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1995 - 2015

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Aston Martin Vantage GTE

“It’s not difficult to keep the server full of different simulations, but you need to make sure you’re getting accurate results that you’re going to learn from”

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DRIVING TECHNOLOGY INTO POLE POSITION

RACE TECH

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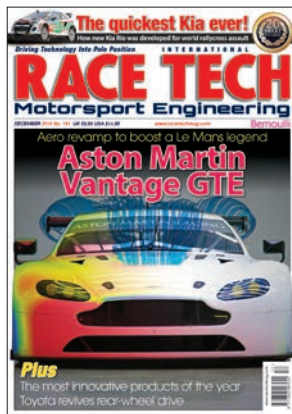
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BRING BACK DARTH VADER

ECCLESTONE endorses Vader – Darth Vader is the ‘right man’ to rule the universe and should have remained as supreme commander of the Imperial fleet, according to remarks made by Formula 1 boss Bernie Ecclestone. No, I haven’t been eating magic mushrooms or writing this after a boozy lunch, but copied it from one of my favourite websites – sniffpetrol.com – which takes a very irreverent look at motoring life, including motor racing.

The article is actually making fun out Ecclestone’s recent interview on Russian television. For those of you who might have missed it, the bullet points are his total admiration for Russian president Putin, his repudiation of democracy in any form, anywhere, FIFA president Sepp Blatter being foolish in surrendering the presidency and the alleged corruption being regarded as a tax football had to pay, Europe being a “thing” of the past that’s not going anywhere and that the US thinks it’s the greatest sort of power in the world when it’s actually little more than a big island. Then doing a double act with former FIA president Max Mosley on German television a week later saying that Formula 1 needs to go back to running V8s next season and that the rule book is like an old Victorian house where people keep adding bits to it but that it now needs pulling down and starting again. Not bad for a fortnight’s work as he approached his 85th birthday.

For those of you who aren’t in Britain and not aware of our local politics, following the general election in May where the Labour party – the party of which Tony Blair was once leader – was annihilated at the polls, Ed Miliband, its leader, immediately resigned. After a long and convoluted process, it came up with Jeremy Corbyn, a veteran of the hard left, Marxist in everything but name, as its leader, who immediately appointed as his shadow Chancellor – the money man – someone who is rabidly anti-capitalist. Not bad for a fervently capitalist country. Now admittedly they are the official Opposition to the government but they are also the official government-in-waiting and so have a responsibility to act accordingly. No doubt both gentlemen would take me to task as they would state that they are doing just that, but in reality they are living in the past and dreaming

of a Utopia circa the 1960s when the unions led by Jack Jones and Hugh Scanlon ruled the roost and had beer and sandwiches at 10 Downing Street to dictate the government’s economic policies and want to take the country back there. I am not suggesting for one moment that Mr Ecclestone is a Marxist, I am just alluding to the fact that times have moved on and the future assumes a different perspective depending on your own age.

I love history, but as I have written before, it is only to see past mistakes and successes and learn from them. I have no desire whatsoever to go back even 10 years, let alone 50, so I suppose what I am saying is that maybe it’s time for new blood in motorsport, someone who’s more in accord with the general mood on all levels and can react accordingly and where money is not seemingly the sole criteria.

According to Mr E, Formula 1 has become too much of an engineers’ formula, nothing happens without their input, to the detriment of the drivers and clouding the sport with technology, and this is turning off the spectators. Possibly true, but I would strongly argue that the driver drones we have in Formula 1, with some exceptions, are dull and boring because they are surrounded by PR people who refuse to let them talk openly and with candour. If you notice, whenever one is interviewed on television, there is usually a PR person standing by, often out of shot, with their own recorder thrust under the driver’s nose. Why? He’s been recorded anyway but it’s just a visual reminder for the driver to mind his Ps and Qs. As a result, we get dull and boring PR speak which tells you nothing and which turns everyone off. In fact, the sport is full of colourful characters, but we are just not allowed to see or hear them.

Actually what we need is for Mr E’s controversial utterings coming from the mouth of a driver, not necessarily saying the same things, God help us, but things that are politically incorrect, perhaps along the lines of Jeremy Clarkson or James Hunt. Now I remember when.....damn, I’m now going back to the past myself. **TK**

William Kimberley
EDITOR



For more information, please email: info@racetechnomag.com or go to www.world-motorsport-symposium.com

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We are delighted that both **Ulrich Baretzky**, Head of Engine Technology at Audi Sport, and **John Iley** Founder & Director, Iley Design have both agreed to be our Chairmen again, chairing what should yet again be a fascinating debate, judging by the interesting response we have so far received.

We are delighted that the following have accepted our invitation to be Cabinet members:



Bernard Niclot
FIA Technical Director



Vincent Beaumesnil
Sports Manager, Automobile Club de l'Ouest



Peter Wright
Technical Advisor, FIA



Gilles Simon
Engineering Consultant



Pascal Vasselon
Technical Director, Toyota Motorsport GmbH



Steve Eriksen
Vice President and Chief Operating Office, Honda Performance Development



Dialma Zinelli
Chief Aerodynamicist, Dallara Automobilia



Alex Hitzinger
Technical Director, Porsche LMP1 programme



Russ O'Blenes
Senior Manager, Performance and Racing Team, GM Power train



Reiner Mangold
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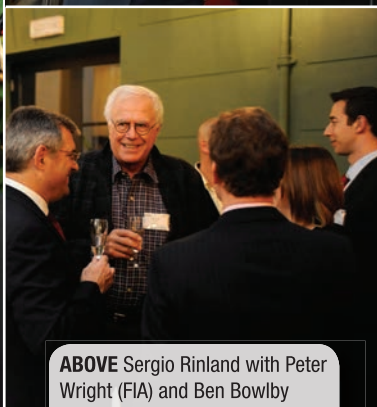
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ABOVE Porsche's Alex Hitzinger and FIA technical director Bernard Niclot



ABOVE Sergio Rinland with Peter Wright (FIA) and Ben Bowlby



ABOVE Soheila Kimberley and Symposium Chairman John Iley



ABOVE Side draft: Quality racing here at Kentucky and at Darlington convinced NASCAR of the appeal of the low-downforce aerodynamic package

Nigel Kinrade/Toyota Racing

NASCAR to cut aero in 2016

Andrew Charman

DAYTONA, FL: NASCAR has announced the basis of the 2016 Sprint Cup rules package, following extensive aerodynamic testing and development described in recent issues of *Race Tech*. As expected, the package focuses on reduced downforce levels, a configuration that earned widespread praise from drivers when tried this season in races at Kentucky and Darlington.

The basics of the package are as used in these two races, comprising a 3.5-inch high spoiler, reduced from the current 6 in, a 0.25-inch front leading splitter edge, down from 2 in, and a 33-inch wide radiator pan, down from 38in. NASCAR's tyre supplier Goodyear will develop rubber compounds to suit the lower downforce cars.

According to NASCAR, using the package will result in more time off the throttle for drivers and slower corner speeds, producing more passing zones around the entire track.

Announcing the package, NASCAR's chief racing development officer Steve O'Donnell

said that the sport has worked tirelessly with teams, drivers, manufacturers and Goodyear to develop a rules package that provides the best racing possible for spectators.

"The success of the races at Kentucky and Darlington in similar trim proved extremely valuable in accelerating rules development for 2016," O'Donnell said. "Now, as teams have even more time to prepare and a strong baseline of data, we anticipate the racing to be even better."

NASCAR will also issue specific rules, including tyre combinations and drivetrain configurations, to try and create the most effective package for the best racing for each track length, layout and surface.

Rear gear ratios will be adjusted to maintain a maximum engine speed of 9,000 rpm and a 1.38 third gear ratio will be used at all tracks shorter than 1.25 miles. The above rules will apply at all tracks except the superspeedways of Daytona and Talladega, which have their own bespoke aero packages. Rule changes announced for these tracks include the replacement of solid lifters in the engine with roller versions. This is expected to add around 10 horsepower

and as a result the holes in the engine restrictor plate used at these tracks will be reduced from 29/32 to 57/64 of an inch. From the race at Daytona in July 2016 a standardised oil cooler/radiator package will be introduced.

As reported in *Race Tech*, the digital dashboard introduced during the 2015 season as an optional piece of equipment will become mandatory in all race cars.

"Our team at the NASCAR R&D Center is constantly looking at the racing, and evaluating ways to continue to improve it," O'Donnell said. "Using science and technology and qualitative data compiled from world-class engineers throughout the industry as our guideposts, we will always look to make the racing better for our fans."

The announcement also revealed a number of safety updates. These include a double NACA duct on right-hand side windows to provide cooling for drivers, new routing for a fire suppression system activation cable and an updated seat belt restraint system.

As *Race Tech* went to press NASCAR was planning a 2016 rules package test at Michigan Speedway on 20 October. **RT**

New GT3 endurance series

William Kimberley

LE MANS, France: With the increasing popularity of GT3 racing, the ACO has announced the creation of the Michelin GT3 Le Mans Cup, a new GT endurance series for 2016. Aimed specifically at gentleman drivers, five rounds will be held as support races, lasting two hours each, for the European Le Mans Series and a sixth round will take place as part of the build up to the 24 Hour race itself at Le Mans.

"This new series represents an excellent path for gentlemen drivers who want to progress in the world of endurance," said Gérard Neveu, ELMS CEO. "Like we have always done in ELMS, we will do all we can so that the dream becomes reality for these gentlemen drivers." **RT**



ABOVE Bentley could be returning to Le Mans, courtesy of the new GT3 endurance series that starts next year

IndyCar takes aero kits to wind tunnel

Andrew Charman

CONCORD, NC: The Verizon IndyCar Series has conducted full-scale wind tunnel tests of the bespoke aerodynamic kits introduced by manufacturers Honda and Chevrolet in the 2015 season, as Honda bids to change parts of its package for 2016. Honda believes that certain areas of its aerodynamic kit suffer significant disadvantages to Chevrolet and is seeking permission to develop and homologate new components.

The manufacturers are already permitted to modify their kits in three areas for the 2016 season, but Honda states that the parts causing concern are outside these areas.

IndyCar is using the Windshear rolling road wind tunnel to conduct the tests, a Dallara DW12 race car fitted in turn with the Honda and Chevrolet kits. The gathered data will be analysed and IndyCar will then rule on whether Honda's request can be permitted.

Honda has also been carrying out private development testing of revised aero kit components, which have been said to include sidepods very similar to those used by rival Chevrolet. **RT**



Chris Owens/IndyCar

BELOW Air flow: Will Honda's 2016 IndyCar side pods look rather different to the current versions?



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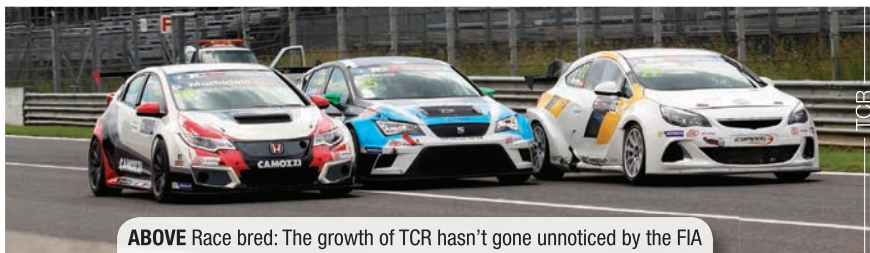
FIA adopts TCR for second-tier formula

Andrew Charman

PARIS, France: The FIA has announced that cars built to the TCR International Series specification will form the second tier of its national Touring Car series homologation, TCN-2.

When first announced in 2014 the two FIA categories for national Touring Cars were TCN-1, based on the Next Generation Touring Car rules created and used by the British Touring Car Championship, and a lower-cost TCN-2 formula based on rules used in the Argentinian Turismo Nacional championship.

So far no national category has adopted either set of regulations. Meanwhile the TCR formula, created by former World Touring Car Championship promoter



ABOVE Race bred: The growth of TCR hasn't gone unnoticed by the FIA

Marcello Lotti, is close to completing a successful first international season and a number of regional and national series have been announced. Six different brands of car have so far competed in TCR with two more believed to be close to announcing programmes.

The FIA's proposals, which have not involved the TCR organisation, will require some safety measures that are not mandatory for TCR events, including a racing fuel tank. **RT**

THE FIA World Council's announcement of the TCN-2 homologation had to be corrected when the original release suggested the TCN-2 cars would be eligible for the World Touring Car Championship. This was quickly revised to the European Touring Car Championship, which has seen TCR-spec Seat cars dominating its Single-Make Trophy class in 2015.

A TCR class is also to be introduced to the Nurburgring 24-hour race. **RT**

Opel's TCR Astra stars at launch event

Andrew Charman

METTET, Belgium: Opel has revealed its first complete TCR-specification version of the new Astra during a launch event for the TCR Benelux Series. The Astra was unveiled by

Opel Motorsport director Jörg Schrott at the event, which was attended by a large number of current and potential future TCR participants. Directly after the unveiling, the car was due to be used in final aerodynamic testing before beginning an on-track programme most likely in

southern Europe.

"Our aim is to complete the technical development as soon as possible and be able to make the first contingent of 10 cars available for sale by the middle of February," said Schrott, adding that it is intended to have another 20 cars ready by the end of May 2016.

The car will be sold for €95,000 plus VAT, a price that will include a sequential gearbox with a paddleshift and a 100 litre fuel tank to enable it to compete in longer-distance races.

"Our priorities are the International Series and ADAC TCR Germany, but we are also interested in extending the Opel presence in the other national championships in Europe," he said. "We are currently talking to a few teams with which we wish to establish high level partnerships. We will support them with a technical package, but they must be able to help in further technical development and to perform at a competitive level."

TCR currently has six confirmed brands of car with two more close to joining – an Alfa Romeo Giulietta is listed on the entry for the Macau finale of the 2015 series, to be entered by Italian team Romeo Ferraris, while Peugeot is strongly rumoured to planning a TCR entry with its 308. **RT**



ABOVE Opel expects to build 30 TCR Astras by May of next year

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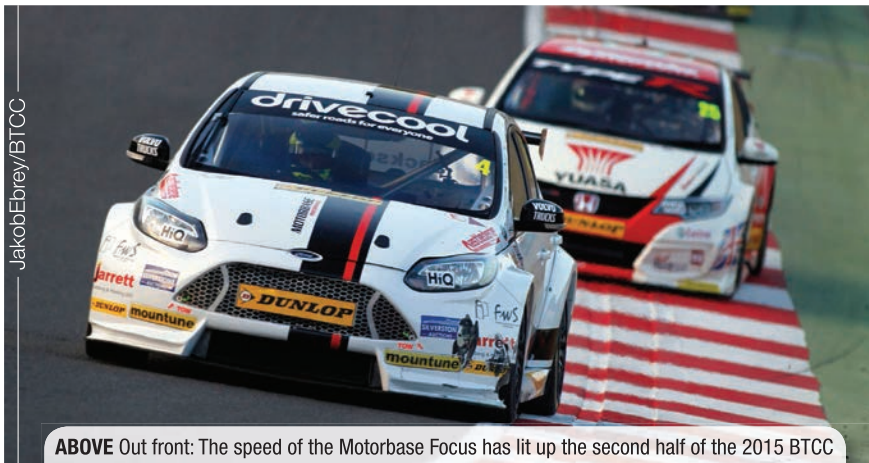
Mountune fights back as rivals criticise fast Ford

Andrew Charman

BRENTWOOD, UK: Ford race engine specialist Mountune Engineering has been obliged to defend the EcoBoost engine built for British Touring Car Championship team Motorbase. Since debuting in the BTCC at Snetterton in August the engine, featured in last month's *Race Tech*, has taken Motorbase driver Matt Jackson to four consecutive pole positions and four race wins.

In the final weekend at Brands Hatch, he scored two wins and a second in the three races and ended the season having led the most laps in 2015 – despite the team missing the first half of the season with budgetary issues

The pace of the Focus, which included slicing six tenths from the qualifying lap record in the final meeting at Brands Hatch on 10 October, has led rivals to claim the team has an unfair advantage. They argue that the boost setting allocated by TOCA has provided the Fords with more powerful engines combined with a lack of success ballast – the Motorbase cars were not in championship contention and were not slowed by ballast additions as were the title contenders.



JakobEbrejv/BTCC

ABOVE Out front: The speed of the Motorbase Focus has lit up the second half of the 2015 BTCC

At the penultimate round of the series, at Silverstone, Honda Yuasa Racing team principal Steve Neal claimed to the website *Touring Car Times* that the Fords had a 20 bhp power advantage while Team BMR driver Jason Plato said the Motorbase cars were pulling out a four-length gap on the straight.

In response Mountune company principal Dave Mountain issued a statement that strongly refuted the claims of rival teams, pointing out that the engine had been through the exact same approval process as all of the other engines racing in the BTCC.

"We submitted the cylinder head to TOCA

for flow testing in 2014 and also the cam profile and from the results of the tests, TOCA issued the boost figure to us," he said. "The cars have also carried the correct success ballast at all times so to say that the engine and car have not had the correct balance of performance is totally incorrect.

"It's true to say the new engine is strong but it should be clear to everyone that there is very little difference between the Honda engine and ours, indeed all the front-running cars are very close. It's also clear that the team have really improved the chassis and Mat is doing a great job." **RT**

Volvo to go World Touring Car racing

Andrew Charman

GOTHENBURG, Sweden: Volvo is to enter the World Touring Car Championship with its S60 saloon, extending to four the manufacturer involvement in the series for the first time since 2009. The Swedish manufacturer last ran a full-time world series programme in 2011 using the C30 hatchback.

Now, in what is being described as a multi-year programme, Volvo's Polestar motorsport subsidiary will build and campaign a pair of S60 cars built to the FIA's TC1 specification. The cars will use race-developed four-cylinder engines from Volvo's latest Drive-e range.

According to Polestar COO Niels Möller, the FIA WTCC appeals to Volvo as combining

the cutting edge technology of its cars with exciting racing all over the world. "The championship enables us to develop our technology further and utilise development from the racing circuits directly to our products for performance oriented Volvo customers," he said.

The car has been extensively tested at the Mantorp Park track in Sweden. Drivers for the race programme are yet to be announced.

Volvo has raced in the Swedish Touring Car Championship in recent years and also has a programme in Australia's V8 Supercars championship. **RT**



ABOVE Volvo's Polestar subsidiary will campaign the S60 in WTCC races

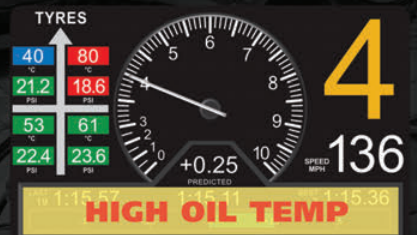
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Actual Screen Images



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Seal of Approval for new Lifeline Fire Safety System



ABOVE & BELOW The new fire suppression system from Lifeline represents a step-change in driver safety



PARIS, France: The FIA has homologated Lifeline Fire and Safety Systems' new fire suppression system, the Zero 3620. Launched at Autosport International in January, the Zero 3620 is the latest system to meet the FIA's demanding new 8865 test and safety standards. It has been awarded the FIA Gold Standard for use with unleaded petrol, diesel, ethanol and E85 fuels. Following the homologation, it has been mandated for use in the WRC in 2016 and officially recommended for all other categories by the FIA.

"This system represents another step-change in driver safety," said Lifeline's managing director Jim Morris. "The FIA has clearly recognised this, and we are delighted to receive the Gold Standard award. It is further proof that the future of fire suppression is here."

The Zero 3620 has undergone extensive testing, development and validation in both the motorsport and defence sectors. It is deployed in both the engine bay and cockpit, as per the new, stringent FIA regulations.

The engine-focussed side of the system features Lifeline's patent pending dual discharge technology – the primary side of the cylinder quickly knocks the fire out and is then supplemented with a secondary discharge, using the residual energy from the first, to deploy a specifically blended coolant fluid to prevent any re-ignition.

The cockpit-facing system is available in two sizes – 2.0 kg for up to 2.3 CuM and 3.0 kg for 2.4 to 4.0 CuM – and features Lifeline's compression discharge technology, with the option of either a fixed or remote outlet.

The entire system is controlled by a unique microprocessor which constantly monitors the state of the system and battery and will advise the user of any potential issues. Lifeline has also homologated a remote activation facility enabling the system to be deployed wirelessly from the pits or safety crew. **RT**

Magneti developing electric motors for Formula E

CORBETTA, Italy: Magneti Marelli has thrown its hat into the Formula E ring and announced that it wants to build electric motors. It is currently involved in the championship as a telemetry supplier but now wants a greater involvement.

According to www.electrcautosport.com that broke the story, the Italian company wants to supply two or three Formula E teams in 2016/17, season three. The decrease in

the minimum weight for a Formula E car from 888 kg to 850 kg for season three was partially behind the decision to develop an electric motor as the company could see that it was able to develop one that was just over 3 kg lighter than the McLaren Applied Technologies unit that was used by every team in season one.

It has reportedly built a prototype that comprises a six-phase motor generator unit

(MGU), two control units, a control software programme and a data logger. With Magneti Marelli claiming it to have an efficiency of up to 95.5 per cent, it is reportedly capable of 300 kW power output, offering 20,000 rpm and torque of 200 Nm. For season three, the energy available from the battery will increase from 28 kWh to 32 kWh for the 2016/17 campaign, while the peak power output will rise from 200 kW to 250 kW. **RT**



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F1 for sale to the Chinese?

AS *Race Tech* was going to press, a story was breaking on Sky News that China Media Capital was set to buyout Formula 1 for \$8.5bn within the next 90 days. A Chinese consortium recently purchased Pirelli, the Formula 1 tyre supplier which has recently agreed to remain as sole supplier until 2020. The bidders are one of China's largest investment firms, and their offer is being backed by Stephen Ross, the owner of Miami Dolphins, an American football team.

According to the report, the only drawback to their attempts to become the sport's majority shareholder is that they will need another investor to contribute \$2 bn extra equity. The consortium was keen for Bernie Ecclestone to retain his role overseeing its racing operations while a new commercial team would look to exploit the sport's media and sponsorship rights more aggressively. A source from Sky News stated that they believed they could "Double F1's profits." CVC, F1's majority shareholder since 2005, was set to respond to the consortium's proposals very soon, but declined to comment. **RT**



Steven Tee/LAT

IN BRIEF

VOLVO/POLESTAR, BMW, M-TEC (Mugen) are among the manufacturers and engineering specialists that are part of the Formula E Manufacturers Advisory Group. According to Motorsport.com, the first meeting took place in Geneva in October and the three were joined by McLaren and Williams Advanced Engineering.

NASCAR Sprint Cup team Furniture Row Racing is to switch from running Chevrolet to Toyota cars in 2016. The single-car team will enter into a technical partnership with lead Toyota squad Joe Gibbs Racing. Toyota will lose at least two of its present Sprint Cup roster at the end of the 2015 season with the closure of Michael Waltrip Racing.

NASCAR has doubled the length of restart zones following cautions at its tracks, to counter growing instances of drivers breaking restart rules. Under a double-file restart the second-placed car cannot accelerate before the leader when the latter is in the restart zone. The zone length is traditionally double the pit road speed, so at the one-mile Dover track it was 70 ft as

the pit road speed was 35 mph. For the 4 October race the zone was lengthened to 140 ft. In the previous round at New Hampshire, Brad Keselowski was penalised for jumping the restart.

VOLVO Car Corporation completed the installation of the DiM (Driver in Motion) motion platform designed by VI-grade and engineered and manufactured by Saginomiya. The new dynamic platform for the driving simulator will be used for testing and optimising the handling and ride behaviour of new vehicles as well as to test new control algorithms for active safety.

JAPANESE company Dome has been homologated by the Automobile Club de l'Ouest to be a manufacturer of the new LMP3 class car. It joins Ginetta, Onroak Automotive, Riley Technologies and Adess AG. Oreca will look after the entire client-service back-up for the single engine, a normally-aspirated 420 bhp V8 developed by Nissan/Nismo that is the same for all teams. XTrac supplies the gearbox and Magnetti Marelli the electronics.

BRITISH Touring Car Championship competitors Team BMR moved into new premises in Buntingford, Herts on 15 October, days after driver Jason Plato failed by four points to take the BTCC drivers' title from Honda's Gordon Shedden. BMR, which runs four Volkswagen CCs in the series, took the BTCC teams title.

BRITISH Touring Car Championship team Eurotech, which runs Honda Civics in the series, is set to upgrade to the latest Civic Type-R model for the 2016 season. An agreement for Honda works squad Team Dynamics to build the cars and to share data with Eurotech – which the two teams did in the 2012-13 seasons – was being finalised as *Race Tech* went to press.

PERSONNEL

INDYCAR team manager **George Klotz** has left Andretti Autosports to take up a similar role with A J Foyt Racing. Klotz, described as one of the most experienced and respected members of the IndyCar pitlane, will take up day-to-day directing of the team allowing team president Larry Foyt to work on longer-term programmes such as sponsorships.

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MAKE QUALIFYING A RACE



ABOVE A staggered start for the qualifying race might take some heat out of the melee



A ridiculous concept? Two races; lots more overtaking: what, asks **Chris Ellis**, is there not to like?

HERE is one way to deliver extra value and excitement to spectators and TV viewers without significant additional costs. Replace conventional qualifying on the Saturday with a qualifying race.

It will last only an hour, to ensure the drivers have plenty of energy for the 90-minute (?) main event on the Sunday. The Sunday race will be sacrosanct, naturally, remaining much the same as now. The grid for the main race will be determined by the result of Saturday's qualifying race, instead of lap times.

However, the starting grid for Saturday's race will be determined by the results from the previous GP, in *reverse order*. So the DNFs from the last race will be at the front of the grid, with the previous winner last.

The Saturday qualifying race will carry a small percentage (say 20%?) of the total points for the weekend. The Sunday race will be almost the same as now, but with its grid determined by the result of Saturday's race. Clearly, there will be much more overtaking during both races, particularly in the first.

The fundamental problem caused by qualifying is it sets the race up to have the

minimum of real racing, exemplified by minimal competitive overtaking, other than lapping using DRS. And qualifying itself is boring. There, I've said it. And most TV viewers agree.

One obvious objection to my proposal is the possibility that some lesser drivers will be tempted to take out the best drivers in the initial scrum, but I am sure the stewards will be watching for this, and hand out suitably tough penalties: not just to the offending driver, but also deduct constructors points. There will be two podiums, increasing the number of drivers, teams and flags in the spotlight, pleasing more fans, with two races for the price of little more than one. And much more action. What's not to like, for everyone?

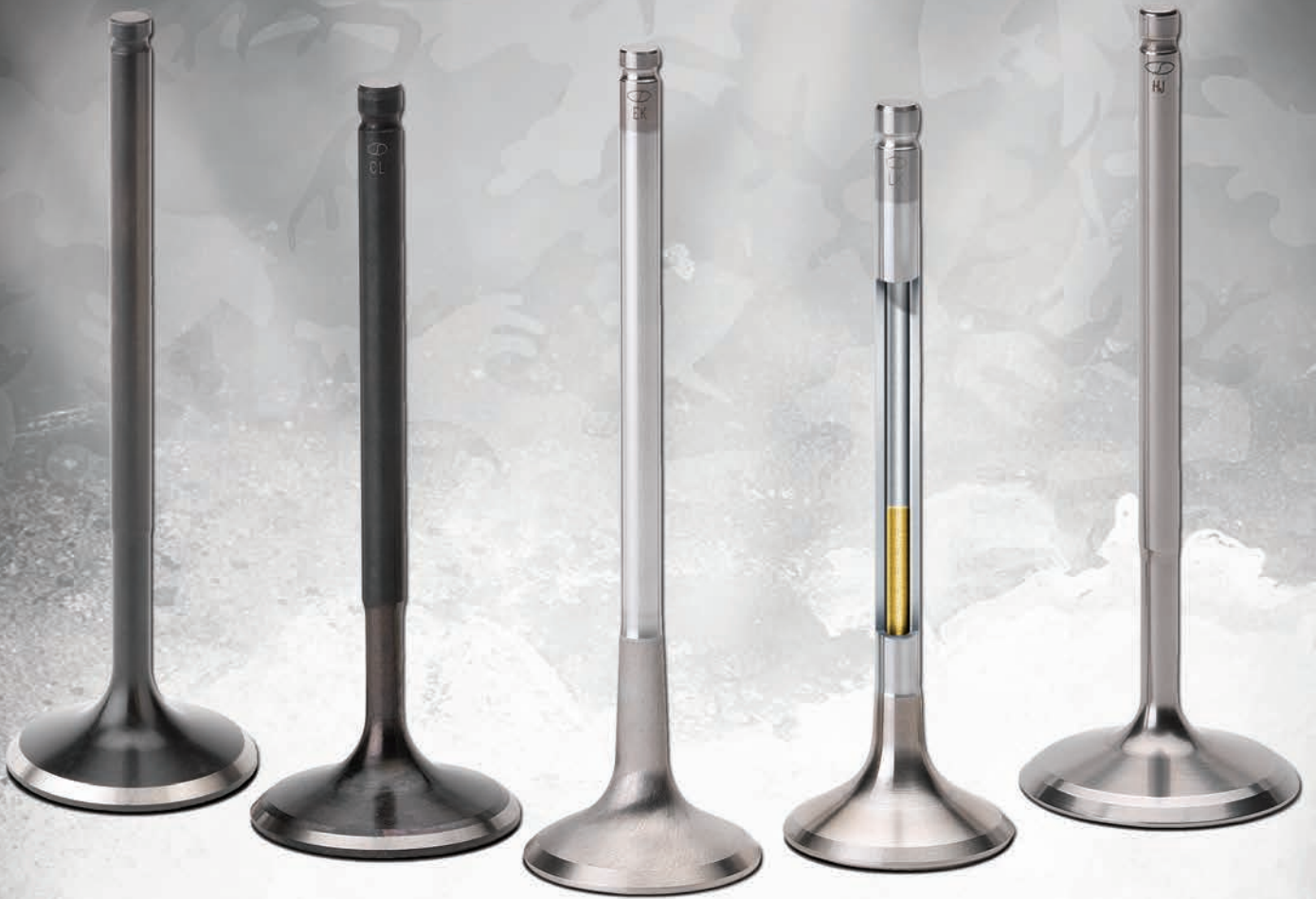
How to prevent the start of Saturday's race from becoming a vicious melee? One possibility is a staggered start, with only the first two rows moving off when the red lights go out, followed by the third and fourth rows, three(?) seconds later when the first red light comes on again. And so on. Obviously, this will need extensive and thorough testing. The last four cars will start 15 seconds after the first. Simulations

should provide a good indication of how a typical race will develop, but my guess is the fun will really start about five laps in, all around the circuit. Gentlemen, start your simulations!

Because this proposal requires no changes to the cars, it can be introduced gradually, and yet fast, probably next year. For example, perhaps only three circuits will run with the new format in 2016, Silverstone being one of them, naturally. If the British fans like it, everyone else should, right? But Monaco should probably stick to the old format indefinitely, for obvious reasons. And there may be several other circuits that decide to keep to the old regime.

The first weekend of the first year (next year?), will probably start with conventional qualifying. For subsequent years, the initial grid could be based on the result of the previous season's final race, with suitable regulations to deal with new teams and driver changes.

To conclude: I cannot think of anything that could produce such a big jump in entertainment value so quickly at such low incremental cost. And this is just the start of the idea. Initial reaction has been uniformly enthusiastic. Particularly the fact that a qualifying race can be introduced gradually, with almost zero impact on the technical side. Let's see what the great minds of our sport make of it. **RT**



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How do we react to testing times?



Our **Expert Witness** – a knowledgeable F1 insider – suggests ‘Emissiongate’ has awkward implications for a motorsport industry increasingly questioning its relevance to the automotive sector

REVLEVANCE, compliance, competition and the role of manufacturers are all issues that exercise motorsport minds at present. In truth, I firmly believe all four are linked and hope to share why.

It’s been an extremely tough few weeks for the automotive community. We face the fact that an engineering test was set to control road car emissions. The test was passed. However, it turns out that a vehicle interprets it is being tested and reverts to a cleaner mode in order to pass. This therefore is neither a real test nor an actual result, just a legislative hoop that has to be jumped through in order to be signed off as complying. Our problem is that any intent or ‘spirit of the regulation’ has been neatly circumnavigated to the detriment of the genuine objective.

In motorsport, depending on the shade of grey of the rule, this can be seen as creativity, ingenuity and the pursuit of ultimate performance. But in the road car market, with its consumer rights and effects of scale, it has been a marketing, brand and product disaster.

RBR/VW DREAM OVER

There have been rumours for some time that the VW Group was seriously considering an F1 programme, having previously been put off by one or two incidents or by outspoken individuals. VW also already has successful links to Red Bull through both WRC and the Dakar Rally.

On the other side from Red Bull’s dominance of the F1 championships between 2010 and 2013, the switch to reduced capacity hybrid powertrains in

2014 found it suddenly with the wrong technical supplier, Renault. To be clear, the Renault was not the strongest engine before, but with such an increased importance from the regulation change on the powertrain, Red Bull was now powerless to make up the resulting considerable deficit. So it would seem logical that a partnership with VW would have worked: having dominated with hybrids in the WEC through Audi and, latterly, Porsche, the F1 route might finally have fitted as a new highly promotional platform for VW.

Does this ‘perfect marriage’ actually stack up, though, and what does it deliver for both parties? Personally, I think any chance of finding out if a programme would have worked has ‘gone up in smoke’ because of the costs of Emissiongate, but would like to explore the potential ingredients of this manufacturer and team relationship further.

McLAREN-HONDA

One of the most iconic, successful and nostalgic brand partnerships of the Eighties, the McLaren-Honda combination came within a backmarker incident at Monza of winning every single grand prix in a season – a red and white wash. Despite this, it may have been a surprise to many when the obviously benchmark Mercedes engine was replaced in the back of the McLaren by the returning Honda. The subsequent struggle has seen this once dominant duo reach the lowest level of results in the team’s long history.

The reasons must have been compelling enough to make the change. Budget was

clearly a factor: it is no secret that these latest hybrid powertrains, initially at least, are extremely expensive. So having one provided, rather than committing a large slice of your reducing annual budget to use one, makes financial sense – was perhaps even a necessity. Additionally, in this age of ‘primary sponsors’ allegedly no longer existing, Honda could contribute significantly to the driver, team and R&D budgets.

The angle I would like to pick out though is competition, racing DNA. Yes, I am





convinced that nostalgia played a part, but the driving force for the deal was the belief that, in this new powertrain-dominated situation, having 'the same' as your opponent would not guarantee success, even if it was best in class. I feel like I need to qualify my comment to MHPP here, as I am sure there are all sorts of clauses and efforts to achieve performance parity from the factory team to the customer units. However, a direction was chosen that only by partnering an alternative manufacturer

(Honda), was there an opportunity to have exclusive or prime use of the leading power unit.

So what has gone wrong? Two things. The first is expectation, which was ridiculously high, fuelled by statements about "winning the first race back", "we will have the most powerful powertrain", and "we are 25 HP ahead of the Renault". I understand the pressures to perform and deliver, but most of those have been self-imposed and in this data-rich environment, the truth will

out, not least on a simple stop watch. Two former World Champion drivers coming towards the end of their careers, contracted at considerable budget on the basis of their experience, yes; but their desire to be competitive and have a shot at a further title has exposed the team's shortcomings: their frustration has been palpable.

The biggest problem, though, is time. There is still a perception, not always discouraged by those who should know better, that things in motorsport can ►

“Both road and track must make rule application and investigation real – not just to pass the test, but relevant to improve the breed”

happen by ‘magic’. Even if it exists, it is increasingly less possible. There was a time when ‘impossible’ feats were achieved by throwing people, money and sheer hard work at a problem, but with resource restrictions and curfews you can’t even time-compress any more.

Mercedes has the dominant powertrain. Fact. Was this by accident? No. Did it strategically start its programme behind closed doors with considerable investment years before its public introduction? Yes. McLaren-Honda, by contrast, is trying to play out those years of catch up in the very unforgiving glare of the public eye, while also trying to compete. Worse, the opposition is not standing still waiting for them to catch up.

So how comes what was formerly a dream combination is not working now? The introduction of the reduced capacity, turbocharged, energy recovery F1 powertrain in 2014 was critical. Not popular with everyone, at a time of severe financial difficulty, the most expensive part of the whole package was being fundamentally changed. Renault was unlikely to continue, unless this new format was adopted, so with pressure and debate this more contemporary format was agreed to be the way forward.

More efficient, hybrid, quieter and more industry-aligned. Excellent. Except it shifted the power base even further away from the independent privateer teams, firmly towards organisations that were both powertrain and car manufacturers. This was not by accident.

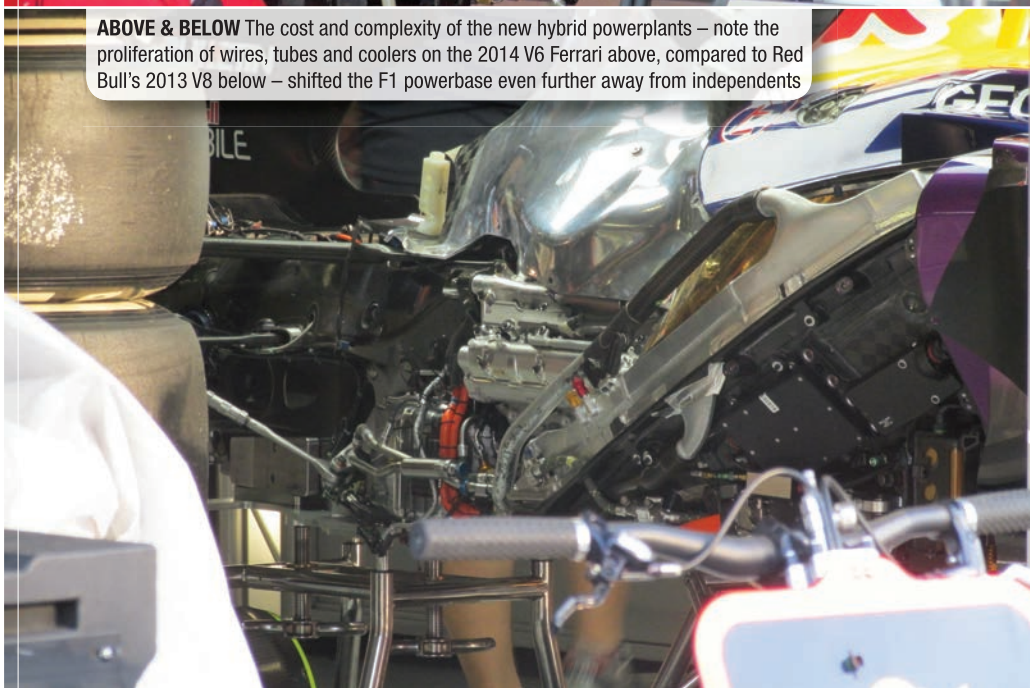
You have to remember that up until 2013 the Red Bull-Renault-Newey-Vettel combination had been dominant for the previous four seasons. Opposition were understandably not happy with this. How could you disrupt an aerodynamic design stranglehold? Change the framework so suddenly the powertrain was much more important.

Coupled with ever-increasing restrictions



Craig Scarborough

ABOVE & BELOW The cost and complexity of the new hybrid powerplants – note the proliferation of wires, tubes and coolers on the 2014 V6 Ferrari above, compared to Red Bull’s 2013 V8 below – shifted the F1 powerbase even further away from independents



on development in aero or powertrain, the scenario that arrived in 2014 would more or less be set for the foreseeable future, with reduced scope to address any new status quo. From a position of success and a reluctance to accept any rule change, Red Bull was suddenly looking for any way to review the uncomfortable revised pecking order.

INTEGRATION

With the previous 2.4-litre V8, much of the freedom or scope for development was removed. This helped create a more level playing field and kept costs down in this

most expensive area. By also restricting V-angle, crank height, rpm, bore, stroke, centre of gravity etc., it meant that it was much more straightforward for a car to transfer from one engine supplier to another.

A post-2014 hybrid powertrain is a different animal altogether. The complexity of the cooling, electronics layouts and sheer extent of all the components means it is now a fully architectural piece of the entire car layout. Any ability to make a short-term switch from supplier A to B has long gone.

Without seamless lines of design communication and freedom between car and powertrain, privateers are now at a distinct disadvantage, so the two current ►

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manufacturer teams are in a position to dominate, while also generating revenue by selling customer units – state of the art, or not.

THE MANUFACTURERS

So, by careful investment, planning and lobbying, Ferrari and Mercedes, and perhaps even Renault or Honda eventually – *if* there is the budget and patience – now find themselves in the box seats. They are the big players in a game where the conditions to win and survive require access to impressive funds and powertrain technology. For everyone else they can take part, but they cannot truly compete.

As the sport's operator, do you want wealthy OEMs or independent teams with only a quarter of the financial power? The answer, correctly or not, is inexorably heading towards the former, with a customer package being provided to those that still want to take part. In an ideal world you would like 11 manufacturers participating, but if the costs and the difficulty of catching up and competing are so big, I would suggest it is not an appealing proposition to any new car

manufacturer players.

What is in it for the manufacturers exactly? Top of the list must be the platform's global and marketing potential, to be seen by so many viewers being successful at the pinnacle of motorsport. But viewing figures are in decline and Suzuka suggested even running at the front offers no guarantee of getting the requisite coverage, for some

reason. Conversely, Nissan, new to WEC LMP1, came with a radical car approach and extensive advertising, pushing the theme of "innovation" hard for the brand. This arguably yielded far more impact with the public than Porsche's impressive return to the Le Mans winners circle. So manufacturer return seems to depend on what your objectives are and why. ▶

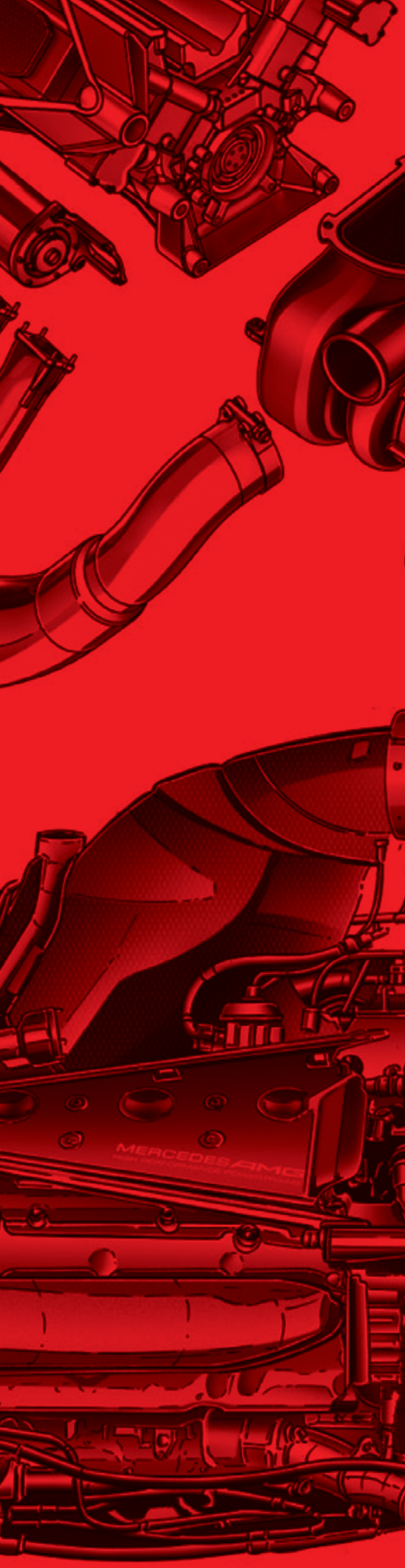


Daimler



ABOVE & BELOW Merc's Nanoslide technology, used to coat cylinder bore surfaces, is an example of direct tech transfer from racetrack to road

Daimler



FORMULA 1 2014/2015 Technical Analysis

Giorgio Piola

Size: 24,3x27 - Pages: 128 - Photos: over 400 technical drawings in colour
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EAN: 978-88-7911-623-7 - Price: £32.00 + plus post and packaging

RADICAL changes in terms of technology and regulations marked the 2014 season, with the cars being equipped with 1600 cc, six-cylinder turbocharged engines with dual internal combustion and electrical power delivery (the so-called Power Unit) in place of the classic naturally aspirated V8s. Electronically controlled rear braking and a series of aerodynamic restrictions were also introduced, the latter having a major influence on the external appearance of the cars which were very different to their predecessors. These changes and innovations also had significant sporting repercussions with the Mercedes of Rosberg and Hamilton undisputed protagonists of the World Championship, the surprising Daniel Ricciardo doing better than his teammate Vettel and the Maranello team featuring in another grey season with Fernando Alonso already heading towards McLaren. Revealing the technical secrets of the 2014 cars and providing a broad preview of the season to come is as ever Giorgio Piola who, drawing by drawing, illustrates and describes in the most minute detail the entire World Championship field.

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McLaren



ABOVE Where has it gone wrong for McLaren-Honda? The complexity of the modern powertrain, allied to development restrictions, left the team's star driver singing "GP3 engine" over the radio to an audience of billions

RELEVANCE

To only have your name involved, you achieve a high performance halo by association, but if your product is actually used, or benefits from the racing environment development, then this carries substantially more power. The conversion of invention into innovation: the crucial difference is that the former is creating a new idea, the latter is actually finding a way to get commercial benefit from it.

Motorsport can be a constant research and development activity, unless it is a one-make category or the areas of most technological interest are frozen by regulation.

When the 2014 powertrain was first announced, not enough was made of the efficiency gain that was made in completing races with less than 100 kg of fuel, a reduction of around 50 kg from the year before. Utilising the hybrid technology was not just a requirement to be competitive, but essential to harvest enough energy to cover the distance. Fears were widespread that cars would run out of fuel and it would become an economy run, but this has not been the case, cars going to the grid with increasingly less fuel in order to save weight and gain lap time.

With this in mind, are further levels of fuel reduction being implemented, to push efficiency and make the hybrid technology more effective? What about CO₂, NO_x, particulates? With manufacturer

involvement, surely there is an opportunity to implement genuine competitive frameworks that enable the development for these road car companies to achieve ever more stringent targets: 2020 95 g/km CO₂; 2025 70 g/km CO₂; and 2030 50g/km CO₂.

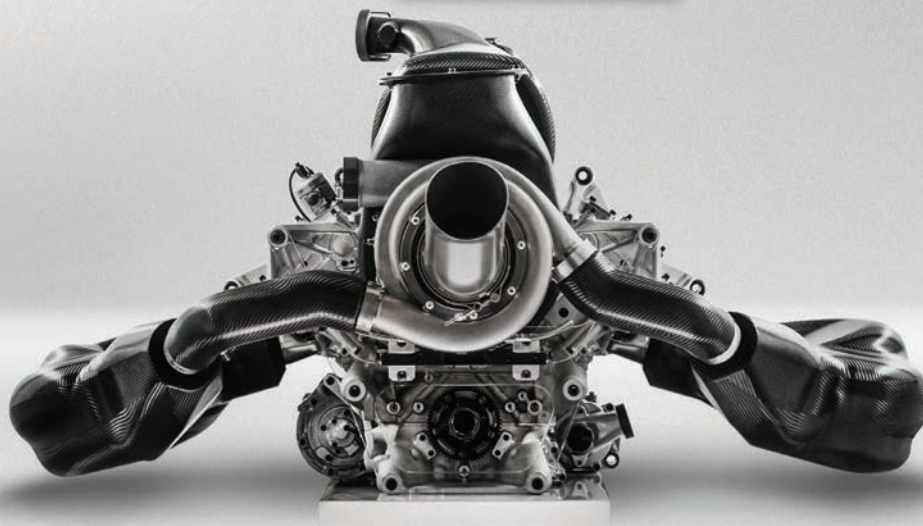
VERDICT

VW was found to be achieving a test result by incorrect means, and that threatened to cost Red Bull its future competitiveness

and ultimate participation in F1. The responsibility on both road and track is to make the rule application and investigation real, not to just pass the test but relevant to improve the breed so that we can achieve the tough future targets required.

If constructed correctly, this should encourage competition, more manufacturers and actually justify the investment in innovation. If not, it becomes an increasingly expensive entertainment industry that cannot continue to justify its existence. **RT**

RenaultSport



BELOW Not enough has been made of the efficiency gains that came with F1's new hybrid engines

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ABOVE A dedicated team worked on the project for months, perfecting the model of the base car and investigating aero options

Going out with a bang

Aston Martin's Vantage GTE races into 2016 boasting a comprehensive range of aerodynamic tweaks and a power increase. **Chris Pickering** reports on what is likely to be the car's last big revamp

If you set out to define the quintessential GT car it would probably look a lot like the Aston Martin Vantage: a large naturally aspirated engine at the front, plenty of cylinders making all the right noises and a beautifully sculpted cab-rearward stance. It's a template that stretches right back to the 1950s, making it one of the most compelling and desirable automotive stereotypes.

The Aston Martin Vantage GTE racer might not have been around for quite that long, but it's still something of a veteran, tracing its roots back to the Vantage GT2 released in

2008. A series of updates have kept the car competitive – picking up a class podium in either GTE Am or GTE Pro almost every time it has visited Le Mans since the GTE version came out in 2012.

Now the venerable old warhorse is receiving another overhaul – possibly its last before a replacement comes in 2018. But with a comprehensive range of aerodynamic tweaks and a power increase for the 4.5-litre V8, it looks set to go out with a bang.

The update package has been prompted by

a series of changes to the GTE regulations for 2016. The aim is to distance the class from its little brother GT3 and make it easier for manufacturers to bring cars of increasingly disparate layouts and engine configurations into the series.

Most notably, the restrictions on aerodynamic modifications are being relaxed significantly. Where constructors previously had to retain most of the original road car panel surfaces, the rules now define specific volumes around the car – for instance the areas around the front splitter and the rear diffuser – where the aerodynamicists are more or less free to do as they please.

It's no secret that mid-engined cars like the Ferrari 458 Italia GT2 and the incoming Ford GT provide a better starting point for aerodynamics than classic front-engined GTs like the Vantage.

"The greenhouse is a lot bigger on a front-engined car and the drag tends to be a lot higher, which means we have to do a lot more work to get down to the performance windows," comments Aston Martin Racing technical director Dan Sayers. "As it stood with outgoing regulations we wouldn't have been able to achieve the new aerodynamic targets."

While the regulations have become a little

more liberal, the homologation criteria are more tightly controlled.

"It's now more like GT3," comments Sayers. "Generally the aerodynamics are fixed. There will be a low drag kit for Le Mans and you've got adjustable pillars on the rear wing, but otherwise the car basically has to be run as it's homologated; if you homologate with diveplanes, for example, you have to run them."

The discussions on the regulations themselves have proved somewhat protracted, kicking off around 18 months ago. "Timing [for the recent update] was very tight. It's always tricky in that situation," he admits. "You either risk

“This is the first car we’ve done pretty much solely in CFD”

starting early when the regulations aren't very well defined, or wait and lose development time. It's a case of finding a compromise between the two."

Aston Martin has since carried out the first full test at Estoril, as well as the FIA's performance balancing test at Ladoux. Sayers is confident that any further tweaks will be minor ("maybe a diveplane here or there," he comments). So essentially, what you see here is the 2016 car.

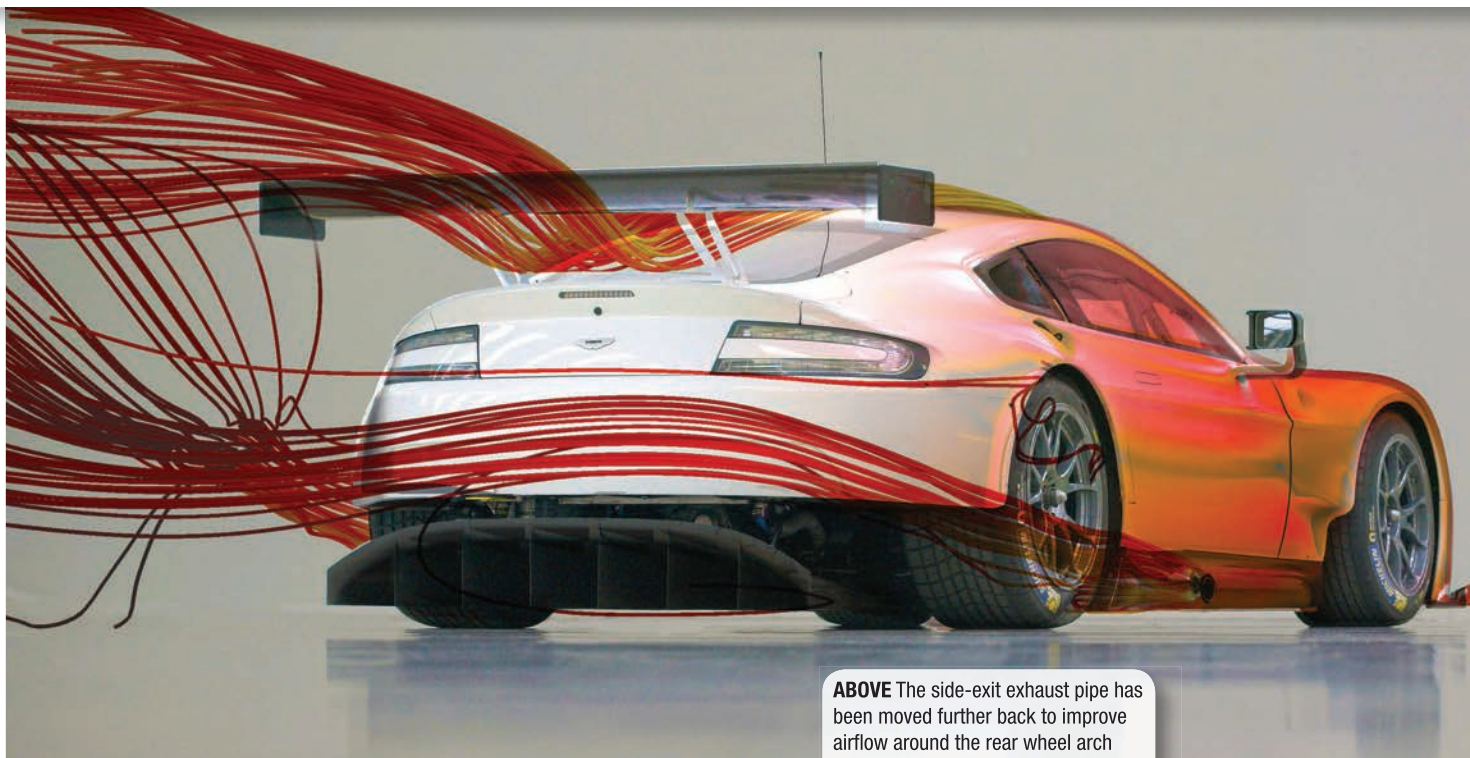
VIRTUALLY PERFECT

"This is the first car we've done pretty much solely in CFD," comments Sayers. "Literally we finished it on a Monday, it did one run up an airfield and then it was put on a truck and taken to Ladoux [for balance of performance testing] on Tuesday."

Aston Martin Racing carried out most of the CFD work in-house, with help from technical partner TotalSim. A dedicated ▶



ABOVE Some of the biggest gains were found around the front splitter, where airflow is relatively complex



ABOVE The side-exit exhaust pipe has been moved further back to improve airflow around the rear wheel arch



ABOVE Greater freedom in the diffuser design has increased the emphasis on underbody aerodynamics

team worked on the project for a number of months, perfecting the model of the base car and investigating different options.

"In the past we've relied a lot more on external companies," Sayers remarks. "This is the first time we've done the majority of the CFD work in-house. That's given us more opportunities to try things, but it's resulted in a pretty steep learning curve. It's been useful to start with a slightly smaller job before we embark on a completely new project, which is likely to be the Vantage replacement for 2018."

A lot of the work simply went into achieving the required level of detail on the model. Every little nuance of the geometry has to be represented perfectly to get a good result and there's also quite

a complex Design of Experiments aspect to getting the most out of the simulation time.

"It's become apparent that you can get quite lost in aero results if you're not careful," comments Sayers. "It's not difficult to keep the server full of different simulations, but you need to make sure you're getting accurate results that you're going to learn from and benefit from on the car. You then need to run all the best parts you've found in a certain combination to make sure they interact in the anticipated way."

No one part of the car can be considered in isolation, so the Aston Martin Racing engineers went for a methodical, but relatively straightforward approach. "We started from the front of the car, running

quite a lot of iterations around the nose and then we just moved rearwards," comments Sayers. "That way you minimise the unexpected interactions between parts."

Generally speaking the biggest disruption to the airflow occurs when it first meets the front of the car, so this outwardly simplistic approach has a lot going for it. Some of the biggest gains on the Vantage were to be found around the front splitter, where the airflow is relatively complex.

AERO EFFICIENCY

For 2016, the aerodynamicists' main priority was to reduce drag. Almost every single body panel has been changed, with only the bonnet, tailgate and rear fenders escaping the knife. The front end is all new, with a heavily revised splitter and detail changes to the wheel arches to smooth the flow around the wheels. Thanks to an improved cooling package the intakes in the front bumper have also been reduced in size and now more closely resemble those of the Vantage road car.

The side-exit exhaust pipe has been moved slightly further back to improve the airflow around the rear wheel arch, Sayers explains: "This is something we looked at on the CFD model. It simulates the exhaust gas being pumped out and it helped us to optimise the position of the outlet. One of the things that we'll be looking at in the next iteration will be refining other heat sources and air flows like the brakes."

Due to the regulations, the rear wing has shrunk, but greater freedom in ►

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the diffuser design has increased the emphasis on underbody aerodynamics. The Vantage's diffuser occupies around 90 per cent of the 100 mm projection allowed in the rules, while the rear wing has been moved backwards a corresponding amount and the bumper has been remodelled slightly to aid extraction of the air. Overall downforce is up – initial results from Ladoux suggest it now sits slap bang in the middle of the target window – while drag has been reduced. The net result is a substantial increase in aerodynamic efficiency.

BREATHE EASY

Internally, the Vantage's engine is completely unchanged. The GTE technical regulations set out a baseline restrictor size, with tables for naturally aspirated and turbocharged engines, based on capacity. All existing cars will receive an increased baseline restrictor size for 2016, although each design will still be subject to individual performance balancing that may add or subtract to that figure.

The Vantage GTE engine was originally developed for larger restrictor sizes, so

this change should suit the car well, but Sayers is still nervous about the prospect of the incoming turbo cars: "We've run the car for a few years now, so the organisers have a huge amount of data and they can balance it nicely. The downside to that is that the turbo cars are likely to be a lot trickier to balance [so the process could work in their favour while the FIA and ACO are getting to grips with it]."

MECHANICAL MODS

Mechanically the car is virtually unaltered. "The Vantage was already a good platform and focusing on the aero, rather than engine or mechanical changes, means we have avoided the need for expensive and costly endurance testing," Sayers notes.

That's not to say it's completely identical, however. Next season will see a new Xtrac ▶



ABOVE The looks are still menacing and the 2016 GTE features a substantial increase in aerodynamic efficiency

“It's not difficult to keep the server full of different simulations, but you need to make sure you're getting accurate results that you're going to learn from”



ABOVE The mirrors have been changed for aerodynamic reasons, but they have also been moved to the doors to improve cockpit visibility

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differential replacing the standard ramp-plate type unit currently used in the Vantage GTE. This should provide more progressive locking behaviour, with its engagement governed by the relative wheel speed of the two sides rather than the torque difference.

The new regulations do allow teams more freedom to move the suspension pick up points, but Aston Martin Racing has stuck with the well-proven geometry of the double wishbone set up, which was substantially re-engineered during the car's last major update in 2013. The bespoke wishbones and uprights introduced at that point replaced the original road car items, increasing stiffness and shaving some eight kilos off the total unsprung mass.

From a safety standpoint, the GTE gains a new FIA 8862 seat, impact foam in the driver's door and removable door glazing,

plus a new clutch disengagement system for the marshals, which works on the external electrical cutout.

The new regulations have also brought in mandatory roof hatches across the board, designed to aid driver extraction in an emergency. In the case of the Vantage, the roof is semi-structural but its contribution to the overall stiffness is pretty small with the roll cage installed and cutting a hole for the hatch doesn't have any great impact.

Sayers and his team have also worked on the cockpit visibility. The doors are new and the mirrors have been changed for aerodynamic reasons, but they have also been moved to the doors rather than the glazing, which frees up some forward visibility.

Most of the 2016 update kit consists of body panels and flooring. Cutting the roof

hatch is one of the biggest jobs, but apart from that it's all relatively routine, Sayers explains: "It's basically a panel swap. At the Estoril test we ran one day in the 2015 spec, spent the following day re-prepping it on-site and then ran in 2016 spec on day three."

Theoretically this could be carried out by customer teams, although most of the Vantage GTEs in circulation go back to the factory to be looked after.

With a little help from these modifications the Vantage should still be competitive in time for its 10th anniversary. Beyond that, its replacement is almost guaranteed to be turbocharged – the production car will use a derivative of the V8 from the new AMG GT – but in all other respects you can expect it to stick to the same classic Aston Martin template. And that's no bad thing at all. **RT**

BELOW Changes to the GTE regulations for 2016 prompted an update package for the old warhorse, seen here running in 2015 spec

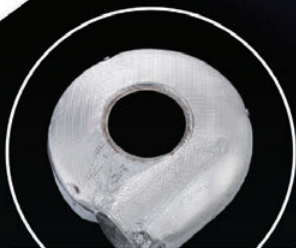


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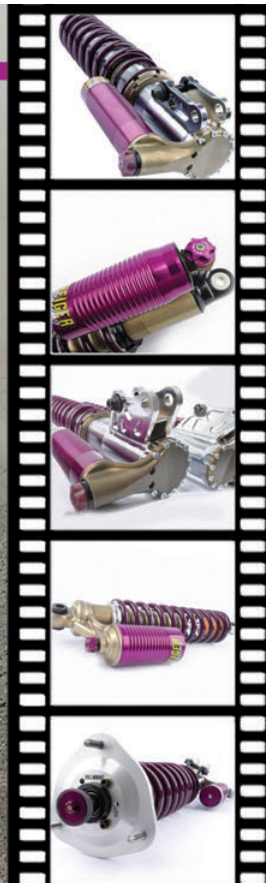
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ABOVE High-flier: Galli launches the Rio on the car's competition debut

A GOOD KOREA CHOICE?

Kia's stunning-looking Rio joined the World Rallycross Championship at the series penultimate round. **Hal Ridge** quizzes the car's creators

THE FIA World Rallycross Championship has many different marques with motor racing pedigree competing in the top-level Supercar category. The likes of Peugeot, Audi and Ford have motorsport running through their veins, so although the mixed-surface discipline is unique and requires a strong package to run at the front, it isn't a total surprise that those names regularly appear at

the head of the results sheets.

A name less frequently heard in the motorsport arena is Korean firm, Kia. A cursory flick through the history books suggests that although a major player in the automotive industry, success for Kia in motor racing isn't, well, rich.

While existing marques may be attractive to newcomers, one of rallycross' charms is the 'List of cars not homologated with the FIA

but eligible in Supercars'. This creates fantastic diversity and has allowed machines like the Saab 93, VW Beetle and Volvo C30 to take part in recent years.

Former world rally driver Gigi Galli, a hero in his Italian homeland, made his World RX debut in his home round at Franciacorta in 2014 in an OlsbergsMSE Ford Fiesta. Galli decided he wanted to create his own team, and 12 months on, armed with a brand-new Kia Rio Supercar, he returned to the sport, and has plans to contest the full season in 2016 with a two-car team.

Galli tasked Italian company Danisi Engineering with the build of his new Rio. Back in May lead designer Ashley Gaunt and project manager Michele Fabbri therefore travelled to the British round of the World Championship at Lydden Hill to assess the competition.

"After a lot of consideration, the decision was made that the Kia Rio was the best platform with which to build a rallycross Supercar," explains Fabbri. "The standard dimensions are very good and the car is unique to rallycross currently, which has obvious advantages.

"As Danisi, we have worked in many different types of motorsport before, but not rallycross. We started the project slightly

before Lydden, then we went there to learn about the teams and the environment. We didn't have any real reference to go from because this is a non-homologated car; so we have to do things exactly by the book and learn as we go along."

Historically, although much time went into the design of rallycross cars, it isn't unfair to suggest that many builds and developments were trial and error. As such, experienced squads like Kenneth Hansen's team were regularly one step ahead.

As with any new project, there will always be a degree of that development process, but things are changing. At Danisi, Galli's Rio was fully designed in CAD, before work even began on the bodyshell. All in all, this project has come together in an incredibly short timeframe, as Fabbri explains.

"Danisi specialises in vehicle dynamics, and

we designed the car in CAD. That allowed us to make key decisions at the CAD stage. For instance, the engine has been transverse, longitudinal, transverse, longitudinal and we've had the steering rack here and there a few times. Things were very fluid for a while, which obviously took quite a lot of time. In real terms it was four months to do the car from nothing, but it was a crescendo of work to get to job done."

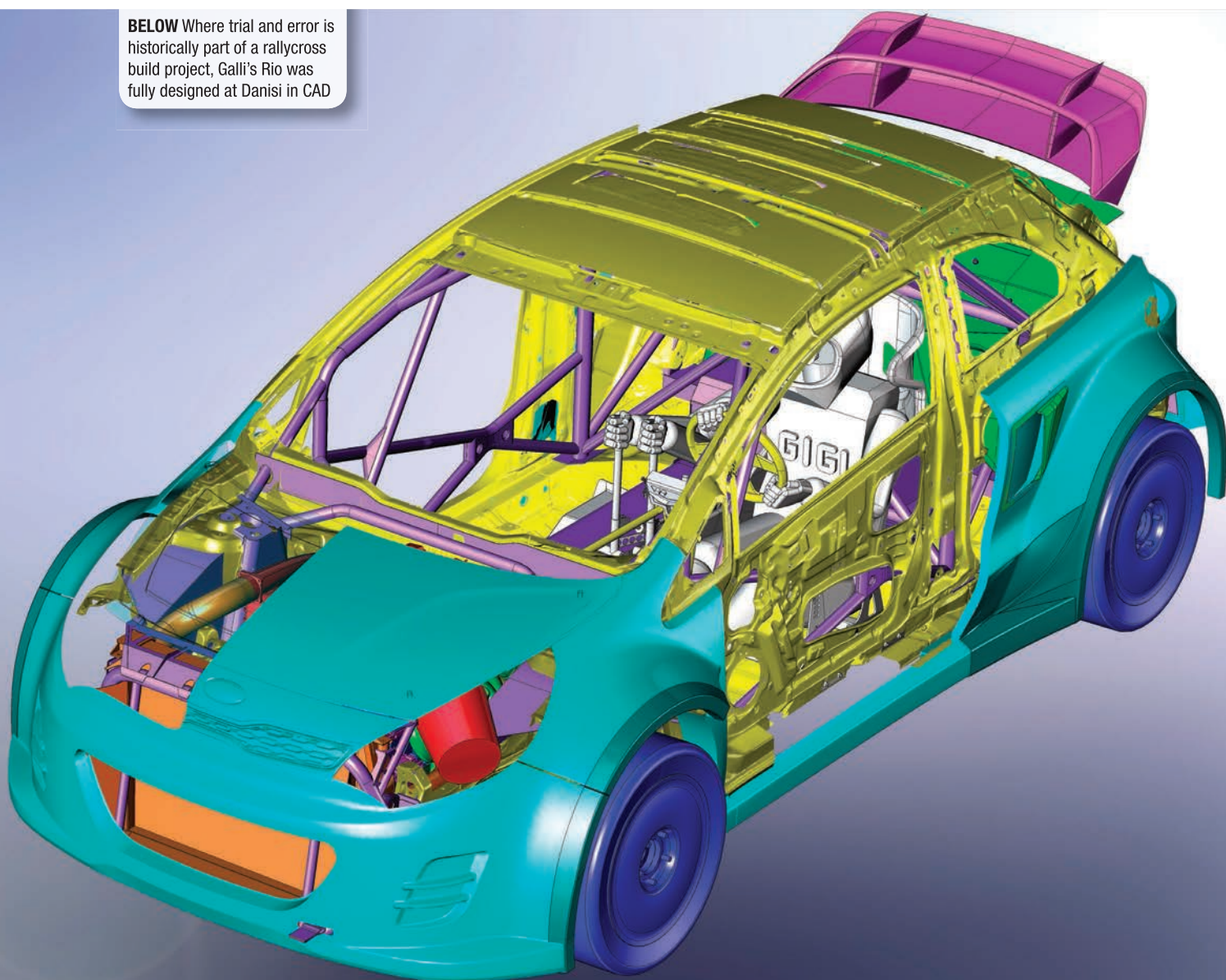
With key design decisions made on the computer, construction of the Rio began at the end of June, while the team received the painted bodyshell at the end of September. It turned a wheel in anger just a couple of

weeks later. "It's been a bit of a challenge," agrees Fabbri. "This build has been quite dynamic because of the timescale. We had to structure a team and build almost everything from scratch. The body was designed in-house, working between Gigi and the regulations.

"It was important that the car still looks like a Kia Rio as much as possible," notes Gaunt, referring to the car's aggressive wide-track styling and rear wing. The bodywork is constructed of a combination of fibreglass, Kevlar and carbon fibre, although as per the regulations, the driver's door has to remain steel. ▶

“It was a crescendo of work to get the job done”

BELOW Where trial and error is historically part of a rallycross build project, Galli's Rio was fully designed at Danisi in CAD



Danisi spent considerable time focusing on the balance and weight distribution from the very start of the project. "From the beginning we had a clear idea about the mass distribution (thanks to Gigi's experience), and working together with the suspension engineer, we started moving things around inside the car to reach that. You've got to start with what the mass distribution is going to be," says Gaunt. "You have to concentrate on the heavy parts of the vehicle to balance it out, and to get the mass where you want it. We spent a lot of time trying to optimise the package, in terms of trying to get as close as possible to the rules with the smallest possible margin, because we know how tight it is here in terms of competition."

A supercar must weigh 1,300 kg (including driver) and impressively, the Rio is already down to that limit. "We can get a load more weight off yet, so we can start to put it where we want it," he says.

Gaunt stresses that the accuracy of the Rio's build is to within just a couple of millimetres, a feat almost impossible to achieve without the use of computer design. "We're working to an accuracy of one or two millimetres through most of the car in terms of subframes and packaging," he says. "The packaging of the engine is very tight. You have to make everything fit inside the tunnel; oil, water, exhaust and cooling pipes, there's a lot to get in!"

Those cooling pipes are attached to the rear-mounted radiator in the Rio. Rallycross Supercars locate radiators in the rear, not only for protection, but also to be able to force air into the core through vents in the rear quarter panels, and to leave as much room as possible in the front for the intercooler.

FIRST BIG HEADACHE

"The cooling package was the first big headache," smiles Gaunt. "We needed to fit the largest possible radiator because we didn't know how much cooling the car would need. There's a lot of stuff that's difficult to know, before you've built the car and done any aero testing. It's the same for the inlets; there's a lot of different ways that people do it. In the end we opted for the biggest that we could make in the package and it ended up being similar to a lot of the existing cars.

"There's so much to consider, like how far

the fans need to be from the core. Normally, people like PWR fit the radiator on a test bed, put it in a tunnel, get some data and then from that do some CFD. But we needed to build the car and go and race it. The car doesn't overheat, so it works. The intercooler in the front is the biggest here," he says, gesturing to the paddock. "Maybe we will go smaller in the future. At the moment we don't know. We've gone with what we do know, which is better to be too big than too small."

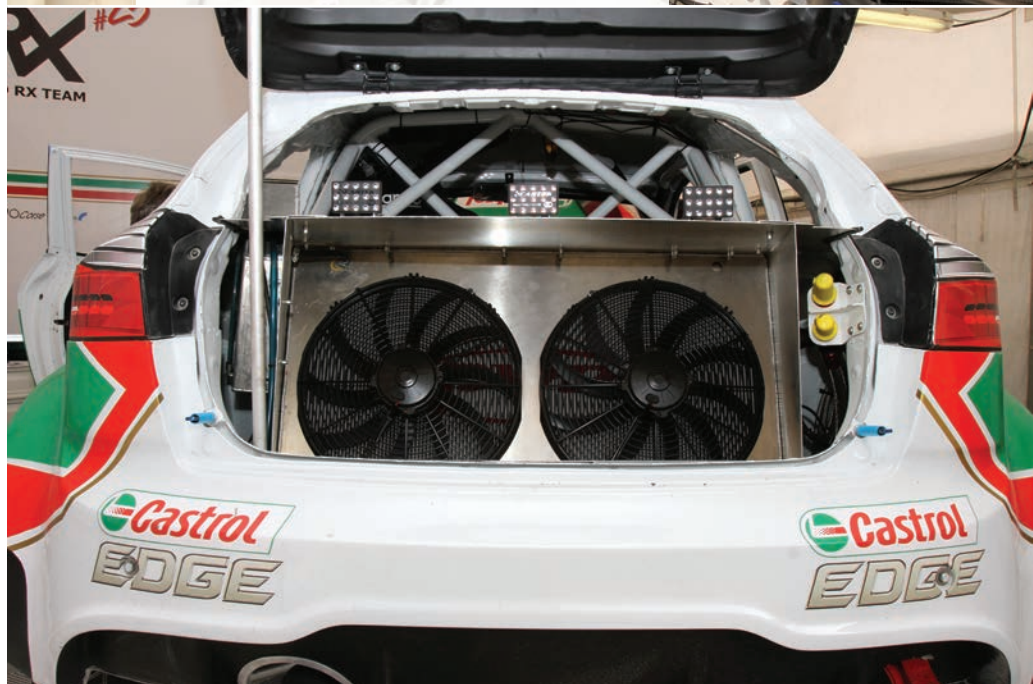
There is much debate in the rallycross paddock about which is the best direction to go down with regards to engine orientation

in Supercar. It is a trade-off between weight distribution and having mass over the front axle for startline performance. Having modelled the chassis in CAD, and settled on a longitudinally-mounted unit, Danisi needed to make the package fit.

"There was a lot of discussion surrounding the engine," admits Gaunt. "In the end we went with longitudinal for weight distribution. A lot of people say it affects the way the vehicle comes off the line, but from our vehicle dynamics experience, we tried to get the best traction we can. Also packaging and choices of transmission played a major part." ▶



ABOVE & BELOW Cooling pipes feed the rear-mounted radiator



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BELOW The use of a 'custom engine' made the whole project viable, Danisi eventually opting for a longitudinally-mounted unit. Packaging, as you can see, was a challenge



That packaging is made more difficult by the type of engine the Kia utilises. Fabbri won't be drawn on the motor's origin or any performance figures but, as a general rule of thumb, the power figures for the two-litre four-cylinder turbocharged (with 45 mm restrictor) rallycross Supercars edge their way towards 600 bhp, with around 800 Nm of torque.

Prior to 2015, a rallycross Supercar had

to use an engine block from the original manufacturer of the chassis, but new 'custom engine' rules allow for a different block to be used, as long as it fits within a series of strict measurements and regulations. Without that rule coming into place, it wouldn't have been possible for the Kia to compete.

"We had to use a custom engine because at the moment, Kia don't have anything

suitable in their range," says Fabbri.

"This engine is constructed from a lot of components from different places. There are quite a few parts that we haven't had the time to make from billet, so you have to make the parts fit around each other.

"We've just started the process of making things even better for the packaging. On our engine, the intake manifold is on the right, with the exhaust on the left. Other teams have the other way round. The driver is on the same side regardless, which makes things a little tricky, but it all fits."

LATEST FOUR-WHEEL DRIVE

Bolted to the back of the north-south engine is a UNIC six-speed sequential four-wheel drive transmission. Built by Swedish engineer Mats Karlsson, the UNIC gearboxes are now commonly used in World RX, notably by reigning champion Petter Solberg. "Mats helped us with our initial setup, and the recommendations he gave us were a pretty good base, so we're happy," says Gaunt.

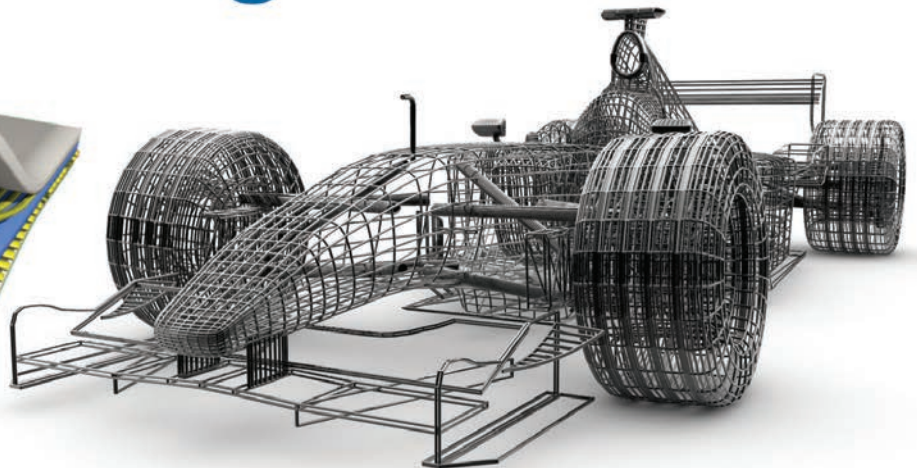
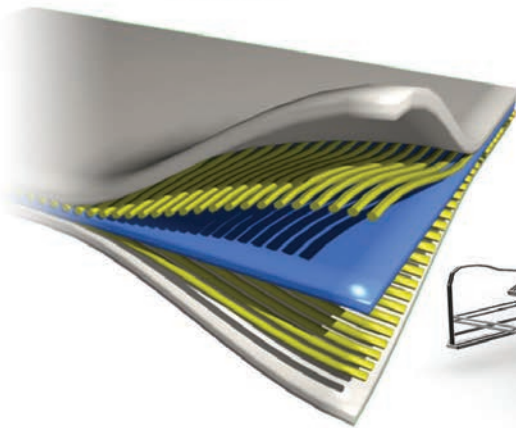
Sandwiched between the engine and transmission is an Alcon clutch, the team taking time to make sure it works as ►



ABOVE The Kia's aggressive looks will be a fixture on the RX scene in 2016



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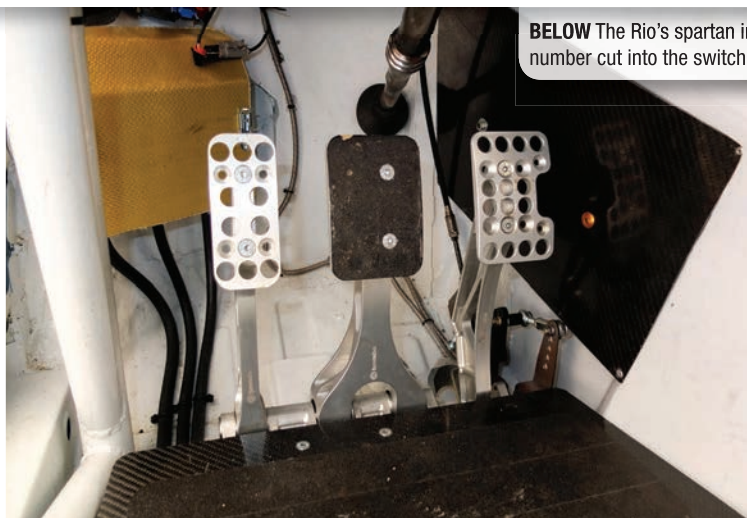
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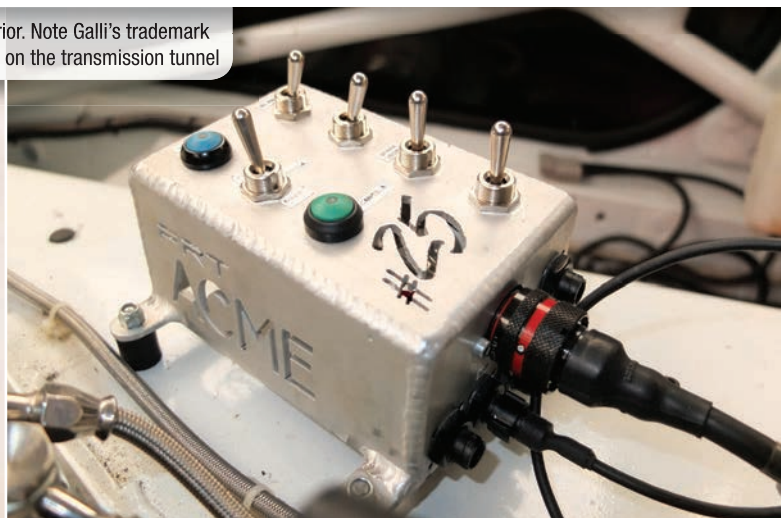
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BELOW The Rio's spartan interior. Note Galli's trademark number cut into the switchbox on the transmission tunnel



smoothly as possible. That's not an easy task when a rallycross Supercar launches from the startline to 100 kph in around two seconds.

The Rio runs a MacPherson suspension setup at every corner, with the latest rallycross Reiger dampers, located at the bottom of the upright with a lower wishbone. With time limited in the project build, Danisi elected to utilise available existing parts but, says Fabbri, expects to manufacture bespoke items as development continues: "We use a mix of components in the suspension – a large percentage of them we made in-house. We have CNC in-house and will make the parts, but that takes time. If you make the car in four months, you can't spend four months building the suspension!"

SUSPENSION PACKAGING

"Tim Wright, vehicle dynamic engineer at Danisi, worked for a month in order to do a full dynamics job and simulation on the suspension system. Then Ashley packaged the components into the subframes [which house the front and rear drivetrains and bolt to the chassis as per the regulations], so we used existing parts to save time. Most of

“ We started off looking at the anthropometrics of Gigi and the cars he has competed in”

the suspension is universal front and rear. It works from a dynamics point of view and of course it is beneficial for spare parts too.”

For the Rio's brakes, Brembo four-pot callipers have been used, with vented discs. "We used these because they are the smallest we could find," says Fabbri, referring to the constant rallycross compromise between braking performance and achieving the lowest rotational mass possible to aid the getaway from the startline. "We started with the biggest brakes we could fit into the wheels, then worked back over so we're still within a safe margin for functionality but at the same time as light as possible."

Operation of the brakes, throttle and clutch is via a custom Brembo pedalbox, with the pistons underneath Galli's feet. The 17-inch wheels for the Rio project are courtesy of Evo Corse, forged specifically to achieve the offset required on the new car, with additional bespoke structural differences. All competitors in

the championship have to run the control Cooper tyre in dry and wet conditions with a single compound and tread pattern for each.

The roll cage installation and bodyshell fabrication was done in-house at Danisi, where the CAD modelling came into its own, locating Galli into his new car and its typically functional and utilitarian interior. "We started off looking at the anthropometrics of Gigi and the various different cars he has competed in," explains Gaunt. "We mocked up a few positions and then built a CAD model. I physically measured Gigi, his hands and his feet, and used our experience. Gigi then got in the car, and we changed things a little, like the gear stick and handbrake. In the end we got him in a position that he is happy with, and a good position in terms of the mass of the car."

The Rio build was completed just in time for a shakedown at a media event at Franciacorta in the lead up to its debut

event. With limited testing and development time, the Rio suffered an oil pressure problem in free practice on its debut, and the team elected not to risk further damage by competing. A testing programme ahead of 2016 began immediately following the event. The team will build two new chassis, based on lessons learned with this version, what Galli calls 'the zero car'.

"MASSIVE LEARNING"

When the car was finished, it was run up and down at a local airfield. The team was satisfied to have pulled off the first part of the project in such a short timescale. "We only made a few kilometres, but they were good," recounts Fabbri. "Every kilometre is massive learning.

"We've pretty much got the blueprint for what the car needs to be. It's not so different from what we have, but you end up changing everything. We've just arrived, also largely down to the help of GG's own team of mechanics, G.Car Sport Racing, and we feel we're in a strong position. There's a lot of little boxes ticked, but we've got a lot more work to do and will try different things. We definitely have a strong direction for this to work very well."

What Galli and Danisi have achieved to date is remarkable given the timeframe. The fact they didn't make it beyond practice in their first event is somewhat irrelevant. If progress continues at its current rate, the Italians could play a significant role in Kia's place in motorsport history. **RT**

Kia Rio Suppliers

Body shell	– Danisi Engineering
Engine	– 'Custom engine'
Radiator	– PWR
Turbo	– Precision
Inlet Manifold	– Jenvey
Transmission	– UNIC
Clutch	– Alcon
Brakes	– Brembo
Pedal Box	– Brembo
Dampers	– Reiger
Fuel Tank	– Merin
Wheels	– Evo Corse
Tyres	– Cooper Tyres*
Fuel	– P1 Racing*

*Fuel and tyres are control items in FIA World Rallycross Championship.



ABOVE The latest Reiger rallycross dampers are utilised



ABOVE Danisi worked to an accuracy of within one or two millimetres for assemblies like the subframes



ABOVE The team won a race against time to make the car's debut, the whole project being completed in just four months

FINDING THE FUN FACTOR

Toyota Motorsport GmbH is bringing rear-wheel drive back to the stages with its new GT86 CS-R3 rally car. **Chris Pickering** reports



ABOVE The GT86 renews Toyota's strong historical link with rear-wheel drive rally cars

“The first time anyone has tried to do a rear-wheel drive car in R3”



WHEN the late great Colin McRae retired from professional rallying he decided to keep himself occupied with a little project. Small, light and most of all rear-wheel drive, the Mk2 Ford Escort was the plaything of choice for one of the rally world's biggest stars. Developed into a 330 bhp carbon fibre-clad missile, McRae's Escort was certainly quick, but the real reason he chose it was because it was fun. The same could be said of other rear-wheel drive rallying icons like the Fiat 131 Abarth and the Toyota AE86.

Three decades on, the engineers at Toyota's motorsport division TMG believe it's time to rediscover that fun factor. And they might have just the car for the job.

Modern rally cars are almost exclusively front-wheel drive or four-wheel drive, frequently turbocharged and usually based on everyday hatchbacks or saloons. But TMG wanted to shake things up a bit. Its answer is based on the rear-wheel drive, naturally aspirated GT86 coupe produced by parent company Toyota.

"We were thinking that if we launched a new rally car it would have to be something different – something that came from a different angle to the other cars out there," comments Nico Ehlert, principal engineer, customer motorsport at TMG. "We already had quite a lot of experience with the GT86 in circuit racing and Toyota has quite a strong historical link with rear-wheel drive rally cars, so it seemed like a good solution. A lot of people still remember the spectacle of seeing a rear-wheel drive car at full throttle on a rally stage and we were determined to give back a piece of that history."

Ehlert and his team set out to develop the GT86 for the FIA's R3 regulations, but it rapidly transpired that homologating a rear-wheel drive, boxer-engined coupe in a world of front-wheel drive hatchbacks ►

wasn't going to be easy.

"The regulations evolve year-by-year with new ideas from manufacturers and the FIA, but all the questions that had been raised in the technical working groups until now had been for front-wheel drive cars," he says. "This is the first time anyone has tried to do a rear-wheel drive car in R3, so we turned up with a completely new set of questions."

UNDER THE SKIN

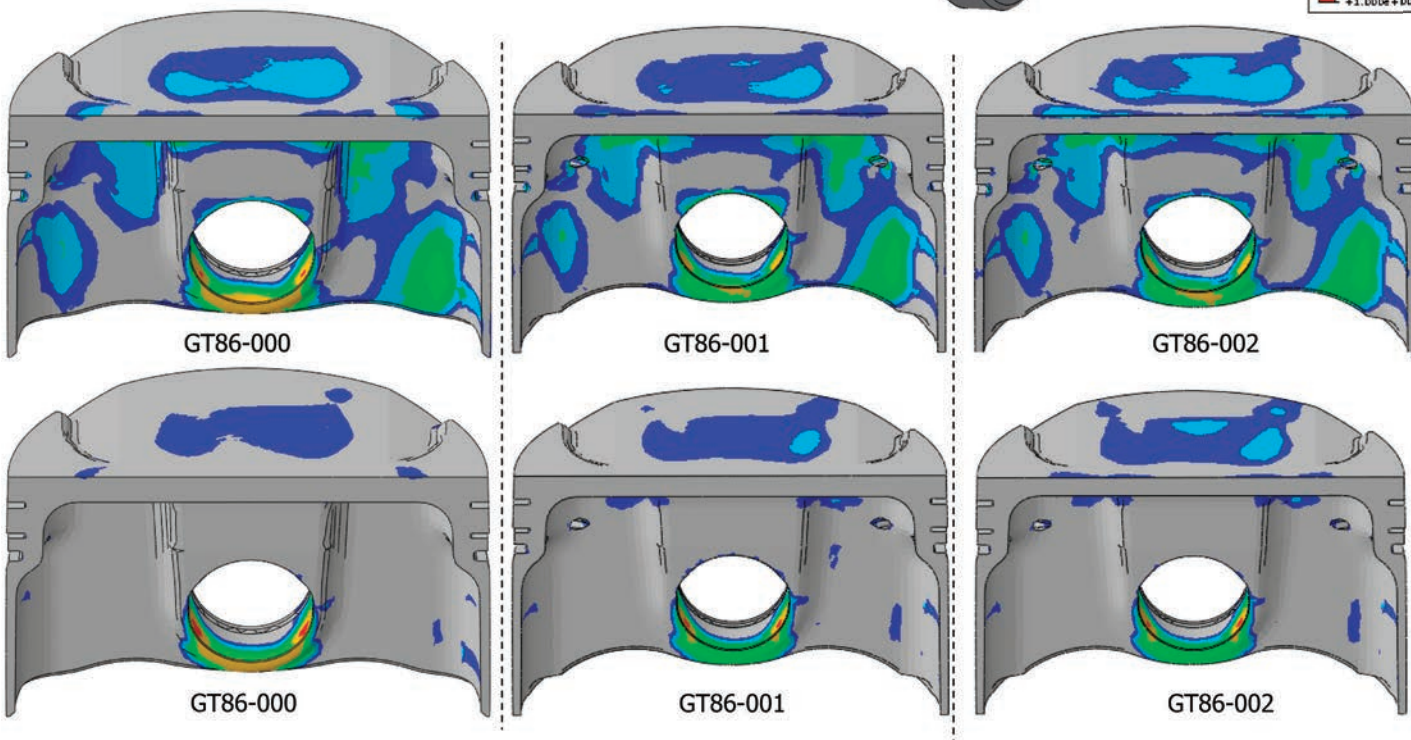
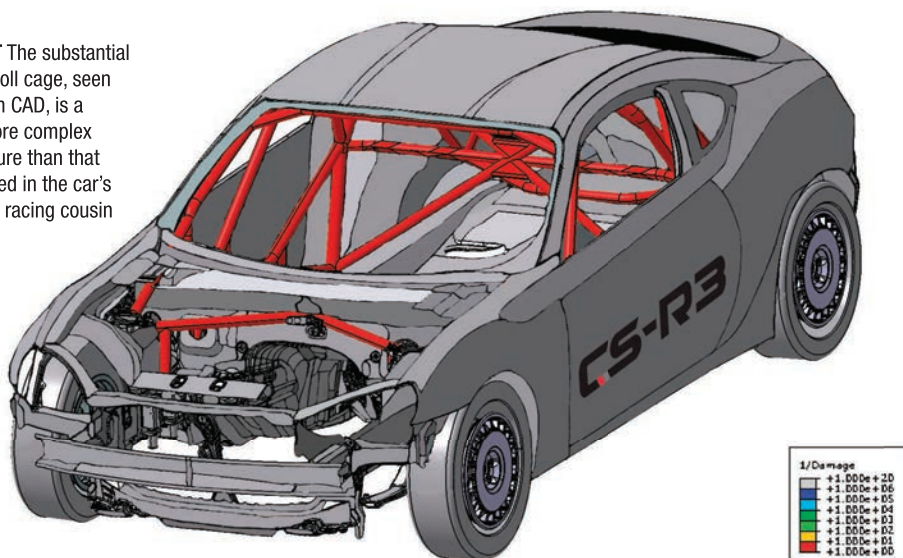
The steel monocoque structure that underpins the new Toyota GT86 CS-R3 is basically the same as the production car, but it's reinforced by a substantial steel roll cage. While some aspects of the car take their inspiration from its circuit racing cousin, the CS-V3, the roll cage is a far more complex structure. That's driven partly by the need to position the driver significantly higher up in the rally car for visibility, but it's also been designed to meet full FIA international requirements, whereas the circuit car currently only has a national homologation.

Priced at €84,000 plus tax in kit form, it's around twice the price of the heavily production-based CS-V3, but you can see where the money goes. While the circuit racer makes do with the standard gearbox and the road car's Torsen differential, the CS-R3 uses a 6-speed sequential gearbox ▶

BELOW Significant effort has gone into the two-litre, normally-aspirated boxer engine, not least because R3 regulations required the compression ratio to be decreased from the road car standard



RIGHT The substantial steel roll cage, seen here in CAD, is a far more complex structure than that featured in the car's circuit racing cousin



ABOVE TMG's state-of-the-art engine development tools were employed to coax a maximum power of 232 hp and peak torque of 235 Nm from the engine internals and software. This is the design evolution of a piston

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ABOVE A variety of protective panels shield the underside of the car from the ferocious punishment endured on gravel stages



ABOVE The driver is positioned significantly higher up than in the car's race or road counterparts



and a ramp-type limited slip differential from Dutch transmission specialist Drenth.

The suspension too, is completely bespoke to the rally car, although it retains the GT86's layout with MacPherson struts at the front and a multi-link arrangement at the rear. Three-way adjustable dampers from Reiger Racing Suspension are used on both ends, with different options for tarmac and gravel.

Similarly, the Alcon-supplied brakes use the same calliper arrangement on both surfaces (four-piston at the front, two-piston at the rear), but smaller discs are supplied for use on gravel. This is partly as a result of the

wheels, which shrink from 7 x 17-inch to 6 x 15-inch in gravel trim, with both sets provided by Italian manufacturer OZ. A variety of protective panels complete the transformation from tarmac spec, shielding the underside of the car from the ferocious pebble-dashing that can occur on gravel stages.

One of the biggest challenges in the project was getting the steering right, Ehlert explains: "Initially we'd planned to use hydraulic steering, but we couldn't find a suitable unit within the regulations, so we decided to use the production car's electrically-assisted rack."

The electric power steering system on

the GT86 is one of the best of its kind in a mainstream automotive application. However, in production form, it doesn't offer the adjustability that you get from a hydraulic rack, which typically allows you to tailor the power assistance characteristics by changing the valves on the steering pump. In the end, TMG turned to a software solution.

"Integrating the electric power steering with the CAN bus and the new electronics wasn't straightforward," comments Ehlert. "We're pleased with the results, though, and you can now vary the level of assistance in the software by changing the steering map." ▶

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BOXING CLEVER

The GT86 CS-R3's flat four boxer engine retains the production car's 86 x 86 mm bore and stroke and its 1998 cc capacity (the '86' name, in case you're wondering, is not a coincidence). Under the R3 regulations, however, the compression ratio has had to be reduced from 12.5:1 to 12:1, which left the team with a certain amount of ground to make up.

Boxer engines offer a naturally low centre of gravity and good primary and secondary balance, but they come with a number of drawbacks. Due to the horizontally

opposed layout of the cylinders they're prone to oil surge under heavy cornering, and to that end TMG has had to fit a baffle plate within the sump of the CS-R3. Also, because they have two cylinder heads – effectively it's a 180-degree vee engine – they have all the extra mass, friction and complexity that comes with two sets of valvetrain components.

New pistons, specially developed camshafts and a motorsport ECU running a bespoke calibration all contribute to the power output, which climbs a modest 35 bhp over the standard road car to 232 bhp. Drawing on its findings from the race series, TMG has

decided to retain the standard crankshaft and connecting rods, which helps to control costs.

The intake system is new, with a purpose-built airbox that's unique to the CS-R3. Likewise, the standard exhaust pipe and manifolds are substituted for a high performance system from HJS Racing, which emits a suitably off-beat snarl.

RISKY BUSINESS

So, it looks right and sounds right, but will it sell? Ehlert is refreshingly honest about the challenges facing such an unconventional design. "It's risky being the first manufacturer to bring this sort of car back to the market," he says. "We really hope that the teams, fans and drivers will share our enthusiasm."

Initial indications are encouraging. TMG has already taken a number of pre-orders for the car and the company's in-house tests suggest its performance should be competitive with the more conventional opposition overall, although it's fair to assume that tarmac stages will be the car's real forte.

With a single-make series planned as part of the German Rally Championship you might argue that outright pace against the more mainstream opposition isn't, in fact, the most important thing. Fun factor is sure to play a part. And in that respect the GT86 has to be a prime contender. **RT**



ABOVE Alcon supplies the brakes, Reiger the suspension

BELOW And now for something completely different: the GT86 CS-R3 is the first new rear-wheel drive rally car to be granted FIA homologation in the 21st century



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2015's TECH HEROES

William Kimberley reveals the contenders for the prestigious technical awards to be presented at this month's World Motorsport Symposium

RACE ENGINE DESIGNER OF THE YEAR

Dave Henninger, GM Racing GT2 Corvette Engine Development and **Russ O'Blenes**, Senior Manager, Performance & Racing Engines, GM Powertrain

When Oliver Gavin crossed the finishing line at Le Mans this year to win the GTE Pro class, it represented a major achievement for everyone concerned at Corvette Racing and GM Powertrain. The team was down

to one car as the other had been written off in a qualifying accident. The odds were firmly stacked against the remaining entry reaching the podium, let alone winning the race against such strong competition from Aston Martin, Ferrari and Porsche. The fact that it did triumph was down to the drivers, the teamwork – and the engine.

One of GM's proud claims was that the C7.R was developed with the Z06 production car, sharing chassis, aerodynamic strategies and engine development. Because the road car had direct injection, it meant that the engineers from GM Powertrain could get their teeth into the technology for the first

time since the end of the GT1 era in 2009, and produce something that was quite state-of-the-art.

Corvette engines have a long-held reputation for ruggedness and reliability, a status the C7.R has maintained. Apart from its famous victory at Le Mans, it also won the Daytona 24 Hours and the 12 hours of Sebring – sports car racing's Triple Crown – and then later in the season Antonio Garcia and Jan Magnussen clinched the GTLM title in the Tequila Patrón North American Endurance Cup championship in the No 3 Chevrolet Corvette C7.R.

Thomas Kraemer
Manager, Development LMP1
Engine Design, Porsche

In only its second season of competition, the Porsche 919 Hybrid has had a triumphant year, not only winning most of the races in the World Endurance Championship, but the biggest prize of all, the Le Mans 24 Hours.

At the heart of the car is the 2.0-litre petrol turbo V4, developing around 500 hp, the configuration being chosen for short length and excellent structural



ABOVE Corvette celebrated what had looked an unlikely victory at Le Mans



ABOVE VW's re-homologated 1600 cc straight-four engine features more torque and power, but its weight has also been pared down to a minimum

properties. It was also very light and sat as far forward as it could in the car to make the most of the front tyres and to take as much advantage of the relatively free front aero regulations as possible.

One of the keys to its success this season is the fact that the team was the first to step up to the WEC's 8 MJ category. It is the only car in the series utilising two different energy recovery systems. There is a conventional KERS-like system, recovering energy under braking from the front wheels and storing this energy in Li-Ion batteries inside the cockpit. The second system is new and uses an additional turbine generator unit in the exhaust system that works in parallel with the turbocharger, and converts energy from the exhaust-gas stream into electricity. Thus, the Porsche 919 Hybrid is the only car that recovers energy not only when it brakes but also when it accelerates.

"The most efficient engine Porsche has ever built," is how Wolfgang Hatz, member of the Porsche AG executive board, research and development, describes the 919's 2-litre V4 turbocharged petrol engine. "For the combustion chambers and port design, as well as for the camshaft drive and the direct injection system, we refined materials used in Formula 1," he says. "The 919 engine is a trailblazer in terms of fuel injection and internal friction."

Donatus Wichelhaus

*Head of Engine Development,
Volkswagen Motorsport*

Volkswagen Motorsport came, saw and conquered the World Rally Championship – in one go. The German team has absolutely dominated proceedings from the moment it entered the Polo R WRC in 2013, putting an end to Citroën's five-year winning streak. In fact, the Polo has the best win ratio in WRC history – better even than the quattro or Lancia – having won 32 of its 37 WRC events as Race Tech closed for press.

VW Motorsport put the knowledge gained from running a pair of Skoda Fabias in 2012 to good use, because out of the box the Polo R WRC was fast and reliable. The car came second in its first WRC event in Monte Carlo, followed by a win on the Swedish Rally. From that day to this, it has been the benchmark to which others aspire. That mantle was underlined this season when it clinched its third straight drivers' and manufacturers' crowns.

For 2015 the team appeared with major revisions to its Polo R WRC. Strictly controlled by the regulations, the engine was pared down to equal the minimum 81.5 kg weight limit while developing 318 bhp. This in itself may not sound much but it is the way in which the power is delivered that is important, while the engine has also been designed to make for easier servicing.

David Mountain

Managing Director, Mountune

Late out of the box due to the team lacking the funds to start its campaign in the British Touring Car Championship until midway through the season, Motorbase Performance has come back with a bang, much of it due to the team's new Ford EcoBoost engine developed by Mountune. The engine was so successful, with four outright wins from the last nine races, that by the end of the season rival teams were up in arms claiming that the Motorbase unit had an unfair advantage.

Featuring a raft of new technology, it addressed all the weak points of the older Duratec unit that the team had been using. For example, from the combustion chamber upwards, the EcoBoost engine starts to look very different to its predecessor with direct injection and variable valve timing, both largely taken from the production unit. Together they have helped address the weakness of the Duratec engine, namely response and torque.

Nonetheless there still remains a distinct family resemblance between the 2-litre 16-valve EcoBoost and Duratec engines with, for example, the size and location of the crankshaft bearings being basically the same, as are most of the external mounting points. However, there are subtle differences in things like waterways and oil paths and while the EcoBoost engine uses a production crankshaft, the production sintered conrods have been replaced with steel ones from Arrow Precision.

TOCA rules do not allow any modifications to the cylinder head casting, so the ports are completely standard, as is the roof of the combustion chamber. Piston design is open, though, Mountune going to great lengths to optimise the bowl shape on the top of the piston. ▶



ABOVE Mountune's EcoBoost engine ruffled feathers with its pace in the BTCC

The Dino Toso award for the **RACECAR AERODYNAMICIST OF THE YEAR**

In previous years, this award has been given to the outstanding racecar aerodynamicist of the year, but in each case it was accepted on behalf of the team rather than as an individual. We have consequently revised this, and guided by our Chairman John Iley, the criteria is now recognising a standout car and its aero team.

Scuderia Toro Rosso

Toro Rosso's STR10 has been one of the surprise packages of the 2015 F1 season, the team punching well above its weight.

As Craig Scarborough observed in the April issue of Race Tech, before the season had

got underway, Scuderia Toro Rosso was less subject to management turmoil and funding problems than its midfield peers, the team marching onto its tenth chassis. The STR10 is a curvy car with neat and innovative touches, from its unique system of ducts in the roll hoop area, to its trademark gearbox casing made from a hybrid aluminium and carbon fibre construction, and the elegant swan neck mount for the Y100 winglet over the exhaust.

With two young rookie drivers and the Renault engine, which sister Red Bull Racing was so forthright in denigrating, the fact that the team was often challenging other well-funded outfits, including its

mighty sibling, is tribute to the entire squad. Apart from the highly talented drivers and the very smart organisation under technical director James Key, tribute must be given to the team's aerodynamicists for providing such a competitive car.

Porsche

It is an open secret that Williams Advanced Engineering played quite a significant role in the development of the Porsche 919 Hybrid's aerodynamics, but the guidance and direction still resided in Weissach under the watchful eye of Damien Favre. ▶



ABOVE Toro Rosso's STR10 has impressed, in spite of running an engine denounced by its sister team

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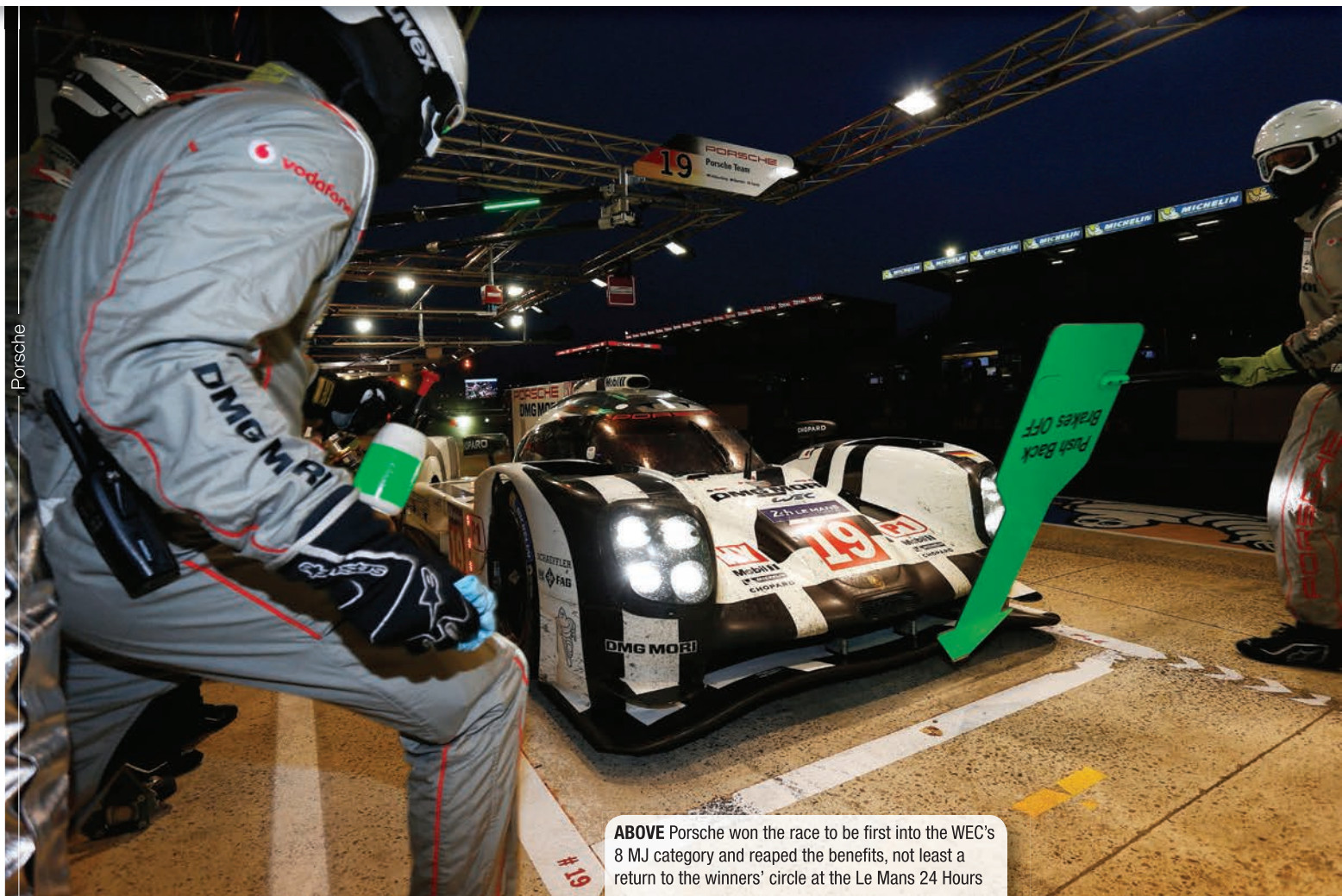
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ABOVE Porsche won the race to be first into the WEC's 8 MJ category and reaped the benefits, not least a return to the winners' circle at the Le Mans 24 Hours

There is no question that the car had a wonderful engine but it was the combination of power unit and aero that enabled the drivers to get the best out of the 919. Despite the win at Le Mans, the aero team did not rest on its laurels and developed around 80 per cent new bodywork for a higher downforce configuration that looked significantly different compared to the low downforce aero spec for the endless straights at Le Mans.

At the time of writing, the team had totally dominated the rest of the season, going on to win at the Nürburgring, the Circuit of the Americas and Fuji.

Nissan

Bearing in mind the dreadful time the team endured at Le Mans, the only race in which the radical GT-R LM NISMO raced, perhaps it is surprising that Ben Bowlby is being nominated for this award. However, the car performed badly due more to its hybrid system not working properly than the car's aerodynamic setup which was designed for an 8 MJ energy recovery system. In fact, the hybrid system was ultimately disconnected for the 24-hour

race, leaving the car hobbled.

Bowlby is no stranger to innovative designs, having won this award in 2011 for the DeltaWing even before the car had turned a wheel. There is no question that he has been pushing the boundaries with his latest creation.

The jury is still out as to whether his concept is correct or not, but installing the

power unit in front of the driver, rather than behind, is in itself an adventurous idea.

The reason for this was that he was trying to exploit the more open aero regulations relating to the front of an LMP1 car and there is no reason to think that he was on the wrong track. Assuming that the power unit is sorted for next year, we will find out whether his theories translate into reality and success. **RT**



BELOW The through-duct is at the heart of the GT-R LM NISMO's audacious aero philosophy

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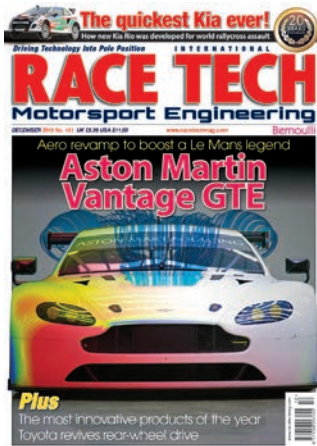


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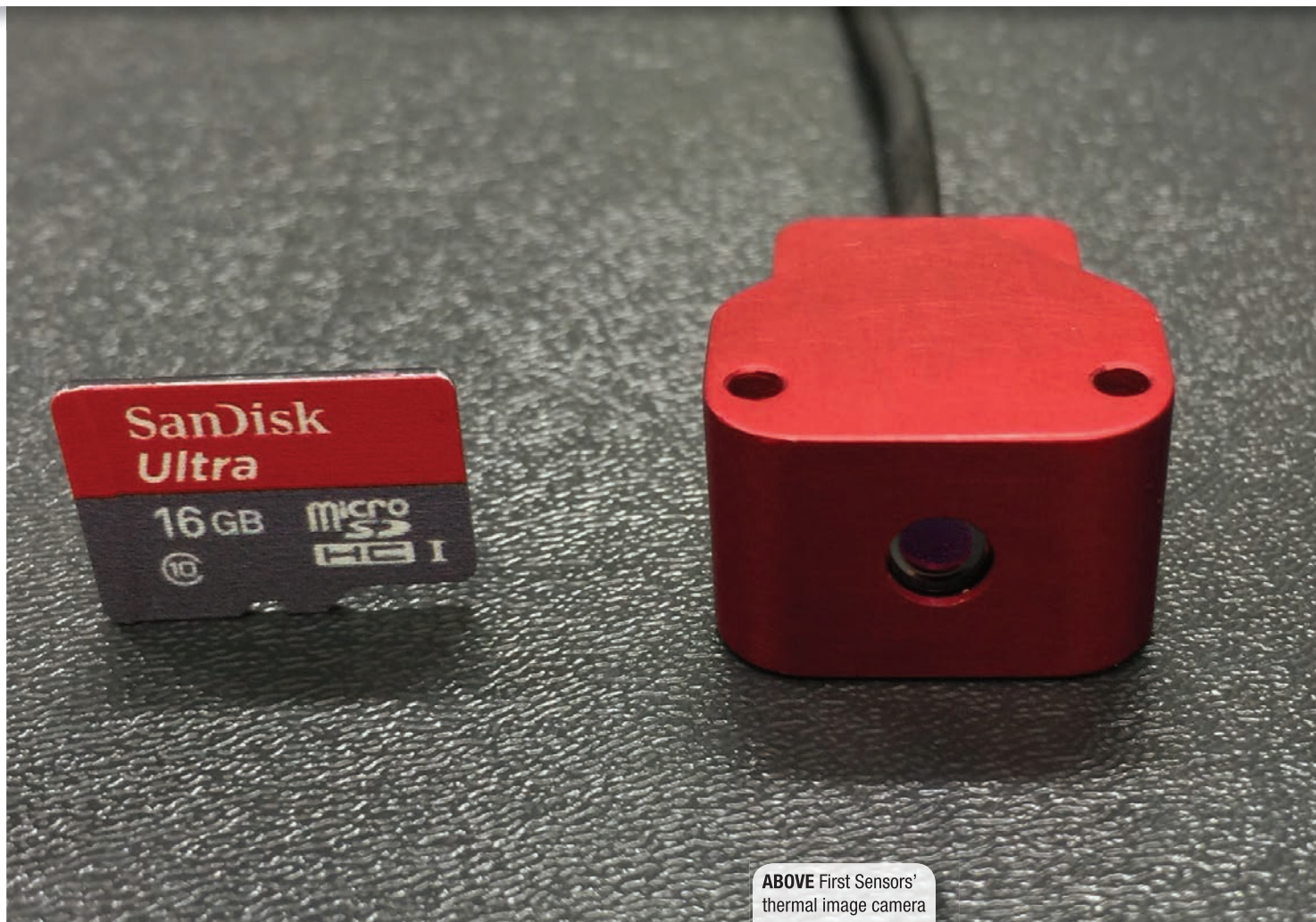


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ABOVE First Sensors' thermal image camera

PRODUCTS THAT COULD TRANSFORM OUR WORLD

William Kimberley reviews the contenders for the Most Innovative New Motorsport Product of the Year accolade, to be presented at *Race Tech's* World Motorsport Symposium

First Sensors

for producing the world's smallest thermal image camera designed for tyre management

Thermal imaging has become a vital tool for controlling temperature management and tyre performance with quite a number of products on the market to cater for it.

However, First Sensors has developed what it claims is the world's smallest thermal camera for tyre management.

With two fields of vision – 25 and 50 degrees – and three different modes of operation, it is very flexible. It offers 80 by 60 pixels at 9 Hz recording, 80 by 1 pixels CAN output at 9 Hz and 80 by 60 pixels CAN output at 6 Hz. It features 16

gigabytes of storage built in to enable 10 hours of recording storage. With the ability to operate as a standalone system or connect to a CANbus, it is not surprising that it quickly came to the attention of a number of Formula 1 teams and others who want to know more.

Intercomp

for the SW656 iRaceWeigh Scale System

Intercomp's iRaceWeigh Wireless Scale System is the most convenient way for scaling a car using an iPhone, iPad, iPod Touch or any smartphone or tablet for Android. Utilising iRaceWeigh, the first app to control, view, and record live scale data,

and fully integrated RFX wireless weighing technology, it provides complete, secure control over scales and setup data.

Intercomp claims that its industry-leading system is the most advanced wireless weighing technology of its kind and is trusted by officials and teams in all forms of motorsport.

Its iRaceWeigh App is available for free on iTunes and Google Play, and can be downloaded to as many devices as desired. As new updates become available, the app can be updated right from the device, keeping racers armed with the most up-to-date features and functionality.

The system includes four 15" x 15" x 2.5" (381 x 381 x 64 mm) wireless RFX billet



ABOVE Intercomp's SW656 iRaceWeigh Scale System

scale pads, an updated iRaceWeigh module, batteries for the scale pads, and a two-year warranty. Users need only to supply their preferred compatible smartphone or tablet and can be up and running in minutes. Intercomp also offers a variety of other wireless weight indicators that can be paired with this system if desired.

Lifeline Fire & Safety Systems

for its new Zero 3620 fire suppression system

Lifeline's Zero 3620 is the latest system to meet the FIA's demanding new 8865 test and safety standards and has undergone extensive testing, development and validation in both the motorsport and defence sectors.

The engine-focused side of the system features Lifeline's patent-pending dual discharge technology where the primary side of the cylinder quickly knocks the fire out and is then supplemented with a secondary discharge, using the residual energy from the first, to deploy a specifically-blended



ABOVE Performance Friction's NASCAR Cup brake package

coolant fluid to prevent any re-ignition. The cockpit-facing system is available in two sizes – 2.0 kg for up to 2.3 CuM and 3.0 kg for 2.4 to 4.0 CuM – and features Lifeline's compression discharge technology, with the option of either a fixed or remote outlet.

The entire system is controlled by a unique microprocessor which constantly monitors the state of the system and battery and will advise the user of

any potential issues. Lifeline has also homologated a remote activation facility enabling the system to be deployed wirelessly from the pits or safety crew.

It has been awarded the FIA Gold Standard for use with unleaded petrol, diesel, ethanol and E85 fuels. Following the homologation, it has been mandated for use in the WRC in 2016 and officially recommended for all other categories by the FIA.

Performance Friction

for its NASCAR Cup car package

The main goal of Performance Friction Corporation's new for 2015 NASCAR Cup package was to maintain the high stiffness but the innovative feature was the brake cooling ducts that have been integrated into the calliper.

The backside of the pad is cooled because as it's fitted onto a 15" wheel, high temperature is a big problem. While there is a decent enough air flow due to the front bumper ducts, there is the challenge of managing the thermal energy that has to go ►



ABOVE The Zero 3620 cockpit unit with remote nozzle

into such a small space.

Apart from the cooling, the new NASCAR brake package also features innovative lug nut guards that weren't required by NASCAR but by the teams. If the lug nuts come off, they can get caught between the bottom of the callipers and the hat and can sometimes knock off the bleeder, so these guards prevent that.

Another clever design feature of the calliper is that it can stall the air, the airflow fully adjustable to suit the application so that it reduces the hub temperature by 50°C. With the brake's optimum temperature taken into account, the disc's thickness can then be varied and usually reduced, PFC producing a chart that correlates the desired temperature of various brake packages and the weight that

can be taken out of the disc, ranging from one to three pounds per corner.

Basically what PFC has done is take into account the pad, calliper, disc and even brake fluid, treating them all as one interactive system.

Life Racing

for its D5 dash display

Life Racing's D5 dash is a 5" full colour sunlight-readable WVGA display with two CAN2.0B ports, USB, RS232 and twin Gigabit Ethernet ports plus eight, high brightness 'shift' LEDs and four general purpose/warning LEDs. It can be configured using PC software or by an external keypad controller to allow custom layouts, easy page navigation and programmable driver aids,

warnings and alarms. All functions can be simulated in software or by the playback of data files before programming.

It was developed in conjunction with an OEM project. It communicates with all of the engine controllers via fast Ethernet and USB as it is key to have ultra-fast, low latency data transfer because the requirement in new applications is for high density real-time information. The D5 dash allows a stream of almost unlimited ECU data at 100 Mbits/sec and can store 32 GB for instant recall when needed.

It's also got flexible CAN, user-definable inputs, and plug-and-play system layout. One of the unique features is automatic adjustment for ambient light, which makes its use fool-proof whether in bright sunlight or complete darkness. ▶



ABOVE Life Racing's D5 dash

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Stack*for its LCD Motorsport Display*

Stack claims that its colour LCD Motorsport Display is the next evolution of driver communication and data acquisition.

The carbon composite housing is IP65 sealed against water and dust intrusion and will easily withstand 20g of continuous vibration and 50g of shock. The 7" LCD panel ensures easy visibility under all circumstances with unmatched brightness and an optically bonded lens for extreme glare suppression. The display layout is configurable to meet individual specifications and features perfectly rendered virtual analogue needles, value display bands, digital value indicators for vehicle parameters and configurable full colour text warning messages.

The system will accommodate two programmable data bus channels – I CAN and I serial – in conjunction with discrete analogue sensors and its integrated 3-axis accelerometer. Data collection can occur at up to 1,000 Hz and the internal memory allows for appropriate recording time.

User-definable warnings take advantage of super-bright, multicolour LEDs placed around the perimeter of the chassis to alert the driver to critical on-screen information.

BELOW Stack says its LCD Motorsport Display scales new heights

Williams Advanced Engineering*for its 2015 Formula E battery pack*

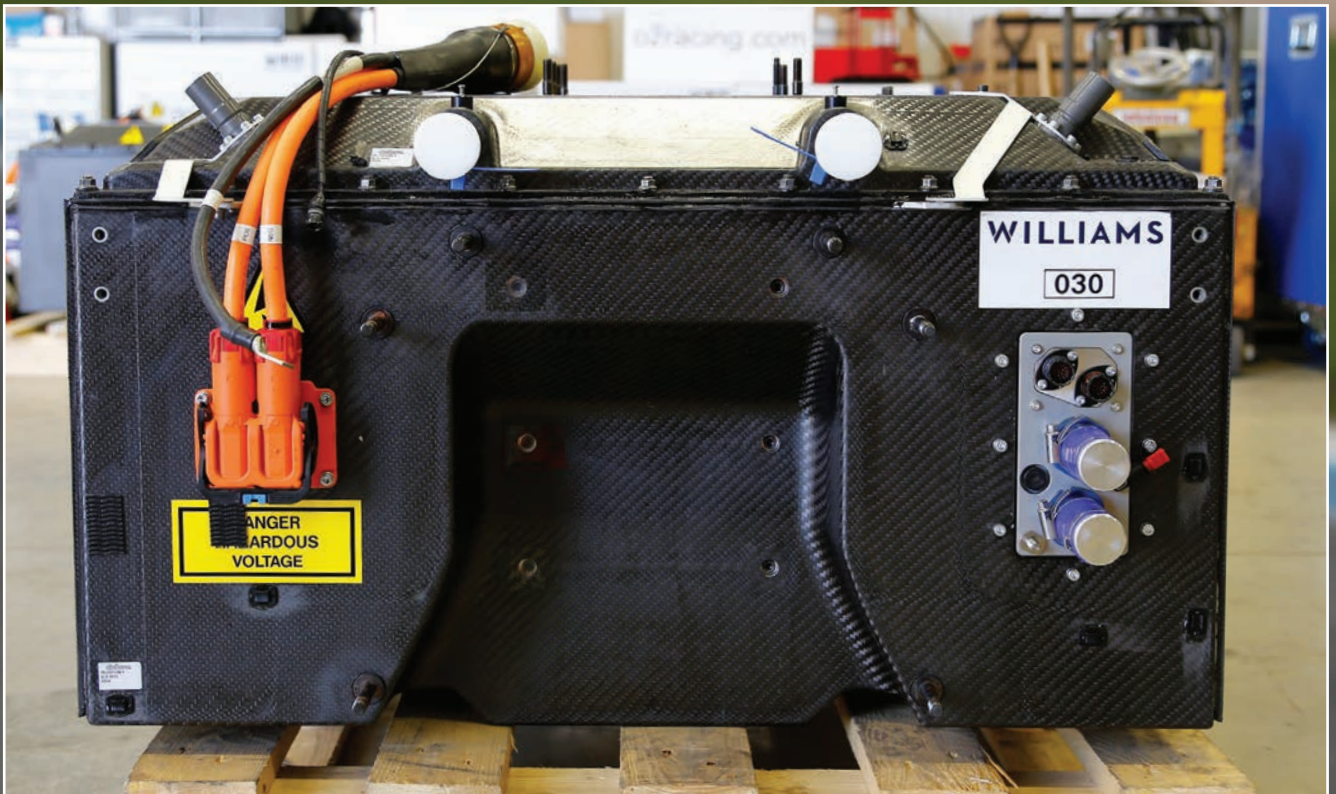
In a series that is unique and groundbreaking, the most innovative component of all in FIA Formula E is the battery that has been developed and produced by Williams Advanced Engineering.

Built to a specification determined by the FIA in terms of power, charge time and longevity, the work that has gone into powering the world's first all-electric racing series could only have been performed by a company with the racing pedigree of Williams – from being awarded the tender to running on track for the first test took just six months.

There were a number of hurdles that the design team needed to clear, such as the dimensions of the battery being determined by the available space within the design of the Dallara chassis. This created a challenge for packaging and installation. The next issue was ensuring that the battery received sufficient cooling; thermal management is at the core of the design as temperature defines the whole performance parameters.

Then, as the battery safety cell would form part of the car's structure, for the first time ever a battery would have to be used in an FIA front impact test. In the event, it was able to demonstrate that all the battery health reporting and safety functions were still in place after each test and the battery could still be used if needed. **RT**



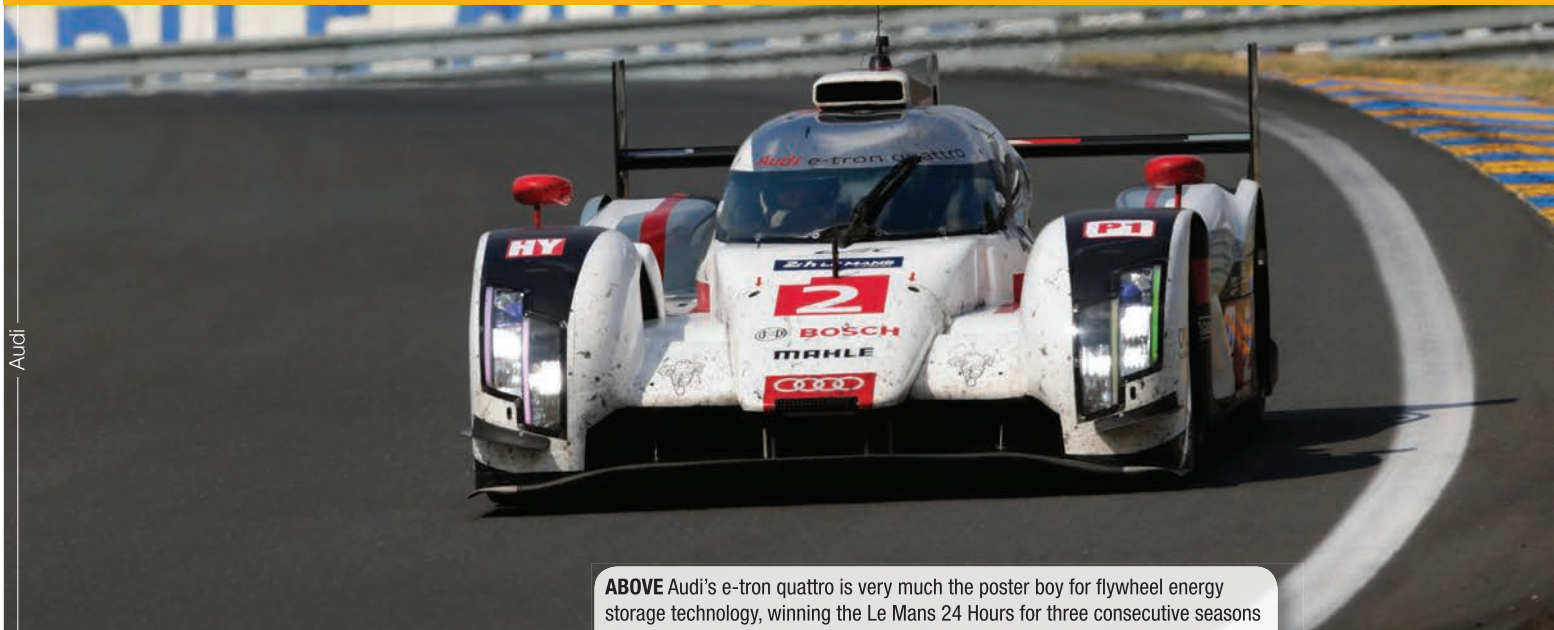


ABOVE & BELOW A battery pack with a difference and one that has powered and continues to power the entire Formula E grid



HONOURING EXCELLENCE

William Kimberley talks to two companies that have just received prestigious awards from the RAC Club



ABOVE Audi's e-tron quattro is very much the poster boy for flywheel energy storage technology, winning the Le Mans 24 Hours for three consecutive seasons

THE Dewar Trophy dates back to 1904 when it was presented to the Royal Automobile Club by Sir Thomas Dewar. Today, the trophy recognises outstanding British technical achievement in the automotive industry.

The list of past winners is stellar: the Stanley twins in 1906 for their land speed record in the Stanley Steamer; Rolls-Royce a year later for the 40.50 hp model covering 15,000 miles; Rover in 1951 for its gas turbine-powered car; Vandervell for the design, development, production and performance of the Vanwall Formula 1 car in 1958; and Alex Issigonis a year later for the Mini.

In 2014 it was presented to Andy Cowell, managing director of Mercedes AMG High Performance Powertrains, so the roll of honour reads like a Who's Who of innovative engineering over the years.

The Simms Medal is an award which recognises a genuine contribution to motoring innovation by individuals or small companies that also exemplify the spirit of adventure. The first medal was presented to Mick Hyde of Radical

Motorsport in 2003 for the SR3 sports racing car, with Prof Gary Savage receiving it a year later for the BAR Formula 1 team's carbon fibre gearbox. Ben Bowlby was recognised for the DeltaWing in 2012 and Lord Drayson in 2013 for his successful World Electric Land Speed Record runs.

Like the Dewar Trophy, the Simms Medal is awarded only in the years when an example of sufficiently innovative automotive design and/or manufacture has taken place, rather than it being a fixed annual award. Judging for both is undertaken by the Dewar Trophy Technical Committee, which is chaired by John Wood MBE.

This year two companies have been recognised with these prestigious awards due to their pushing the engineering boundaries.

GKN will be known to many for its driveline business. It employs 22,000 people at 56 facilities in 22 countries, and while it produces standard driveline components for vehicle manufacturers around the world, it has evolved in the last five years from being the world's largest supplier of limited slip differentials, constant velocity joints

and lightweight driveshafts into a leader in intelligent hybrid and all-wheel drive systems. It worked closely with Porsche on the 918 Spyder and with BMW on its i8 while in September it released details of its new electric "torque vectoring" axle technology for hybrids, which it claims will make the next-generation hybrids more dynamic.

However, it is for its flywheel technology that it is receiving the Dewar Trophy. The concept was developed by Williams Hybrid Power technology, when hybrid systems were first coming into Formula 1. In the event, it was not found to be the correct solution due to packaging issues, but it was taken up by Porsche which adapted it for its groundbreaking GT3 R hybrid that came within a gnat's whisker of winning the gruelling Nürburgring 24 Hours in 2010 in its first outing.

The flywheel accumulator itself is an electric motor with its rotor spinning at speeds of up to 45,000 rpm, storing energy mechanically as rotational kinetic energy. The flywheel generator is charged whenever the driver applies the brakes, with an electric motor

reversing its function on the front axle – in the case of the motorsport application – and acting as a generator. Then, whenever necessary, such as when accelerating out of a bend or overtaking, the driver is able to call up extra energy from the charged flywheel generator, the flywheel being slowed down electromagnetically in the generator mode and thus supplying up to 200 kW back to the electric motor at the front from its rotational kinetic energy. This additional power is available to the driver after each charge process for several seconds.

The technology was taken up by Audi Sport and became an integral part of the R18 e-tron quattro's powertrain, helping the team win the World Endurance Championship in 2012 and 2013 and Le Mans 24 Hours in 2012, 2013 and 2014.

As the technology was proving itself on

endurance racing. The high efficient high power transfer to and from the e-storage and an insusceptibility to performance or life degradation over a wide range of operating temperatures made this flywheel the ideal technology for the Audi project.

As the car has been developed, so has the flywheel technology. In 2015 its accumulator system's capacity increased from 500 kJ to 700 kJ as the Audi's energy output was raised from 2 to 4 MJ.

"We made the big leaps with the flywheel each year that Audi required in order to remain competitive with other energy storage technologies," says Gordon Day, operations manager at GKN Hybrid Power – who joined the company with the Williams acquisition – "so it meant we had to focus on mass efficient increases in power and energy and on improving the thermal efficiency.

"We've made some advances in terms of the materials sciences with the rotor, enabling a higher top speed for

the flywheel which gives an energy storage advantage, corresponding with the square of the rotational speed where kinetic energy is roughly equal to mass times velocity squared. That was one of the main advances and Audi moved up a category in terms of energy storage.

"We are also very involved with Audi from a packaging standpoint and getting the cooling system integrated and the flywheel best situated, but it's really up to them to bring all

of the hybrid system elements together. As the system becomes more complex we have more to do with the power electronics, for example, to keep it an integrated part of the system.

"For motorsport applications, thermal issues are always high on the agenda to address. We moved up in terms of average power rating, but keeping the unit essentially the same size as the prior year, so we made advances in the thermal efficiency of the overall system to achieve that by improving the internal cooling concept."

BUSES BENEFIT

While the motorsport applications are very important, in the wider world where volumes matter, commercial vehicles, especially city buses, have been identified as key if this technology is to be more widely adopted.

It was last November that bus manufacturer Alexander Dennis Limited (ADL) signed an agreement with GKN Hybrid Power to accelerate the introduction of low carbon bus fleets, committing to the purchase of 250 "Gyrodrive" electric flywheel systems. ADL will focus initially on the introduction of the low emission technology to bus fleets in London and Oxford but anticipates rapid deployment across the UK in the next few years. It will also be working closely with GKN to develop the technology for international markets.

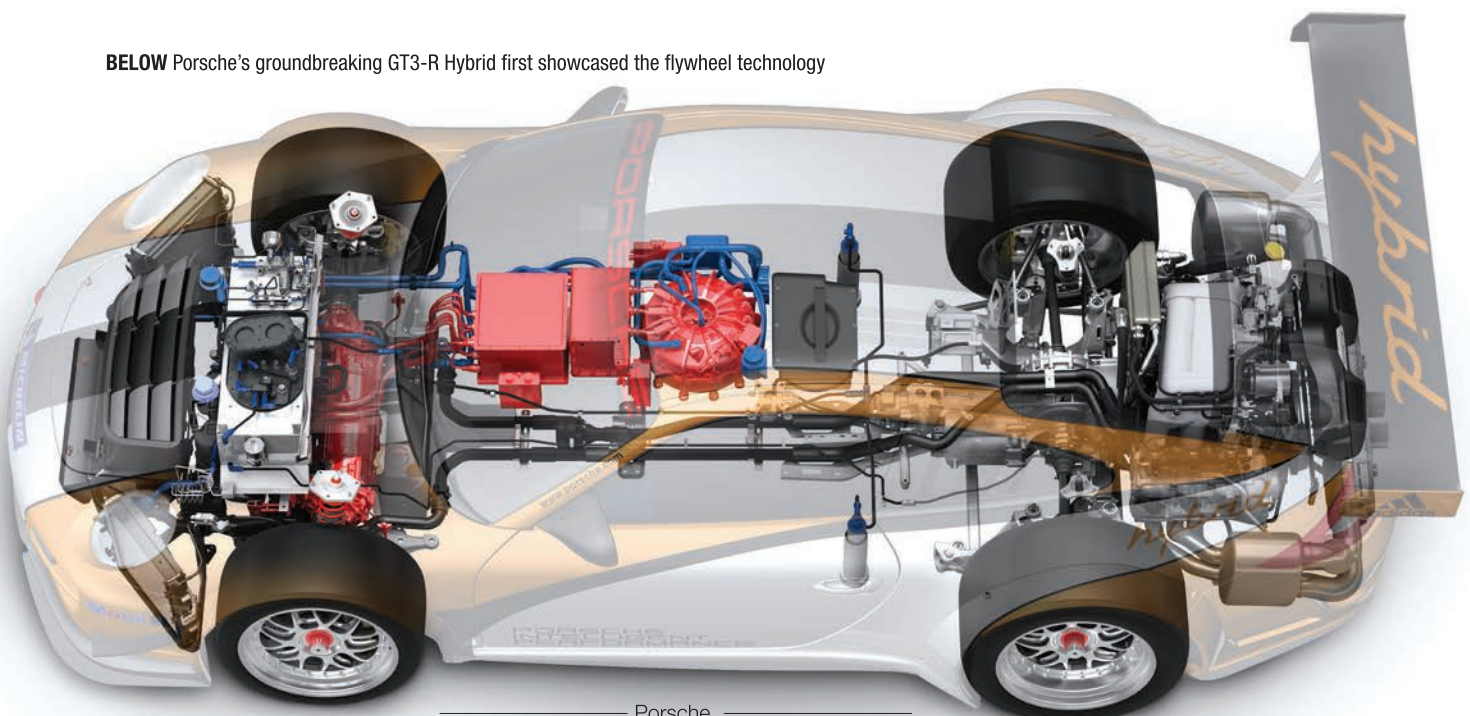
The Gyrodrive system uses the same high-speed flywheel made of carbon fibre to store ▶

“Recognised for pushing the engineering boundaries”

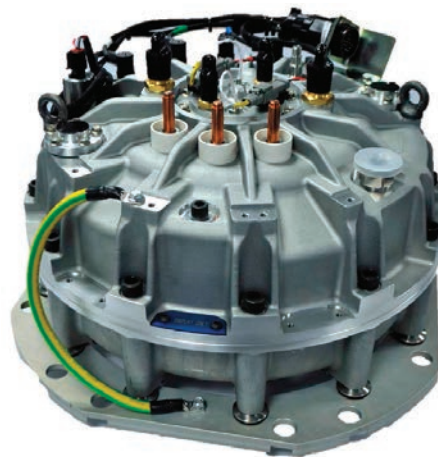
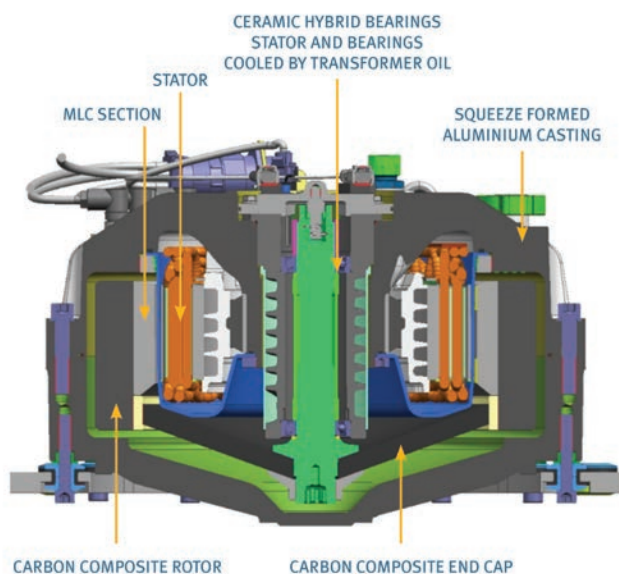
the racetrack, it became apparent that it was reaching a stage when it could go into full production, but essentially as an R&D company, Williams was not in a position to progress matters. As a result the company was sold to GKN in April last year so that the technology could be taken further.

However, as GKN Hybrid Power, work has not stopped on the Audi Sport front, especially as the key features and benefits of this innovative system are highly suited to

BELOW Porsche's groundbreaking GT3-R Hybrid first showcased the flywheel technology



BELOW GKN Hybrid Power's Gyrodrive Flywheel Energy Storage System cut its teeth in endurance racing



GKN

BELOW The Gyrodrive system offers a 25 per cent fuel saving on bus fleets

Standard bus one gallon travel



Gyrodrive one gallon travel



One bus = one mile



GKN

the energy generated by a bus as it slows down to stop. It then utilises the stored energy to power a GKN EVO electric motor which helps accelerate the bus back up to speed, generating significant fuel savings at a considerably lower cost than battery hybrid alternatives.

ADL's Euro6 Enviro400 bus, the UK's best-selling double deck – fitted with the Gyrodrive system – recently achieved low carbon emission bus certification, which acknowledges a 30% reduction in greenhouse gas emissions and entitles operators to enhanced fuel rebates.

Earlier last year transport operator Go-Ahead Group also selected GKN to supply 500 systems for use on buses in cities across the UK following successful trials in London.

"Fundamentally it's the same flywheel technology that we are now applying on commercial vehicles," says Day, "so there's a transfer of the learning as we go along from an R&D programme, such as a motorsport one with Audi, to our commercial vehicle programme."

The Gyrodrive system is designed to last

for the life of the bus. This eliminates the need for any battery changes and offers much lower whole-life costs than other hybrid alternatives, making it a truly viable proposition commercially.

"The opportunity to work directly with a manufacturer on the integration of our technology is an exciting one," comments Day.

"We also have our eye on the truck market where annual global volumes are around three million, and we are looking closely along with Alstom at mobile energy storage solutions for trams and have an early stage R&D programme. If the tram can travel from one stop to the other under its own power it does have infrastructure cost-saving implications. There are also multiple exciting future applications for this technology beyond commercial vehicles. For example, off highway is a sector of real interest, as are port-side diesel cranes."

As Day acknowledges, the initial cost is a real focus and as the technology is developed, the costs will reduce, while the whole life nature of the technology proves it to be very cost-effective.

SIMMS MEDAL WINNER

Williams Advanced Engineering is involved in a huge number of projects, as detailed in Race Tech 177 (August), but it is for its pioneering work with battery technology that it has been awarded the prestigious Simms Medal.

For all the question marks that surrounded Formula E before the first race in Beijing in September last year, the first season turned out to be a huge success: the racing was good, the events were well attended and it created a huge amount of media interest.

The learning curve for the drivers and teams, who were all racing the same cars, was quite steep, but not as much as it was for the suppliers. This was a new racing category that was breaking fresh ground and there was really very little to go on.

For Williams Advanced Engineering, that learning curve was even steeper because it was a late arrival at the party, the championship organisers asking it to fill a gap vacated by another company that suddenly withdrew at short notice. It therefore had a little over 12 months to design and build batteries for the ►

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40 cars on the grid. Fortunately, though, it had built up a knowledge bank from its Formula 1 activities and its development of different hybrid technologies, together with the work it had done for other customers, so it wasn't working from a blank sheet of paper.

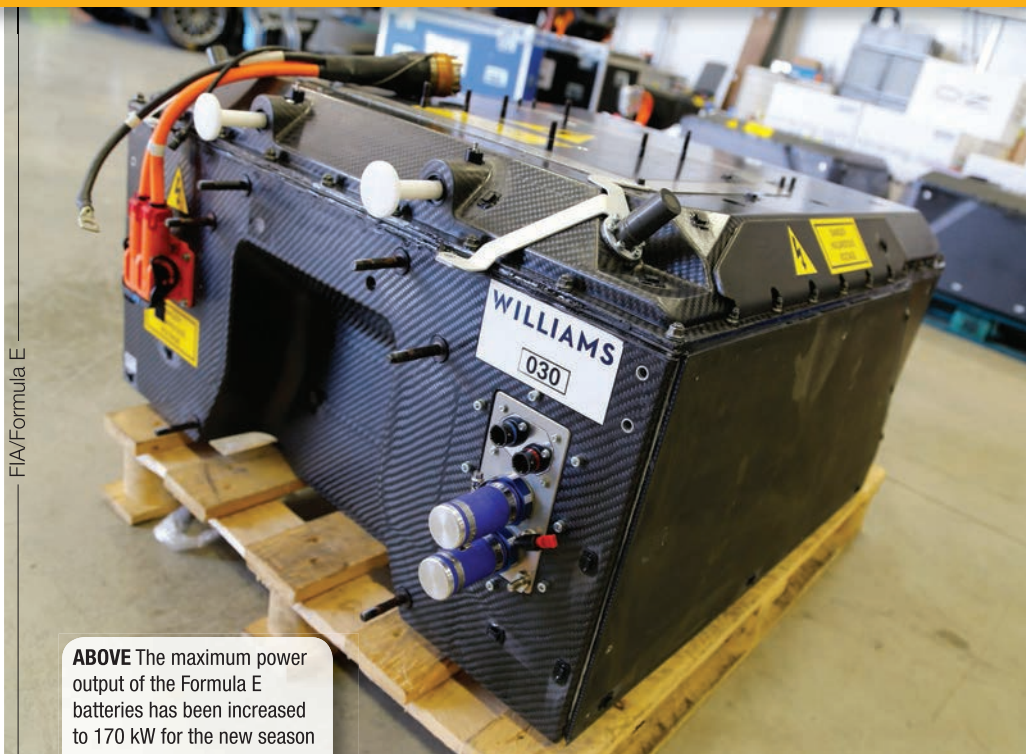
"There's no question that it was a major challenge, but as an organisation with its roots in Formula 1, we are more than used to dealing with short development timescales," explains Craig Wilson, managing director of Williams Advanced Engineering. "We had a working prototype in six months, and started full manufacture of the batteries in March last year in time for testing."

Using cells from Michigan company XALT Energy, the battery was designed to meet the specific technical specifications mandated by the FIA and Spark Racing Technologies. The fundamental requirements were a 200 kg cell weight limit, a 1,000V maximum allowed bus voltage, a 200 kW peak power limit and maximum usable energy of 28 kWh, although Williams designed a battery with some excess stored energy levels that stayed within the FIA regulations via the incorporation of XALT Energy cells.

"It was essential that we produced a component that was 100 per cent consistent from one team to the next, with each battery lasting for an entire season with no loss of power or performance," says Wilson. "We could have provided teams with a battery that was more powerful or longer lasting, but the first season provided a starting point from which to build on. It also tied in with the organiser's wish to showcase the evolution of battery technology over the next few years."

One of the issues facing the team tasked with developing the battery pack was that the chassis had already been designed. "This created another challenge for packaging and installation that needed to be overcome from the start," says Wilson. "We then had to make sure that the battery was sufficiently cooled – thermal management is at the core of the design because temperature defines the performance parameters in almost all racing cars and our battery is no different. This led to our developing an innovative liquid cooling system."

Another important consideration was safety, especially as the battery packs were destined for single-seater cars that were racing on street circuits. The racing promised to be close and with few run-off areas, high impact collisions were a probability, so they needed to be robust enough to withstand such punishment.



FIA/Formula E

ABOVE The maximum power output of the Formula E batteries has been increased to 170 kW for the new season

"We designed the battery according to the FIA's rules and regulations, car specifications from SRT, UN airfreight transport specifications, and our own expertise in designing high performance batteries," says Wilson. "Working together with our partners in the project, Dallara, SRT and RSF1, we designed the battery safety cell based on patented Williams battery case technology.

"While working on this, we ran CAE analysis on the internal fitting and fixing for the impact levels expected by the FIA crash tests and 38.3 of the UN Manual of Tests and Criteria test regime that nearly all lithium batteries are required to pass. It was the first battery to pass FIA crash tests as a fully live battery, and did so at the first attempt. Then it achieved UN 38.3 test specification vibration and shock profiles."

The fact that German driver Nick Heidfeld could walk away from a very violent accident in Beijing, when his car launched into the air and then smashed into the barrier on the outside of the final corner, eventually coming to a halt upside down, is testament to the validity of the crash test.

The batteries showed excellent reliability during season one, with only one on-track failure during the 11 races when operating at 150 kW. Williams Advanced Engineering is again the sole supplier of the battery packs for season two but with the maximum power output of the batteries being increased to 170 kW.

"Our next battery generation will have quite a number of improvements that we've largely learnt from the first season, but also from other battery programmes in which we've been involved, and it will definitely push the boundaries," says Wilson. "The challenge is to maintain maximum power and maximum energy for the range and not have a dramatic drop off when the performance is pushed. The objective by season five is to have the grid consisting of 20 cars that can race hard for the entire race without the need for a change over.

"Motorsport has always been a brilliant way of validating the next-generation of technology. It's about pushing the boundaries of what we currently have in a bid to gain a competitive advantage." **RT**



FIA/Formula E

ABOVE The push for tough safety standards paid off when Nick Heidfeld walked away from a violent crash in Beijing in season one

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The Cologne Affair

The PMW Expo in Cologne, Germany, has become an important event to get up to speed with the latest motorsport products and technologies.

William Kimberley takes a sneak view at what will be found there

Seal of approval for new Lifeline fire safety system

AS a very important player in the safety equipment market, Lifeline Fire & Safety Systems will be displaying its new fire suppression system, the Zero 3620, the latest product to meet the FIA's demanding new 8865 test and safety standards. This is a much tougher fire test that requires the extinguisher system to have a far greater fire-fighting ability and has to deal with two major fires in the vehicle, one in the engine bay and the other in the cockpit.

This is as before but the fires were relatively small. In the test set by the new regulations, the engine bay, which is divided into four quadrants, is heated up to 500°C and then in any two of those four quadrants the laboratory creates the fires. The extinguisher is only allowed a maximum of two or three nozzles as the test prohibits the engine bay being festooned with them, so it's a real challenge. In addition, because of the high

temperatures, which can cause a reflash, the extinguisher system has to keep it down for three minutes.

The same principle applies to the cockpit test, which consists of three fires that can be in any one of 10 different positions. Again, the fire is placed after the extinguisher has been set up. Once more, the number of nozzles that can be put in the cabin is limited.

To answer these very challenging tests, Lifeline has devised a clever method of discharge and using the extinguishing agents even more efficiently than in the past. The solutions harness the lessons learnt through a great deal of work with the military over the last few years.

The entire system is controlled by a unique microprocessor, which constantly monitors the state of the system and battery and will advise the user of any potential issues.

Improved heat shielding material

SS TUBE Technology, specialists in exhaust systems and thermal management, has developed CeramicLite, a new insulation product that is based around a ceramic matrix composite material. This means it can offer a heatshield and insulating product it claims is capable of working in environments above 1000°C for extended periods of time. It is said to offer superior thermal performance, reduced weight and tighter packaging than the current generation metallic-based heat shields.

The business designs and manufactures exhaust systems and thermal management solutions for high performance industries, including the Motorsport and Performance Automotive sectors.



ABOVE Lifeline is displaying its new Zero 3620 fire suppression system



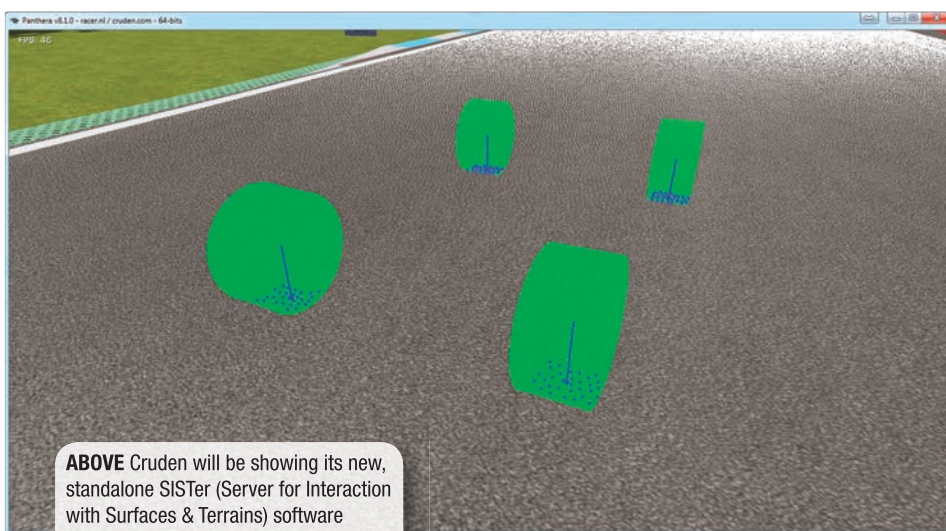
ABOVE CeramicLite, the new insulation material from SS Tube Technology

Standalone SISTER

CRUDEN will be showing its new, standalone SISTER (Server for Interaction with Surfaces & Terrains) software, which enhances tyre models by accessing multipoint 3D scanned surface data. Its engineers will also demonstrate its Telemetry Analyzer and simulator Set-Up Tool functions.

“As a provider and integrator of all modular elements of the simulator package, Cruden is ideally placed to advise the industry on the latest technology advances and their integration, whether for new or existing simulator projects,” says Frank Kalff, Cruden’s commercial director. “All our hardware and software, from top platform design and projection systems to track-building and artificial intelligence, is designed to have race teams and motorsport engineering houses up and running quickly and easily.

“Thanks to increases in computational power and new developments being driven



ABOVE Cruden will be showing its new, standalone SISTER (Server for Interaction with Surfaces & Terrains) software

by the automotive industry, simulators are increasing in realism all the time. This is a good time in particular for race teams to evaluate new software add-ons, such as our SISTER application, available to them.”

Motorsport engineers are invited to meet with Edwin de Vries and Martijn de Mooij on the Cruden stand. De Vries is a senior

modelling and simulation engineer who is widely recognised for his PhD research on model-based brake control, including tyre behaviour. As technical development manager, de Mooij has been responsible for project managing many of Cruden’s more than one hundred simulator installations over the past 10 years.

‘Fast Track’ banner panel system

QUENTOR, which supplies all Formula 1 teams as well as a host of top outfits in a wide variety of championships around the world, will be showing its ‘Fast Track’ banner panel system.

Addressing the demand for quick deployment and all-important time-saving features, ‘Fast Track’ is assembled in a fraction of the time taken to construct traditional frame systems. Each lightweight panel securely locks together in seconds with hidden quarter-turn latches.

Manufactured from lightweight aluminium honeycomb with aluminium extrusions and a high gloss painted finish in the customer’s own colour choice, this frameless system enables large uninterrupted graphics and logos to flow seamlessly throughout the garage.

In recent years, many teams have enjoyed the benefits of upgrading to the Quentor seamless ‘Fast Track’ banner panel system, both in terms of reduced set up times and improved visual appearance. However, as such a system can be just out of the budgetary reach of some squads, Quentor has developed the ‘Fast Track Q’ banner panel system. It has the same high grade aluminium

honeycomb panels, aluminium edging and gloss painted finish but is initially available as a single colour option only in gloss white. The main saving has been made in the introduction of a factory-applied automated painting process.

Optimising its manufacturing process,

embracing new technology and methodology has enabled Quentor to drive down costs further, which it says it is happy to pass on to its customers. Both systems are supplied as standard in a banner panel flight case offering unrivalled security and protection.



ABOVE Quentor has devised a new lower cost Fast Track banner system

Extending the range

VARIOHM EuroSensor has increased the interfacing flexibility of its motorsports-proven Euro-XP non-contacting angle sensor with a new 8 mm diameter D-shaft drive option which is available with a choice of 32 or 38 mm PCD mounting. The D-shaft with its integral magnet makes for easier installation, particularly for throttle position sensing, without the need for a separate coupling. With the optimal magnet to sensing-element gap maintained within the assembly, and a choice of mounting diameters, form-fit interchangeability with competitive models is made easy. The coupling-free sensor is also convenient for direct connection on other motorsport position sensing applications such as steering angle, suspension and gearbox.

The comprehensive 28 mm diameter Euro XP family, also available with Form 'U', spring coupling or separate 'Puck+Magnet' versions, features the motorsport industry-preferred 5 VDC ratiometric output and includes a redundant dual-track 360-degree measuring range for safety-critical use. With two factory programmable angles from 30 to 360 degrees for both measurement range and characteristic curve, the sensor can be configured for a constant voltage output over pre-defined angles that are very useful



ABOVE Variohm's new Euro-XP non-contacting angle sensor with an 8 mm diameter D-shaft drive option

for gearbox applications.

The position output covers 5% to 95% of the 5 VDC supply voltage and being absolute, does not lose position after power loss. The precision of the Euro XP family combines an independent linearity of $\pm 0.5\%$ of each signal range with repeatability to better than 0.2%.

The new D-shaft sensor joins the Euro XP family with completely contactless technology and a mechanical bearing-free design with a long-life specification in excess of 50 million movements. The fully encapsulated sensor element ensures complete environmental protection – rated to IP68, in addition to IEC 60068-2-6 protection against shock and vibration – making it a perfect choice for challenging racetrack conditions. The sensor is moulded

in highly resilient glass-filled PBT plastic with threaded inserts and a reinforced mounting-flange with stainless steel kidney washers that add further durability.

The D-shaft material is moulded nylon 66 and the 32 or 38 mm PCD mounting for two M4 screws includes slots for radial adjustment. A choice of three cable exit offsets is offered and electrical connection for the standard model is Raychem 55 cable and DR-25 sleeving at 500 mm length, with connector options available on request.

Variohm EuroSensor holds large stocks of the complete Euro XP product range which can be shipped, fully programmed, within 24 hours of order receipt. Variohm manufactures and supplies the motorsport industry with a wide range of sensors and transducers including rotary and linear position sensors in contacting and non-contacting technologies, in a range of mounting styles and environmental ratings with a wide choice of analogue and digital outputs.

Tri-band wireless digital infrared temperature sensor

TEXYS International is launching the new tri-band release of its wireless 8-channel infrared sensor texense IRN8W for tyre temperature monitoring. It means that end-users can tune it to whichever region they are in. For example, it would be 868 MHz in Europe, the Middle East and Russia, 902 MHz in North America, South America and Australia and 920 MHz in Asia.

The radio performance between the slave module and the master unit has been improved by a factor of two in comparison with previous versions, particularly in increasing the antenna efficiency.

Based on the same infrared technology of its successful IRN8C-F1 wired version, IRN8W has been developed and designed for an easy installation and to simplify harnesses. Wireless technology also helps to save weight on the entire measurement system and to reduce the source of potential electrical problems due to cables or connectors.

Despite its small size, the IRN8W slave sensor offers sufficient autonomy – up to 20 hours – and has kept the same performance reached with IRN8C-F1 of $-20^{\circ}/+200^{\circ}\text{C}$

temperature range, $\pm 1\%$ FS accuracy, and eight in-line measurement channels with 41.5° total beam angle for any racing tyre footprint temperature monitoring.



ABOVE Texys' new tri-band release

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Unique coolant level sensor

CARTEK will be showcasing new versions of its unique coolant level sensor products, which now incorporate a water temperature sensor along with the original air-in-water detection functionality. The self-contained, aluminium units are simply installed in the upper hose of a coolant system to monitor the presence of air.

Cartek's coolant sensors are designed in such a way that small air bubbles do not trigger the sensor. The sensors only alert the driver, and/or ECUs and dataloggers, when the water level within the cooling system drops dangerously low, which can happen when a radiator is punctured or a hose becomes loose, but is often not noticed by the driver until it is too late, resulting in engine damage. With the addition of a temperature sensor, this neat and compact product now offers two important functions instead of just one.

The original coolant level sensors were developed by Cartek in 2011 and have found application in all areas of motorsport, with the latest demand coming from all Cosworth Duratec-powered cars competing in Uruguay's Superturismo championship.



Under pressure

KA SENSORS will be showing a large variety of sensors available including force, torque, temperature, position, acceleration and speed. However, it is its pressure sensors that are the most popular-selling products, particularly the Model ASL which is designed to be a medium specification sensor and is cost-effective with fast delivery times. It is available in pressure ranges from 1 bar up to 400 bar (15 psi up to 5800 psi) and standard pressure fittings of M10x1, -3 and 1/8NPT.

KA Sensors' Model ASH and ASU high performance, high temperature pressure sensors are becoming popular with applications where extreme durability is required such as direct fuel rail mounting or oil galleries on engines. The designs have been tested and approved in 100g 5 kHz vibration environments up to 150°C (300°F). Pressure ranges are from 1 bar to 400 bar (15 psi up to 5800 psi).

The company is currently working on CAN-based sensors which will open up a whole area of applications. It is intended to embed CAN functionality into the company's laser ride height sensors and accelerometers initially and then roll it out across the whole product range.



Game-changing fastener

ENGINEERS at Specialty Fasteners, working with their production partners Camloc, have come up with what they are calling a 21st century alternative to the Dzus fastener. Called AeroLoc, the key to its improvement is the use of a cross-head stud, which all but eliminates the risk of damaging expensive body panels. It is also available with a bail handle for hand operation where use of a screwdriver is difficult.

The new AeroLoc self-ejecting fastener is interchangeable with the Dzus EHF5 series and is more secure when fastened, thus negating the occasional need for tank tape to keep it in position. So retro-fitting is not only possible but designed in. A cam receptacle replaces the Dzus spring, providing a more positive lock.

"We have had the product under test for some while now and the results have been conclusive enough to convince us that AeroLoc will be a game-changer in the area of panel fastening, in much the same way as our AeroCatch," claims Graham Leo, sales manager for Specialty Fasteners.

Seat inserts for all motorsport categories

BSCI's European distributor Old Hall Performance will showcase the company's newly FIA-approved seat insert materials. The new BSCI Ener-Core inserts, which achieved FIA approval earlier this year, are the first homologation seat insert materials designed for sports cars, grand touring vehicles, prototypes and single-seater driver protection.

The BSCI Ener-Core material is engineered for total driver support and protection, with the company listing many advantages over conventional insert systems. They include its rigorous impact and flammability standards and the product's resilience and durability – replacements are not required after impact and they are proven to last multiple seasons without degradation.

The Ener-Core material is designed to reduce production time due to its fast cure rate. In addition the liquid material conforms perfectly to the body, ensuring accuracy of the mould.

Lightweight panel fasteners

CLARENDON Engineering is adding the new 3334 series of LiveLock lightweight panel fasteners to its extensive portfolio.

The new series has been specifically designed for reduced weight in racing applications using composite panels, with a high strength-to-weight ratio and quick operation. The fasteners are lighter and smaller than the conventional series, with the proven ability to withstand high vibration environments. With a 'hold-out' feature retaining the stud, they are especially useful on curved panels as well as offering easier handling within a racing environment.

The studs are available with recessed combi-drive heads for both hexagon and slot tooling and various combinations of stud length, head style and receptacle to suit all applications.

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ATL's new technology offers safety options

AERO TEC Laboratories Ltd (ATL), a leader in safety fuel cells, has confirmed a substantial investment in new plastic moulding machinery at its UK-based plant. The company says this new, versatile machine will allow for greater freedom to create FIA-certified plastic moulded tanks to custom shapes.

Well known for supplying the entire Formula 1 grid with flexible fuel bladders for over 20 years, ATL says the investment is of particular interest to manufacturers or racing series that do not currently specify an FIA FT3 fuel cell, but would like to increase their level of safety.

"The ATL moulded tanks have had great success as the only genuine low cost option for an FIA FT3 fuel cell," says Giles Dawson, ATL managing director. "With our new manufacturing capabilities we believe we can offer this popular and safe FIA-approved solution to small runs of cars at a far reduced cost. In fact, one manufacturer that we are in discussion with believes that the initial set-up costs will be repaid in a run of only 12 units. We strongly believe in making increased safety even more affordable, and we hope that our investment encourages more manufacturers and racers to adopt the proven safety standards of the FIA."



ABOVE ATL's Saver cell range

High performance, low friction oils

ANGLO American Oil Company will again be at the Professional MotorSport World Expo this year where it will be showcasing its temperature-stable engine and gearbox oils from the Driven Racing Oil series, as well as the latest in Sunoco race fuel technology.

Attention is already focused on Driven's mPAO base oils that are now standard in all Driven Racing Oil products. Anglo American Oil Company says the main advantage of mPAO base oils over ester and PAO oils are its superior viscosity index and ability to dissipate heat. Coupled with the latest anti-friction technology and the correct type and level of ZDDP, these oils are super-strong, resulting in the ability to run much thinner oils (power gains) than usual.

In the summer of 2015, Anglo American Oil Company moved to new premises. The purpose-built fuel blending plant, laboratory, warehouse and offices are located in Poole, Dorset, UK and will provide extra space for the potential growth of the company over the coming years.

The company continues to represent and distribute Sunoco race fuels across Europe and the Middle-East, and will be on hand to discuss future areas of business growth and meet new potential distributors of the fuel or oils across their product range.

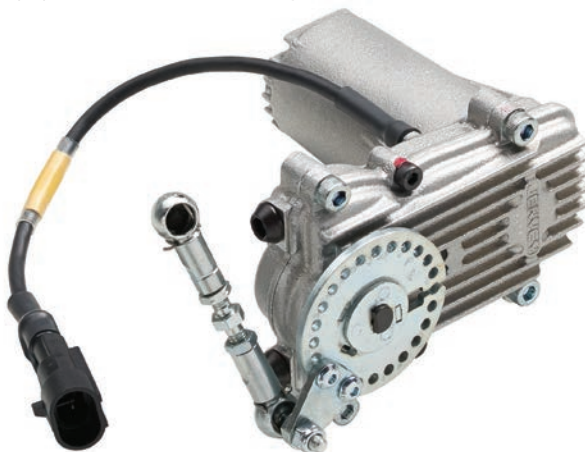
Electronic throttle actuator launched

JENVEY Dynamics is showcasing its newly-launched electronic throttle actuator at the event. The modular unit makes it compatible with a large range of aftermarket independent throttle body (ITB) kits for road or race applications, which offers precise control over throttle actuation to help optimise induction systems.

Jenvey says the actuator provides durability, size and weight-saving advantages over OE alternatives and is cheaper and more robust than complex, bespoke fly-by-wire variants. The company lists the benefits of electronic throttle actuation as including packaging, idle control, especially during warm up, autoblip with paddleshift transmission, launch and traction control, anti-lag, switchable pedal maps, controllable push-to-pass strategy, pitlane speed control and variable bank-to-bank control.

The electronic actuator offers users the ability to monitor pedal position versus throttle position, improve throttle control and ensure active closure or power down to safeguard valuable competition powertrains in the event of any component failure. The unit is tested to function in the temperature range of -20°C to +140°C, weighs just 500 grams and has a maximum torque capacity of 3600 Nm, allowing throttle opening times of less than 0.1 seconds from 10% to 90% throttle.

The electronic actuator, which requires standalone ECU control, is compatible with all Jenvey ITB kits, including its new downdraft SFD and SFD taper kits for the popular Chevrolet LS3 V8 engine.



ABOVE Jenvey Dynamics is showcasing its newly-launched electronic throttle actuator

Building on success

FINALLY, GEMS will be showing its new DA3 data logger. It builds on the success of the DA1 micro data logger with a number of key features, such as eight analogue inputs, two CANBuses and total logging throughput of 100 Kb+ a second, whilst keeping its micro size.



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ONE STEP BEYOND

How the composite design to manufacturing process is being streamlined. **William Kimberley** reports

GRM, UK-based composite analysis and optimisation software provider, has been developing its tools to greatly simplify the transfer of composite laminate designs to manufacturing working alongside Wirth Research. Having adopted GRM's FEA analysis and optimisation solution, Genesis & OptiAssist, for its key capability of efficient mass reduction, Wirth Research recognised the additional benefits of the tools for streamlining its design to manufacturing process.

Having been adopted by Formula 1 teams since 2004, Genesis & OptiAssist has become an industry standard toolset for optimising composite laminates for minimum mass and maximum performance. Through the last decade the toolset has matured to refine the process of developing minimum mass laminate designs and, in more recent releases, has been developed to simplify the process of developing these laminates into manufacturable solutions. Having been used by Formula 1 teams winning the drivers' championship for nine of the last 10 years, Genesis & OptiAssist is well established as the benchmark for design optimisation.

GENESIS STRUCTURAL OPTIMISATION

The traditional CAE process is for a designer to develop a component or assembly and then its performance is assessed using CAE techniques. In terms of structural loading, Finite Element Analysis (FEA) is the most common technique applied. Through the FEA process a design can be assessed under all of its loading requirements and its performance quantified. For designs that do not meet their performance requirements, an iterative development process begins.

As an FEA-based optimisation code, Genesis automatically changes a design, iterating design parameters in order to achieve specific performance requirements. Several different optimisation methods are available, explained briefly in Figure 1, which are defined by the changes to the design that are being made. A key strength of

Genesis is its ability to consider more than one loading requirement. A good engineer can arguably develop the best design for one requirement, maybe two. The Genesis optimiser can consider many requirements and develop the best overall design to meet all of them in the most efficient way. These may be stiffness, strength, vibration, buckling, heat transfer and more.

OPTIASSIST'S ROLE

Initially developed in 2004 by GRM Consulting, OptiAssist was generated as a dedicated environment for composite optimisation, specifically for Formula 1 teams. Since then, its adoption by all of the major F1 squads and, more recently, by UK automotive OEMs has seen the development of OptiAssist to provide a structural analysis optimisation solution for composite engineers.

Four key modules exist within OptiAssist, providing the following key functions: Composite Modeller – layup generation tools to create composite laminates for FEA analysis and/or plybook generation; Global Ply Design – composite optimisation pre-processing environment for the development of optimal ply shapes and layup definitions; Composite Reporter – efficiently generates plybook reports for

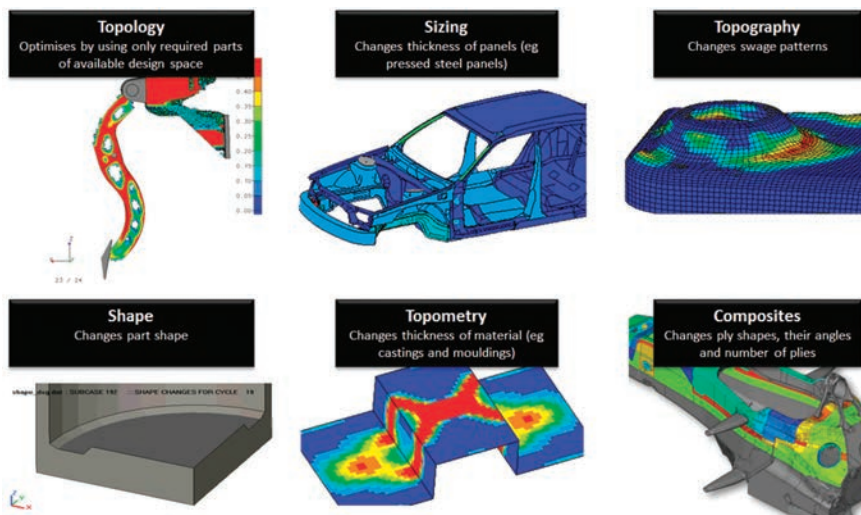
rapidly and accurately transferring layup information to manufacturing; and Sensitivity Plotter – an automated tool to plot and rank which plies provide most stiffness for each loading requirement. The latter allows engineers to focus on which plies will provide maximum improvement and which must have tightest manufacturing tolerance

As an innovative engineering company specialising in research, development, design and manufacture for the motor racing industry and other high technology sectors, Wirth Research identified the potential of the Composite Reporter tool to be used as a plybook generator. It appreciated it could greatly improve the time-consuming step of transferring the optimised laminate schedules to manufacturing. Through the generation of consistent, visual plybook data for each individual ply, the quality and repeatability of manufactured laminates could be improved.

Working closely with Wirth's composite engineers, GRM's software development team have further enhanced OptiAssist's Composite Reporter tool, working to meet Wirth's requirements for efficiently creating the plybook reports.

With Wirth's extensive experience in the manufacture of composite structures for motorsport applications, its guidance to GRM has proved invaluable in developing the Reporter tool to meet the needs of the high value, low volume production process. Having the detailed plybook reports, annotated with dimensions, material selection and orientations, will greatly improve the consistency of manufactured laminates, improving product quality. **RT**

FIGURE 1 Overview of Genesis Optimisation Methods



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Why the Blame Game never works



Sergio Rinland explains why he would bet his hat on an outwardly dignified reaction to adversity working better than aggressive criticism of a team's technical partners

In motorsport terms we could make the analogy of the hat: 'The hat you wear in the first race will be the same hat you wear in the last' – you could change its shape slightly, bend the sides up or the front down, but it will be always the same hat.

Why do I say this? In motorsport, particularly in Formula 1 and LMP1, the teams start the following year's planning and design process after they have finished the pre-season testing. That includes budget, organisation, design, and research and development programmes. 'Power Unit' programmes start even earlier, as much as a year or two earlier.

The teams realise where they are in the pecking order only when they line up for the first race. It does not matter how much work – planned beforehand – they do after that, developing the cars and power units (tokens allowing!); that pecking order changes little. The most they can expect is not to fall back in it, let alone jump positions. Look at the history of Formula 1 and you will realise that this has always been the case with a very few exceptions 'that prove the rule'.

Formula 1 is important to car manufacturers, but it is dwarfed by comparison with the latest VW diesel legislation crisis where, within days, they put aside almost 65 billion Euros to overcome a situation that could bring the company down. Formula 1, as much as we think it is important, will never influence a company's reputation in the same light. Therefore it is unlikely to warrant a similar speed of reaction if and when teams realise they are not to the competitive level they thought they would be.

So, it will not matter how much moaning and criticising to their technical team or partner they do, the rate of progress will go at the planned pace during the season. A planned bigger step, such as a complete re-think and re-design of their car and/or power unit, will only see the light in the following season.

That is something that seasoned motorsport people like Ron Dennis know all too well.

That is why we see his handling of McLaren-Honda's lack of competitiveness this year as very professional and restrained, even if he feels like hitting a wall with his forehead! That composure contrasts with some of his competitors, who take a more aggressive and opinionated position, triggering reactions that can have deep consequences for the business as a whole.

As I have said before in these pages, the current F1 regulations regarding power unit tokens and lack of testing is a contributory factor to the 'hat analogy'.

In LMP1 we see a similar situation with Porsche making a bigger leap forward this year compared to their direct rivals Audi and Toyota. These two thought that the planned progress from 2014 to 2015 was going to be enough; it was not. So, they have to wait until next year to see if they can close the gap with Porsche. The progress they make during the season, even with more freedom than in F1, is only enough to maintain the gap. Here the limiting factor is more to do with budgets than rules.

But nobody in their right mind, in F1 or LMP1, will ever contemplate building a new car or power unit during the season. Such a programme takes a minimum of 8 to 10 months for a car, and much more for a power unit, in order for it to be done properly.

'Blame culture' never works in the long term, so resorting to that policy signals doom and will have costly consequences. **TI**



ABOVE & BELOW While Red Bull issued divorce papers to Renault – only to see any potential deal with VW blown away – Ron Dennis is canny enough to portray unity with Honda



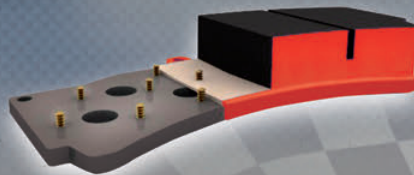
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