a genuine EV alternative to a combustion car?'"

Zytek Automotive has taken the electric smart fortwo from prototype to 1,500 example series production and now operates the production cell at Daimler's smart plant. "In the case of the electric smart, the drivetrain was designed to be a replacement for the IC engine. It sits in a near identical manner in the rear sub frame. So, from a production installation perspective, it was straightforward," says Heslington.

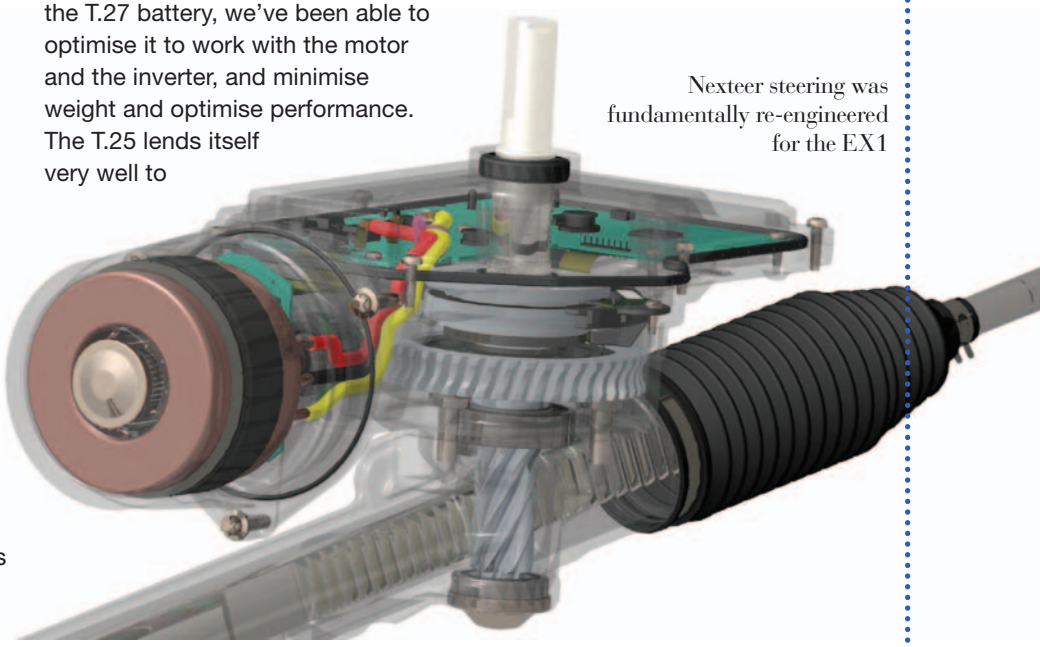
Ultimately, with technology dictating the way cars are constructed, the opportunity for optimising EV design will be dependent on fundamentally changing the way cars are built. In its T.25 and electric T.27 cars, Gordon Murray Design has done this, which meant that Zytek's involvement in the T.27 development, if not entirely clean sheet, was close. "On most EV concepts, battery packaging is a huge consideration. It's a trade-off between energy versus weight and cost," comments Heslington. "The integration of the driveline systems – motor, power, electronics and so on – is very important. As we designed the T.27 battery, we've been able to optimise it to work with the motor and the inverter, and minimise weight and optimise performance. The T.25 lends itself very well to adopting EV technology."

For now, suppliers understand that maximising the performance of the driveline systems is paramount to future EV success. Six suppliers – Valeo, Leroy-Somer, Johnson Controls, GKN, Michelin and Leoni – have joined forces to develop a fully optimised electric driveline.

Focusing on economy, performance and weight reduction, each member of the consortium will work to develop every component from common specifications, so that the chance of developing a fully efficient EV is possible.

BMW is already on the way. Its Megacity car – which should arrive in 2013 – is one example of a second wave of EVs that will be constructed differently, in order to optimise performance. A clean sheet design from carbon-fibre reinforced plastic and aluminium, the Megacity will have a reduced part count and should be cheaper to build, though not cheap to buy.

Such innovation should mean that the next generation of EVs will be a more exciting, and enticing, proposition for car buyers when the advantages of EV ownership outweigh the lifestyle compromises. For city dwellers at least.



Nexteer steering was fundamentally re-engineered for the EX1

A FORCE *for the* FUTURE

'KODO – Soul of Motion' represents the next generation of Mazda design. Ian Adcock talks to the men behind this new theme

After nine years of European-led design – first with Moray Callum, younger brother of Jaguar's Ian Callum, from 2001to 2006, and then Laurens van den Acker until last year – Mazda has turned back to home-grown talent and appointed 51-year-old Ikuo Maeda as its new design chief.

A Mazda veteran of 28 years, he is the son of Matasaburo Maeda, who penned the original RX7, and, unlike his past two predecessors, has committed himself to a 10-year stint at the Hiroshima manufacturer. "Moray and Laurens weren't at Mazda long enough to implement their design changes. My brief is for a decade," he explains, which would take him through to the end of a career that has already produced the RX-8 and Mazda2.

The Shinari, a Japanese word describing the powerful, yet supple, appearance of great resilient force when objects of high tensile strength, such as bamboo, are twisted or bent, is his calling card and the template for future Mazda designs from 2013 onwards.

Although Mazda has design studios in Yokohama, Irvine (California), and Oberursel (Germany), the Shinari was principally a combined effort by teams led by US director of design Derek Jenkins, for the interior, and chief designer Yasushi Nakamuta, for the exterior. It is loosely based on a next generation C-D platform slightly larger than the current Mazda 6.

After its Nagare design philosophy, which took its inspiration from nature, water and sand, Maeda is drawing his stimulus from Kodo – or the soul of motion, as envisioned in the moment a predator strikes it prey to express the moment where energy is instantly released. This is characterised by crisp character lines and sculpted body lines, combined with pronounced cab rearward proportions over powerful rear haunches.

Unusually for a concept car, it wasn't previewed at a motor show, but at a private viewing in Milan. "We wanted journalists and other influencers to have the time and opportunity to examine the car in detail and talk with the design team at length, without the pressure of a motor show," explains Maeda.

While the Shinari didn't preview any novel structures, Clive Birtwhistle, design manager at Mazda's European research and design centre, predicted greater use of lightweight materials in the future. "New lighter weight materials will be much more prevalent and the whole way that a car is constructed is going to change greatly. Advances in materials – particularly plastics – will see complex parts and systems simplified and even eliminated. For example, wheels and tyres may become one single unit. The ability to form single

components within areas or of different stiffness may lead to simpler suspension systems. The entertainment systems in cars will be much more linked to the mobile devices that the owner has with him. All this will mean greater weight and energy savings.

"As concept designers, we need to be aware of what's coming, and be intelligent and create very clever solutions for future challenges."

He talks of materials transforming from two- to three-dimensional shapes or converting from flexible to rigid when impacted. "The good thing about the major suppliers is that they have a competency in things we might not know about, so I am not excluding that kind of support or innovation. But the creativity is my responsibility."

Like all designers, Birtwhistle is battling the CO_2 challenge and has some interesting solutions that would pose suppliers intriguing questions.

"In terms of manufacturing cars, it would be good if we could take some of the content out, by exposing inner structures that have an aesthetic we can show.

"In future, with low-cost small cars, maybe we'll go back to manual or slide windows, and get rid of electric motors and panels. Bespoke areas for side impact bars or airbags won't be hidden, but exposed like an exoskeleton structure. Tooling costs could go up to get the right finish, because body-in-white is unbelievably crude. Lightweight construction is an easy way of improving fuel consumption and reducing CO_2. The thing about materials like carbon fibre is that it's relatively easy to produce, but the problems come in a crash when you take the car in for repair. In future, more body components will be bolted or glued together, for ease of repair."

Although the Shinari's interior eschews Birtwhistle's radicalism, Irvine-based designer Derek Jenkins has incorporated some novel features, such as its communications and navigation system, which can plot the most efficient route, avoiding traffic delays, and search websites such as LinkedIn to download profiles of people that he or she will be having appointments and meetings with throughout the day.

In the evening, the driver could use the communications system to recommend restaurants and even download his/her partner's favourite online music store.

If this sounds familiar, it's because Visteon, with last year's C-Beyond concept, envisioned a similar infotainment strategy. Jenkins assures me that this is coincidental, but indicative of the way the industry sees the role of the car changing in years to come.

The Jenkins designed interior has an air of stylish quality to it, but, says Birtwhistle: "The next generation Mazdas will make a big effort in interior quality which we've lacked – the surfaces, materials, fit and finish, the haptics. If we can at least demonstrate that we are building cars that have prestige attributes, then we might persuade some customers from other mainstream vehicles to come over to us."

And that will be a big challenge for both Mazda and its supply chain.

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At AR Europe, we supply a variety of test equipment and systems for RF and EMC testing, electrical safety, magnetic and radiation hazards. Our products have supported the defense, university, government, semiconductor, avionics and aerospace, test laboratories, research and development and manufacturing markets for more than 40 years.

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Company details:

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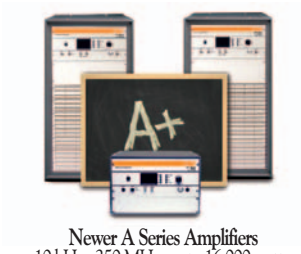

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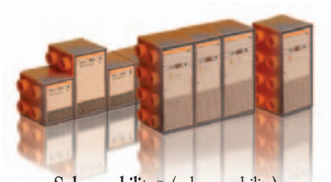

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BOSCH – invented for life

Innovation continues to drive growth at Bosch

Bosch continues to maintain its position as a leading global supplier. The company's products can be found on virtually every make of car currently manufactured throughout the world. To maintain its technological lead, Bosch once again invested substantially in research and development, spending around 4 billion euros in 2010.

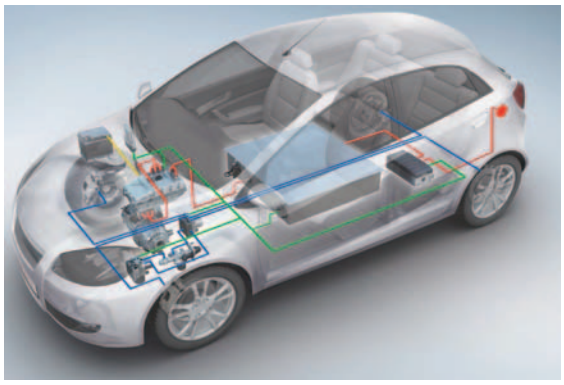
Automotive Technology is the largest Bosch division. The seven business areas are: injection technology for internal combustion engines, powertrain peripherals, alternative drive concepts, systems for active and passive driving safety, assistance and comfort functions, technology for in-car information, navigation and communication, as well as concepts, technology, and service for the automotive aftermarket.

Internal combustion engines still have great potential

The company's aim is to make personal mobility as eco-friendly and efficient as possible. Bosch believes that whilst automobiles of the future will be powered by electricity, the conventional internal combustion engine will remain the dominant drive technology for the next 20 years.

In the years ahead, reducing fuel consumption, and thus CO2 emissions, of the vehicle fleet will mainly be achieved by further optimising internal combustion engines. The trend for engine downsizing should mean a further significant fuel reduction for both diesel and gasoline engines.

By combining improvements in the company's common-rail injection technology with other engine-related developments, the fuel consumption of diesel engines can be further reduced by 33 percent. Bosch is also working on a common-rail system for high-performance engines. This uses injection pressures of over 2,000 bar and piezo valves to atomise the diesel fuel even more finely.



EV technology goes into series production

Since the start of 2010 Bosch has supplied technology for the hybrid versions of two European vehicle models. Furthermore, the company's SB LiMotive joint venture for automotive lithium-ion batteries was awarded its first contracts. From the electric motor and power electronics to the battery, Bosch offers automakers all the components they need for the electrification of the power-train, whether for hybrid vehicles or for all-electric cars.

Component optimisation

Bosch also achieved further reductions in fuel consumption by developing innovations for auxiliary powertrain systems. In 2010, for example, the company supplied the two-millionth starter for start-stop systems. The system can be further improved by operating in conjunction with the Bosch developed high-efficiency generators.

Driver and pedestrian safety

Bosch activities include the development and production of the following systems that are essential for future driver assistance and safety technologies: ESP® (electronic stability program) provides comprehensive data on the movement of the vehicle at any given time. Networked with other systems, it can automatically stabilise the vehicle by applying the brakes at single wheels. Radar systems provide information about traffic ahead. They are currently used by ACC (adaptive cruise control) as well as predictive collision warning.

Bosch is currently working on predictive emergency braking. Studies show that more than a third of all drivers do not hit the brakes in a rear-end collision. Bosch's systems are designed firstly to warn, then to assist and lastly to brake automatically.

In many cases, an initial collision can often be followed by further collisions – measures designed to minimise their effects are known as secondary collision mitigation (SCM). The early pole crash detection (EPCD) function links the ESP® and the airbag control. If the ESP® sensors detect any crucial lateral movement of the vehicle, the airbag control will prepare for a possible side impact. In this case, the side and head airbags can be activated faster than usual.

BOSCH
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Contact details

For more information on these and other Bosch technologies please go to www.bosch.com or www.bosch.co.uk

www.docteroptics.com

DOC3D: High-Tech Optics for Projection Headlights

Lighting technology has always been a high priority issue in the areas of automotive design and production. In recent years, however, this subject has been attracting even more attention, and industry experts assume that lighting technology will become even more important in the future.

There are various reasons for this development. First of all, automobile manufacturers want to use the design of headlights to make their vehicles stand out – night and day. In addition, ongoing improvements in the development of vastly different light sources like HID and LEDs are contributing to this interest. And, finally, the fact that this technology meets the special needs of electric and hybrid vehicles has also attracted the interest of designers.

Cadillac Escalade with full-LED headlights

A Major Milestone – DOC3D

The percentage of vehicles that feature projection headlights as standard equipment is increasing worldwide. The DOC3D process developed by Docter Optics, the market leader in the production of projection lenses for automobile headlights, has been very instrumental in driving this trend.

Free-form lenses for LED headlights

That's because proprietary Docter Optics technology makes it possible to mold optical glass to produce projection lenses of consistently high quality by using a complex thermal process. This represented a milestone not only in terms of economic large-scale production, but also in terms of the potential for lens design.

Freedom of Design

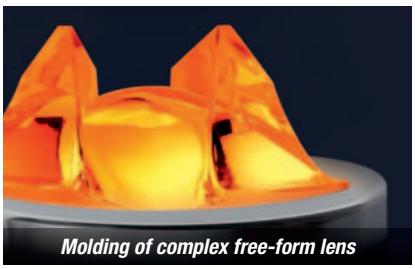
The DOC3D process, which has undergone constant improvement, now stands for the ultimate in freedom when it comes to the design of projection lenses. The production of high-precision aspheres with different signlight or other AFS functions, for example, would previously have been inconceivable without DOC3D technology. The DOC3D process developed by Docter Optics now makes it easier than ever before for designers to give the vehicles they create a completely unique look. After all, this technology represents the only economical way to produce free-form lenses like the ones used for LED headlights with sufficient precision.

LEDs & DOC3D

One of the benefits of full-LED headlights is that high-performance LEDs have a long service life of 50,000 hours and more. As a result, headlight manufacturers are especially interested in free-form lenses that resist yellowing or cloudiness for a similarly long time, and DOC3D optical glass lenses fill the bill in every respect.

Reliable Delivery

Docter Optics ships over 20 million lenses per year to the automotive industry. As a result, the company has the resources it takes to offer carmakers throughout the world not only the benefits of advanced production technology and high-quality products, but also efficient logistics and reliable delivery.



Molding of complex free-form lens

DOCTER® OPTICS

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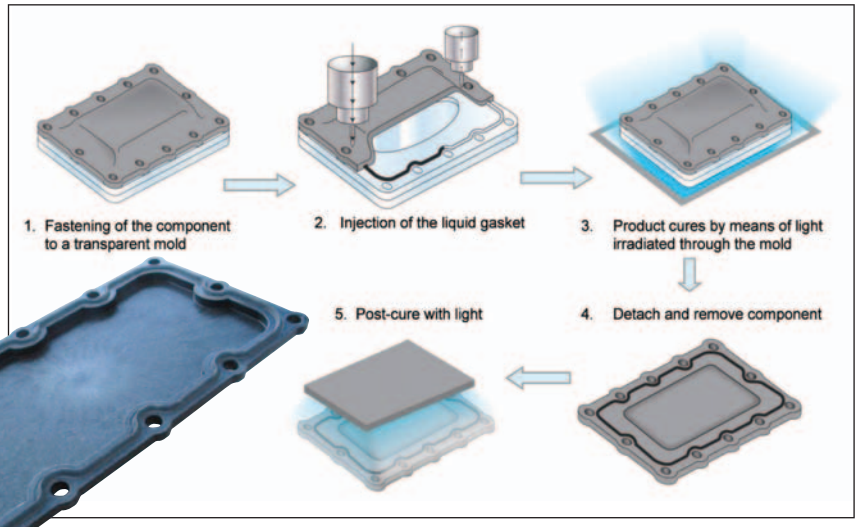
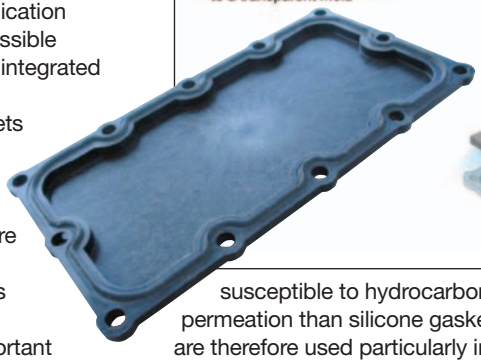
www.henkel.com

New gasketing technology

Henkel has engineered a novel processing technique for liquid gaskets that is better suited to automotive industry needs, offering substantial benefits such as major cost-saving potential and enhanced production flexibility. The new Loctite Mold-in-Place (MIP) gasketing technology combines the use of an advanced gasketing material with a unique application process which makes it possible produce components with integrated gaskets.





For decades, the gaskets used were mainly made of silicone rubber, for example in the form of O-rings. In the meantime, there is a strong trend toward organic gasketing materials based on acrylate blends. Polyacrylates have an important advantage over conventional silicone-based rubber gaskets as they are more compatible with the high-additive oils normally used in vehicle power trains. But these gasketing materials also offer considerably better performance when it comes to meeting increasingly stringent environmental requirements. In addition to reducing the rate of hydrocarbon emissions from the vehicle engine through the exhaust system, a major consideration when designing modern engine gasketing methods is permeation through the gaskets themselves.

Henkel chemists have succeeded in formulating a specialty polyacrylate-based, one-component liquid gasketing material, marketed under the Loctite brand, that is already being used by leading automotive OEMs as an FIP gasket for power train applications. These gaskets are ten times less susceptible to hydrocarbon permeation than silicone gaskets and are therefore used particularly in engines required to meet LEV (Low Emission Vehicles) or ULEV (Ultra Low Emission Vehicles) specifications. This material has been re-engineered specifically for the new Loctite MIP process and is now available in a transparent version. The advantage of this polyacrylate liquid gasket is that it cures within seconds when exposed to UV light.

The new Loctite MIP manufacturing process consists of five steps. In the loading/unloading station a transparent mold is fixed to the actual component and the assembly is then moved into the injection molding station. The special gasketing material is injected through a dispensing needle at low pressure and at room temperature, the process being monitored by pressure sensors. The liquid gasket is then cured in place within seconds by UV light radiated through the transparent mold. Once the component has been detached from mold, a brief post-cure irradiation is required to dry the surface of the high-performance MIP gasket.

One of the most important benefits of using the Loctite MIP technology is its capability to reduce manufacturing costs. Compared to manufacturing processes using conventional elastomeric compression gaskets, the energy costs are significantly lower because the process eliminates the need for compounding and vulcanization. Nor is any post-vulcanization required, which results in considerable time savings. Further compelling benefits include faster cycling and the elimination of manual work steps, which automatically improves quality. Enhanced production flexibility is another advantage. The new automatic process permits the molding of gaskets in many different geometries, which makes it possible to manufacture even small series of components quickly and at low cost.

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www.interzum.com

interzum 2011 on course for success

Once again, experts from the industry and trade visitors will be meeting up at interzum in Cologne, Germany, from 25-28 May 2011, to discover global product innovations, and the latest technologies and design trends on the market. The world's leading trade fair for furniture manufacturing and interior design is the stage on which the entire international industry presents its latest innovations, and, in doing so, sets global trends.

There are already 700 registrations for interzum 2011, 75% of which come from abroad, and just short of 60,000 square metres have already been booked. Around 1,450 exhibitors and more than 50,000 visitors are expected in May. With its international mix of exhibitors and visitors, the trade fair not only combines the domestic markets, but also promotes internationalisation in the area of furniture manufacture and interior design.

In 2011, interzum will continue to live up to its reputation as an exhibition of innovation, inspiring the industry with the exhibitors' latest trends in seven product segments. Each of the exhibition halls focuses on a different theme. The 'innovation of the interior' project in hall 4.2 presents new applications for interior design, including special materials such as solid surface materials, new types of coatings or direct printing technologies. Hall 5.2.is devoted to the natural materials such as wood, veneers, parquet and interior design. In halls 5.2 and 4.1, visitors will find semi-finished products for free-standing cabinets, kitchens, office furniture and dining room furniture. The 'Form & Decoration' section, including decorative surfaces, papers, laminates, wooden materials, embossed cylinders and metal sheets are to be found in hall 6. Halls 4.1, 7 and 8 accommodate functional fittings, locks and furniture installation components. Halls 9 and 10.1 house all the providers of machinery for upholstery and mattress production. In addition to which visitors will find everything associated with the theme of 'Comfort & Bedding', such as upholstery materials and accessories, cover fabrics and leather, in halls 10.1 and 10.2. The presentations focus on the use of textile materials in mobile living spaces such as aircraft, yachts and cars.

Next to the stands of a large number of exhibitors, various piazzas provide an insight into the use of natural materials, surface and texture options, and textile processing. Much more information, including the latest news about the world's leading trade fair, can be found online at www.interzum.com.

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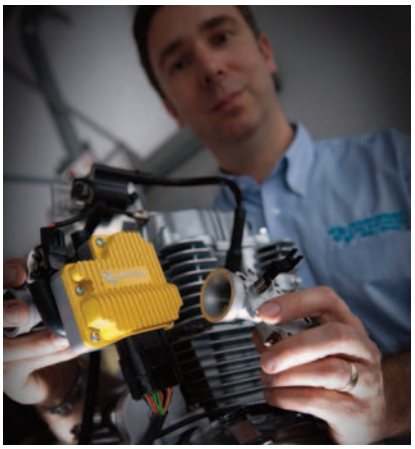
www.protolabs.co.uk

Proto Labs helps Scion-Sprays to win €4million order

When it needed fully functioning prototypes for an affordable, engine management system to impress a potential customer, Scion-Sprays Ltd, based at the Hethel Engineering Centre for advanced manufacturing, near Norwich, chose the award-winning, rapid manufacturing services of Proto Labs®.

Founded in 2002 by Jeff Allen (a former Chief Engineer at Lotus Engineering) Scion-Sprays grew out of research into the electrostatic atomisation of fuel. In the process, Jeff (who is now the firm's Technical Director) came up with the idea of a small, low-cost, constant volume displacement pump, to control fuel flow rates. As

Richard Hoolahan, Scion-Sprays' Manufacturing Manager, says, "That pump proved to have greater market potential than the original research because of its efficient, clean-burn credentials and its simplicity." So with backing from an 'angel' investor, who saw both the business and the environmental benefits of the technology, Jeff and a small team set about developing Scion-Sprays' innovative engine management system called Pulse Count Injection (PCI) and with the help of rapid prototyping services First Cut®



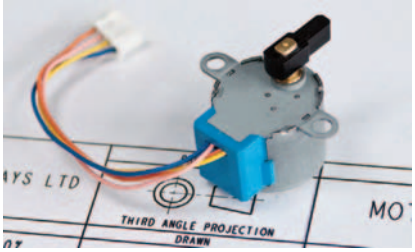
and Protomold® from Proto Labs, is now moving out of development and into production.

By 2006, Scion-Sprays had produced its first working PCI prototype, which in turn led to the development of a fully integrated Quantum Fuel Injection (QFI™) system. The modular design of the QFI system includes a throttle body, PCI technology, sensors, idle control and ignition.

It was while developing a prototype of its QFI for a prospective European customer in the early part of 2010 that Richard Hoolahan turned to Proto Labs. "I needed about 15-20 pre-production QFI systems for customer-testing, which meant they had to be fully functional and made from similar, if not the same materials that would be used in actual production units. I used different rapid prototyping services to produce less critical components," he says, "but chose Proto Labs for the throttle crank and the stepper motor arm because there could be no compromises in the mechanical qualities of those parts."

Richard contacted Proto Labs using the company's two interactive, online quotation systems: ProtoQuote® and FirstQuote®. Both systems let him upload his 3D CAD models and then within hours sent back an accurate quote – not an estimate.

"I was very impressed with the process," says Richard, "It was so easy. Online quoting systems rarely work as advertised, but this time they did. The Proto Labs systems gave us a complete price based on our CAD models; a price



that was updated instantly when we changed the quantity or material, so we knew what we would pay for what we wanted."

The machined parts were delivered within three days of Richard accepting the quote: "And that was their standard delivery – they can do it even faster if we want. The moulded parts took slightly longer but that is because tooling manufacture is required. Nevertheless, they were with me in a matter of days, not months, like other suppliers."

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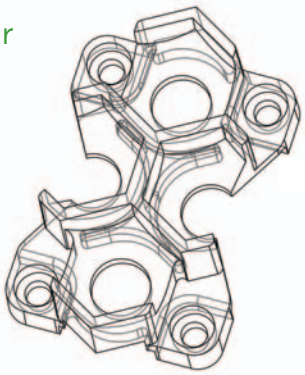

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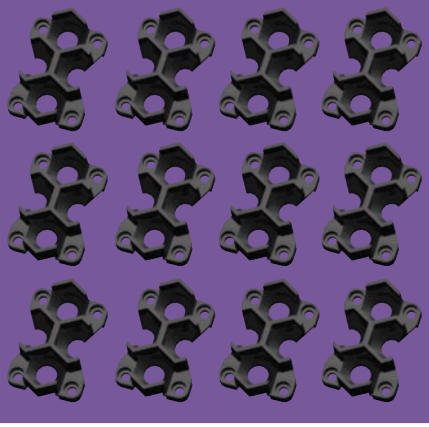

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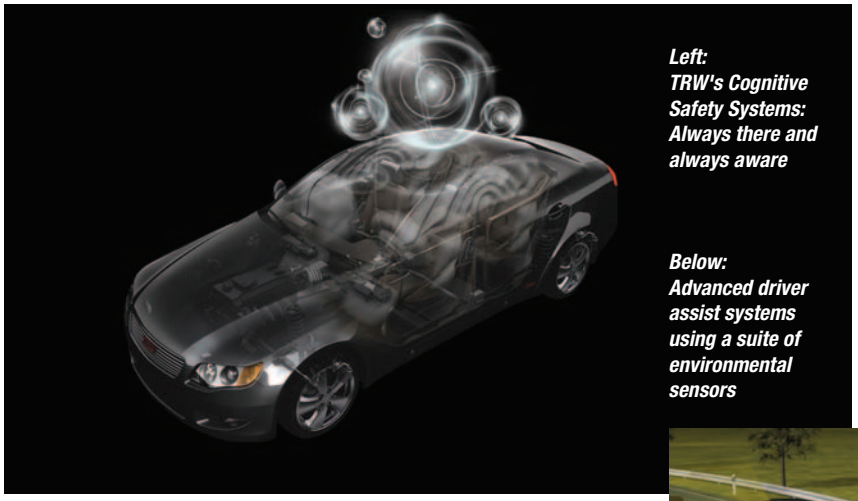
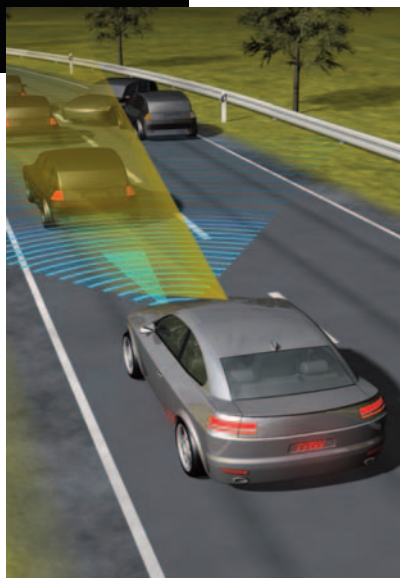
The safety everyone deserves



Left: TRW's Cognitive Safety Systems: Always there and always aware

Below: Advanced driver assist systems using a suite of environmental sensors



TRW Automotive is the global leader in automotive safety systems. The company designs, develops and produces a broad array of active and passive safety products – braking, steering & suspension, occupant safety systems and enabling electronics.

TRW is constantly seeking ways of ensuring it can deliver advanced systems for the complete range of passenger vehicles - not just the luxury segment – for every market in the world. TRW has more than 60,000 employees across more than 180 locations in 26 countries.

Portfolio

As well as its active and passive safety systems, the company produces body control systems, engineered fastening systems, engine components, commercial steering systems and aftermarket replacement parts.

Cognitive Safety Systems

TRW uses the term Cognitive Safety Systems to describe how "we put the thinking" into vehicle safety systems. By creating more intelligent systems, we aim to raise safety to a higher level than ever before.

TRW looks at Cognitive Safety Systems under the headings of: Advanced Thinking for safety; Green Thinking for fuel efficiency; and Smart Thinking for value.

Advanced Thinking

TRW is making cars smarter to help keep people smarter. Seamlessly integrated technology that senses, analyses, anticipates and acts in response to everchanging conditions. Examples include Automatic Emergency Braking, Lane Keeping Assistance, Safety Domain ECU, Adaptive Airbag and Seat Belt Systems.

Green Thinking

To help automakers meet their CO_2 emissions goals, TRW offers a range of fuel-saving and hybrid-enabling technologies, including electrically powered steering, slip control boost - a fully integrated electronic stability control and brake actuation system - and light-weight components.

Smart Thinking

TRW is developing cost-effective technology that helps protect drivers and passengers everywhere. Modular systems designed to make the latest safety systems affordable across the globe and integrated technology, scalable to any vehicle class. Technologies include Scalable Airbag Control Unit, TRW's modular ESC family, mid and short range radar sensors, and modular airbag kits.

TRW has the broadest portfolio of any safety supplier and is committed to help protect drivers, occupants and other road users all over the world. Its team of more than 5,000 engineers are working to deliver the safety everyone deserves.

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All fluid solutions from one source

Hannover, January 2011. As development partner and original equipment supplier, ContiTech Fluid Technology channels the full gamut of media flows in the auto and many other key industries. The product range extends from hose components through to complex line systems. The development and production of perfect-fit connection technology likewise demonstrate the company's systems expertise. The customers profit from this one source capable of offering the full gamut of fluid solutions. This business unit of Hannover, Germany-based ContiTech AG scores, moreover, with its wide-ranging material and process competence, extending from rubber technology through to plastics technology.

Customised all-in-one solutions – consisting of hoses, tubing, fittings and quick couplings – that transport the media required to guarantee that the

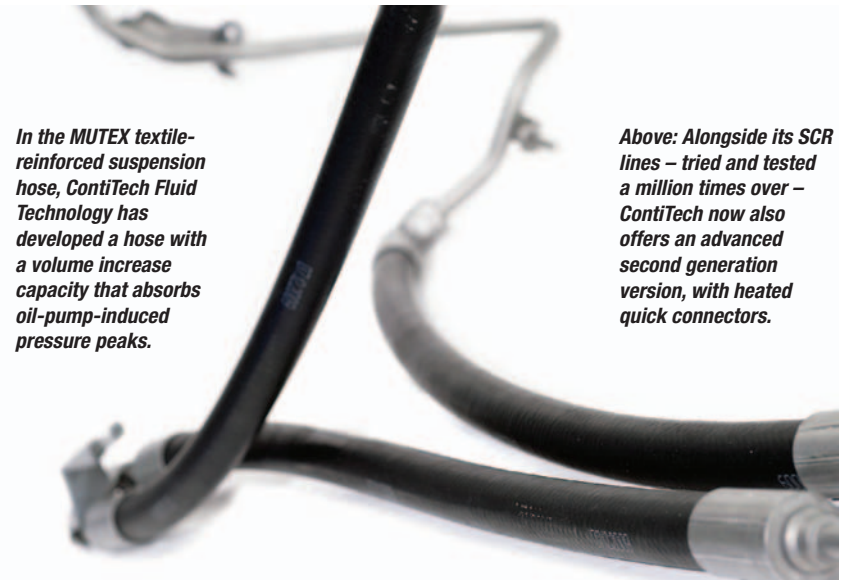
engine is supplied with fuel are also an element in its product range, as are innovative solutions for exhaust gas management. These include heatable hose modules developed specifically for 'Selective Catalytic Reduction' (SCR) technology, as well as hoses and hose lines for particulate filter systems.

The optimum integration of hoses, tubing and fittings enables ContiTech Fluid Technology to produce tight connections for AC units – including those designed to use eco-friendly refrigerants of the future like CO_2. Whether it's hose material sold by the meter, molded hoses or complete line systems with integrated functional parts – also for heating and cooling circuits – the components and complex modules developed by ContiTech Fluid Technology meet the most exacting requirements, in terms of flexibility, pressure and temperature resistance. In the case of hose lines for engines and transmissions, for example, continuous optimisation and advanced development of materials allow for the use of virtually all petroleum-based or synthetic oils commercially available.

Charge air hoses and lines have to withstand ever higher pressures and temperatures. ContiTech develops and produces solutions that meet the most demanding performance requirements for tricky clearance situations. In response to direct customer orders, ContiTech additionally develops specific solutions for hydraulic and electro-hydraulic power steering. In the case of brake and clutch systems for commercial vehicles and passenger cars, the product range runs from pressure-resistant and thermally stable rubber hose lines, through to compressed air brake line harnesses with a practical plug connection – all tailored to the customers' specific needs.

What is more, ContiTech Fluid Technology develops and manufactures all types of intake hoses for use in supplying air to the engine, as well as pneumatic pressure hoses for controlling automotive power units.

With more than 10,000 employees, ContiTech Fluid Technology produces hoses, curved hoses, hose lines and tubing at 29 locations all around the world. In 2009, it realised sales of approximately €860 million.



In the MUTEX textile-reinforced suspension hose, ContiTech Fluid Technology has developed a hose with a volume increase capacity that absorbs oil-pump-induced pressure peaks.

Above: Alongside its SCR lines – tried and tested a million times over – ContiTech now also offers an advanced second generation version, with heated quick connectors.

Continental CONTITECH

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Ticona Engineering Polymers

50 Years of Metal Replacement Innovation

Auto manufacturers are under pressure to optimize weight reduction, increase fuel efficiency and reduce cost. The use of plastics in place of metals is helping manufacturers maintain margins as costs and competition increase. With more than 50 years of material, technical and application development experience, Ticona, through its global reach and resources, is uniquely positioned to help its customers develop innovative products that meet tomorrow's challenges.

World-Class Engineering Polymers

- Celanex® PBT
- Celstran®, Compel® and Factor® LFRT
- Fortron® PPS
- Hostaform® POM
- Impet® PET
- Riteflex® TPC-ET
- Thermx® PCT
- Vandar® polyester alloy
- Vectra® and Zenite® LCP

Brilliant Solutions with Plastic

MetaLX™ metal-effect polymers combine the look of metal with the design freedom of plastics, while reducing costs and eliminating chemical pollutants associated with painting and plating. MetaLX polymers allow the efficient design and application of one-piece configurations with internal features that would be difficult or impossible to produce in metal. The MetaLX metal-effect polymers are available in Hostaform® POM, Celanex® PBT and Riteflex® TPC-ET.

Lightweight Structural Parts

Celstran® and Factor® thermoplastic composites can combine a variety of long fiber and continuous fiber reinforcements with a portfolio of advanced semi-crystalline thermoplastic resins to meet customer requirements for precise mechanical, thermal and chemical performance.

Introducing New High-Strength Hostaform® HS15™ POM

The Perfect Balance of Strength and Stability

Hostaform HS15 is characterized by a unique combination of high stiffness and superior toughness, plus long-term stability to provide the broadest design space of any acetal copolymer available on the market today. This new material delivers cost savings through increased productivity and also exhibits excellent chemical resistance to aggressive fluids such as hot water and concentrated alkaline solutions (pH4 to pH14).

Next Generation High-Impact Hostaform® POM

Hostaform S-series brings new levels of performance previously unavailable in conventional impact modified POMs, delivering up to 75% improved impact performance and up to 300% increase in weldline strength.

Performance and Weight Savings for Under the Hood and Powertrain

Fortron® PPS is perfectly suited for applications requiring high temperature performance, broad chemical resistance to automotive fluids and gas, superior dimensional stability and excellent creep resistance. Fortron® PPS has a high continuous use temperature up to 240°C, no known solvent up to 200°C and can provide potential weight savings up to 50% versus metals.

High-Performance Polymers for a Mobile Future

Besides the already established Fortron® PPS the liquid crystal polymers Vectra® / Zenite® LCP have found their way into automotive electrical systems due to the additional safety and comfort systems in many applications. In the field of electric powered mobility there will be additional requirements which can only be fulfilled efficiently with Vectra® / Zenite® LCP.

Your partner for high performance polymers:
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The automobile future
drives with plastic!

We can only make guesses about the automobiles of tomorrow. But one thing is for sure: Their development will be influenced decisively by high-performance engineering plastics. Whether this concerns novel drive concepts, production processes or components, Ticona contributes valuable know-how and innovative products - as in the field of electric-powered mobility where Ticona delivers innovative solutions with high-performance plastics. Sandwich boards made from **Celstran® LFT** ensure greater stability and lower weight in battery support structures in automobiles. Connectors are already one product for the liquid crystal polymer **Vectra® LCP** which is also used in high-voltage applications, in lighting and as an insulator for actuators or motors. The ultimate material for electrical components is **Fortron® PPS** in pumps for coolants, in fans as well as in coil carriers and relays. **Hostaform® POM** with the low-emission XAP grades is excellent for use in automobile interiors. Electromechanical components in the on-board power supply have long been a specialty of **Celanex® PBT.** And especially light battery separators can be achieved with the ultrahigh molecular weight polyethylene **GUR® UHMW-PE.**

What idea do you want to realize? We look forward to shaping the future with you!

High-performance polymers with perfect profiles

- Lower weight with greater resilience
- Low-emissive in automobile interiors
- UV resistance for visible moldings, resistance against weathering
- Excellent sliding properties and high continuous service temperatures

Your partner for high-performance polymers:

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