LAS VEGAS LAUNCHPAD

Chevy's electric drag racer and 1,000 hp 'Hellephant' among SEMA stars

Driving Technology Into Pole Position

INTERNATIONAL

RACE TECH

Motorsport Engineering

JANUARY 2019 No. 218 UK £5.95 USA $11.99 racetechmag.com

F1 2018

A season smouldering with controversy

Plus

'FAKE' NEWS

HOW TO COUNTER THE COUNTERFEITERS

'THE BEST TEAM RADIO CELEBRATION EVER'

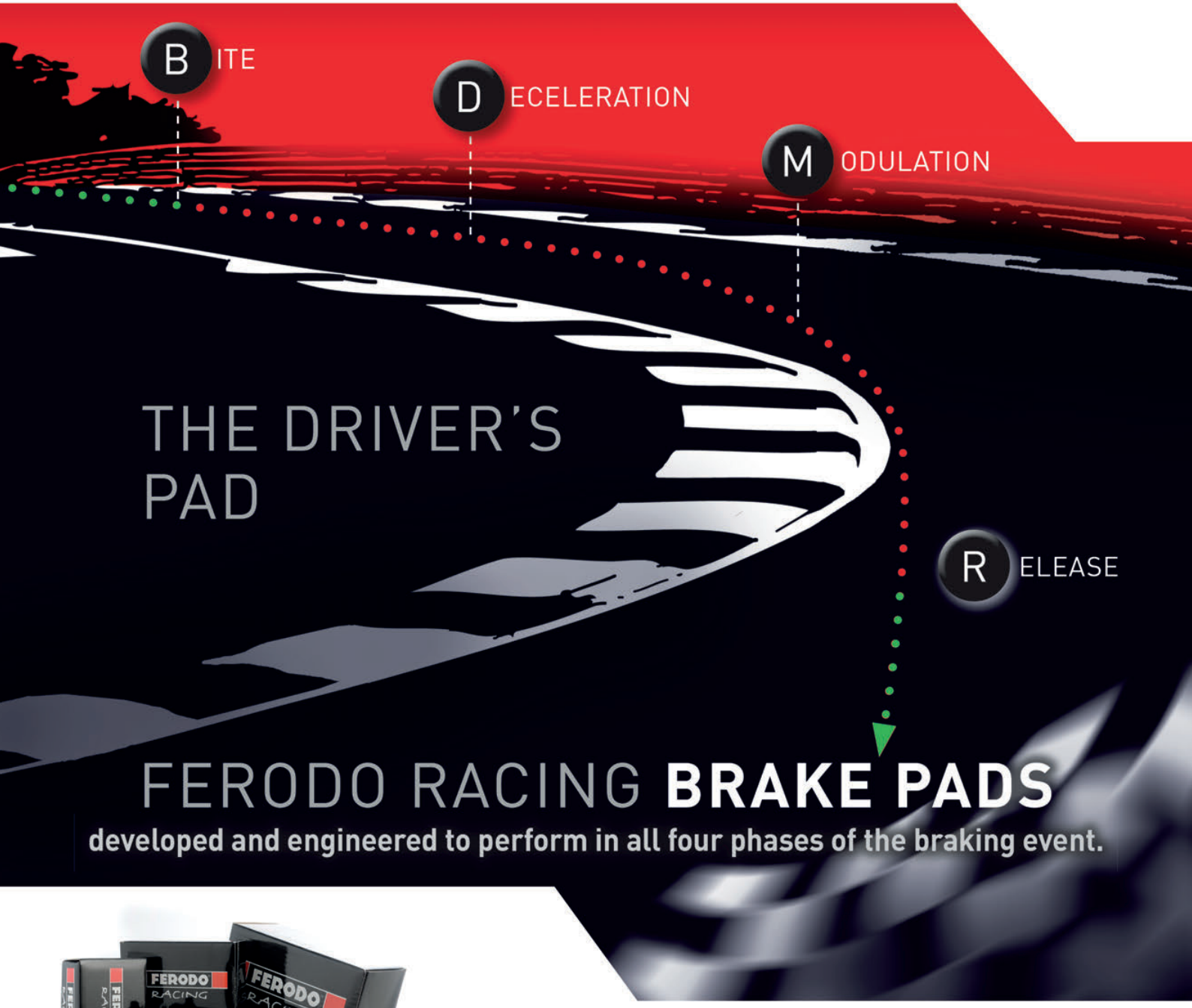
And what it means for the DTM

www.racetechmag.com

FERODO®
RACING

BALANCED BRAKING PERFORMANCE

ALL THE WAY TO THE APEX



FERODO RACING **BRAKE PADS**

developed and engineered to perform in all four phases of the braking event.

In addition to the bite and deceleration expected from a world class race pad, Ferodo pads offer the superior modulation and instantaneous release for maximum exit speeds.
Selected range now available thermally bedded.

www.ferodoracing.com

FEDERAL-MOGUL MOTORPARTS

RACE TECH
Motorsport Engineering

Volume 26 Issue 2
Published December 2018
The next issue will be published
in early January 2019
ISSN 1356-2975

SUBSCRIPTIONS
Subscriptions from Kimberley Media Group Ltd
841 High Road, Finchley, London N12 8PT
Tel +44 (0)20 8446 2100
Fax +44 (0)20 8446 2191

Overseas copies are sent via air mail
Special offer 12 issues for the price of 10
12 issue subscription UK: £45.00
Europe: €97.50, US/Canada: US$127.40
Rest of World: £75.00
All major credit cards accepted. Cheques and money orders only in Pounds Sterling payable to Kimberley Media Group Ltd.

BACK ISSUES AVAILABLE:
8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217
Price including post & packing:
UK: £5.50, Europe: £6.50, Rest of World: £7.55
You can pay by cheque or credit card but please note the minimum on Switch & Delta is £14

Race Tech (ISSN: 1356-2975) is published monthly by Kimberley Media Group Ltd.

Cover image: Hone/LAT

Design & Production:
Maluma Design Associates

COVER STORY PAGE 24

Honda Wins Again!

ARP congratulates Honda Racing
on its 2018 Verizon IndyCar Manufacturers' title.

ARP is proud to be a part
of each one of those engines.

Manufactured in the U.S.A.
Raced All Over the World

ARP fasteners provide strength and reliability for every type of racing.

All ARP fasteners are manufactured entirely in our own ISO 9001:2015 and AS9100:2016 registered facilities in Southern California.

Made In USA

Performance Review Institute Registrar
Achieving Excellence Together
ISO 9001:2015 AS9100:2016
Certified Company

5,000 catalog items
and specials by request

ARP®
automotive Racing products

ARP-bolts.com

Toll-free in the U.S.A 1.800.826.3045
1863 Eastman Ave • Ventura, CA 93003
Outside the U.S.A. +1.805.339.2200 • Special Orders +1.805.525.1497

EDITOR
William Kimberley

CONSULTANT EDITOR
Mark Skewis

ASSISTANT EDITOR
Alan Stoddart

HEAD OF DIGITAL CONTENT
Sara Kimberley

PHOTOGRAPHY
LAT

ART EDITOR
Paul Bullock

ACCOUNTS MANAGER
Vikki Amour

ADVERTISING
Mike Norman

COMMERCIAL DIRECTOR
Maryam Lamond

MANAGING DIRECTOR
Adrian Goodsell

PUBLISHING DIRECTOR
Soheila Kimberley

Driving Technology Into Pole Position
INTERNATIONAL
RACE TECH
Motorsport Engineering

841 High Road, Finchley
London N12 8PT
Tel: +44 (0) 208 446 2100
Fax: +44 (0) 208 446 2191

www.kimberleymediagroup.com

KIMBERLEY
MEDIA GROUP LTD

@racetechmag

facebook.com/
RaceTechmagazine

Let's hear it for the engine

IT was when Jonathan Palmer was picking up a couple of awards at a recent ceremony that he said on the spur of the moment, and without forethought, let's hear it for the i/c engine. It's all about the sound and smell. It's not gone, it's not dead and will be with us for a long time yet, so please, I ask you all here, don't write it off.

For those who don't know him, Jonathan Palmer was a pretty successful driver in his day. British Formula 3 champion in 1981, European Formula 2 champion two years later and winner of the Jim Clark Cup for normally aspirated cars in Formula 1 in 1987 at a time when the championship had both normally aspirated and turbocharged engines. He also came second at Le Mans in 1985. Others may know him as the father of former Renault F1 driver Jolyon Palmer.

However, it wasn't just harking back to the good old days that he made his heartfelt plea, but as the boss of MotorSport Vision, the company that owns Brands Hatch, Snetterton, Oulton Park and Cadwell Park in the UK. Since he took over ownership of these circuits, he has turned around their fortunes by investing heavily in infrastructure and specatator facilties. Last year MotorSport Vision bought Donington Park to add to the portfolio which also includes Bedford Autodrome where PalmerSport is headquartered.

As the owner of circuits that rely on races and track days you could say that he obviously has a vested interest in ensuring that the internal combustion engine has an important role to play in the long term future of motorsport. What was interesting is that when he said those few words, just how well received they were by the audience. It was as if a cork had been released and what was not really allowed to be said any more in public had.

This is not to deny the growing interest in battery electric cars in motorsport. As I have argued before, they absolutely do have a place, but that place tends to be in cities not at the type of circuit that Palmer owns. Also, his bread and butter is not the international championships but the hundreds of club and national series that use his circuits with cars powered by the internal combustion engine.

I was a bit disheartened when talking to a squash playing friend of mine with no interest in cars, let along motor racing, who told me that I must be worried because in the very near future, we will all be driving electric cars and there's no need for motor racing any more. Burning up the envinroment just for enjoyment was totally irresponsible. I had to swallow hard but understood that for the general public such thoughts are becoming the norm, and it's dangerous.

Although only loosely connected, it worries the hell out of me that Britain could lose its grand prix in 2020. At the moment, the only clue that my squash playing friend has that motor racing exists is when the Formula 1 circus comes to Silverstone. Take that away and we are in serious trouble because in his and other people's mind, motor racing will cease to exist or be relevant.

Take tennis. I really don't give a hoot about the sport except when it is Wimbledon, then for two weeks I am hooked. If Wimbledon didn't exist, tennis would be dead to me as a sport.

I have strayed a long way from my opening remarks about Jonathan Palmer's plea, but I think it's all linked up. The internal combustion engine is far from dead and we need the British Grand Prix to underline that motorsport is alive and well and relevant.

William Kimberley
EDITOR

Acura NSX GT3 Evo revealed

William Kimberley

BRASELTON, GA: An enhanced Acura NSX GT3, designated the NSX GT3 Evo, will compete on racetracks throughout the world in 2019.

Based on the race-winning Acura NSX production model, the latest evolution of the multiple race-winning NSX GT3 features a number of important revisions aimed at delivering improved performance and reliability to customer racing teams around the globe.

Revised bodywork, including a new front splitter, diffuser and rear bumper, will reduce drag to create higher top speeds, improve cooling and enhance both balance and driveability for an even wider range of amateur and professional drivers.

Several racing modifications to the car, including a 6-speed, sequential-shift racing gearbox, state-of-the-art chassis and aerodynamic package, and the very latest in FIA-standard safety systems, complete the mid-engined GT3 racer.

New turbochargers will improve throttle response, boost control, and fuel economy and will be retrofitted to all existing NSX GT3s in addition to the new NSX GT3 Evo. Newly built cars will also feature improved hardware and calibrations for the anti-lock braking system (ABS), and an upgraded Bosch display and data logging unit to increase efficiency and enhance the driver experience. These improvements will also be available as Variant Supply (VF) to retrofit to existing NSX GT3s.

The effects of these updates, the result of constant analysis of information generated from within the global NSX GT3 Customer Racing Program over the last two years of testing and racing, will be improved performance and reduced running costs, the result of a 25 per cent increase in engine life and greater component durability.

The twin-turbocharged 3.5-litre V6 engines are built alongside their production-vehicle counterparts at the Anna Engine Plant in Ohio and use the same design specification, including the block, heads, valve train, crankshafts, pistons and dry-sump lubrication system.

As with the current NSX GT3 racer, the chassis originate at the Performance Manufacturing Center in Marysville, Ohio while final assembly is completed by JAS Motorsport in Milan, Italy.

As part of the NSX GT3 Customer Racing Program, Mugen and Honda Performance Development (HPD) are responsible for technical and sales support in Japan and North America respectively, while JAS Motorsport has responsibility for vehicle support in the rest of the world.

The NSX GT3 made its debut in late 2016 and is a multiple race winner in the IMSA WeatherTech SportsCar Championship's GTD division and is one of the main contenders for the Drivers', Teams' and Manufacturers' titles this year.

It is also a winner in the Pirelli World Challenge and a podium finisher in the Blancpain GT Series Asia. Examples have contested ADAC GT Masters in Germany, Super GT in Japan and selected events in the Intercontinental GT Challenge.

"Through the NSX GT3 Customer Racing Program, an international collaboration between a number of Honda's technical partners," said Masashi Yamamoto, general manager, Honda Motorsport, "we have have been able to combine expertise on a global level to define a set of upgrades for the latest version of the NSX GT3 that will benefit every one of our customer teams worldwide."

ABOVE The Acura NSX GT3 Evo will compete on race tracks throughout the world from 2019

BELOW Tom O'Gorman was dominant in the TCA class of the Pirelli World Challenge in the HPD Civic Si

HPD expands successful racing programme

William Kimberley

SANTA CLARITA, CA: As reported in *Race Tech* 217, Honda Performance Development has launched a turn-key Civic Si race car following its success in the TCA series in the hands of Tom O'Gorman. It is also homologated for NASA H2 and SCCA T3.

"We are focusing our racing programme quite a bit and are finding niches in racing that are very successful for us," commented Steve Eriksen, HPD vice president and COO. "We've seen that basically turn-key cars reduce many of the barriers to entry for people who want to start racing, so we've introduced the Civic Si and without really promoting it we quickly got up to half a dozen people interested in buying one.

"It's built on a number of years of building Civic race cars at HPD. We were asked to build a couple as proof of concept cars a fair number of years ago that were successful pretty much out of the box and we've built on that knowledge. Each time a new Civic model comes out we try to be in step so that people can be racing the newest model which helps us promote it. We learn from our experiences in the past and how we can get the necessary elements in place to be able to be concurrently be out there on the race track at the same time as we are promoting the car.

"However, one of the issues with the new model car is that there just aren't many junk cars out there that people can convert into race cars, especially for grassroots racing. As we had some access to cars, we decided to build some and get them out there racing so people can actually see what they do."

"Initially we had offered these parts as a kit so that a competitor could take either a body-in-white or a street car they convert for racing purposes," said James Nazarian, HPD project leader for its grassroots racing projects. "What we found, though, is that there's more interest in a turn-key solution at this level, so our cars are built from a body-in-white that we rollcage and build up with a combination of the OE components and HPD's race-specific parts such as racing dampers for the ability to adjust camber and castor, a higher rate of brake system and a few other components. This is because that when it comes to the more entry level racing category, the sanctioning bodies want us to stay as close to production as we can, so we are given just a little bit of leeway to upgrade the system for the rigours of track use. Nor can we add aero devices as this category of racing is considered a non-aero class, so it's all stock bodywork.

"We also detune the engine slightly for many of the categories that the car races in as it's generally one of the methods plus weight that the sanctioning bodies use to balance the different makes of cars."

Tom O'Gorman's success in dominating the TCA class of the Pirelli World Challenge in 2018 by winning six out of 12 races and being on the podium in 11 of them has helped fuel the interest in the Civic Si.

"I was lucky to do most of the development driving the car before we raced it," he said. "This tenth Gen Civic chassis is unique in that it's one of the first turbocharged lower displacement Hondas that have come out. It's a low torquey engine rather than a high revving screaming Honda unit, so it means we are short shifting every shift to keep it in the power band."

"The turbo element was new from the Civic standpoint as we were used to normally aspirated before," said Eriksen. "It therefore took a little bit of getting used to but because of some experience with the TCR Civic and getting feedback on how we developed that gave us a leg up. We were also helped by the fact that the Civic Type R engine, which is used in the TCR, is also the engine that's used in the US in Formula 4 and Formula 3. We'd done a lot of development work to make them suitable for open wheel race cars, so now we've got this big body of knowledge about the Civic powerplants which has really helped us.

"Cars counts in Formula 4 have been around the 30-35 car count, the highest average car count in F4 globally despite being late to the game. I'm confident that we will have an equally good field in F3 in 2019 because it's a natural progression from F4. The attraction is a ton of track time, three races in a weekend plus practice and it is an affordable series. The engine is reliable, there's not a lot of downtime and is a great platform for people to develop racing skills and then figure out whether it's for them because even though it's affordable they're still raising money and doing all the things that all race car drivers do." RT

ABOVE A rendering of the Glickenhaus SCG007, the first confirmed entry into the new WEC 'hypercar'-based regulations that are coming into effect

WEC has first confirmed hypercar entry

Alan Stoddart

PALM SPRINGS, FL: The World Endurance Championship has received its first confirmed entry for the 2020/2021 season, when new 'hypercar' based regulations will come into effect.

The entry is from Glickenhaus, a boutique supercar and race car producer that has, since its creation in 2014, blurred the lines between road and race cars. Having secured $25 million in sponsorship, the outfit has confirmed that Glickenhaus Racing would not only be running in the 24 Hours of Le Mans, but would also be contesting the full WEC season under the Scuderia Cameron Glickenhaus banner.

The entry is the first that has been confirmed since the ACO and the WEC publically announced the switch to hypercar-based regulations at this year's 24 Hours of Le Mans, although the new rules had been exclusively revealed to industry insiders at the World Motorsport Symposium in November 2017. The new rules are set to prioritise manufacturer designs, based on their hypercar offerings, over aerodynamics, and generate most of their downforce from the underbody of the car.

Glickenhaus said in the official announcement of the prototype. "This is for America. For Briggs [Cunningham], Carroll [Shelby] and Jim Hall. For all of us. SCG will operate at cost for this programme and will fund it no matter what even if it's just one car, the SCG007 LMP1, racing against the World. We are offering a limited run of 25 road legal versions and one race version besides ours. All profits to go to funding our Le Mans programme. Price TBD around $1 million. It's been 50 years since a car built in America finished first overall at Le Mans. We aim to change that.

"We studied the draft 2020 WEC/ACO rules and began engineering a car to be built in the United States of America to compete at the 24 Hours of Le Mans for First Overall in the new LMP Hypercar class."

Jim Glickenhaus, the New York-based owner and founder, has said that he is looking at GM power for the engine but waiting for final clarification on just what hybrid system will be specified in the regulations.

The cars will be built by Podium Advanced Technologies in Turin that has been the technical driving force behind the Scuderia Cameron Glickenhaus SCG003C, a limited edition sports car and racing car.

Podium Advanced Technologies' engineers designed the car from scratch in the record time of 14 months from the preliminary style sketch to the first track test. The specific targets of the racing variant, the 003C "Competizione" as it was designated, was to compete successfully at the Nürburgring24 hour race. The net result was two successful seasons in 2015 and 2016 Nürburgring VLN championship, culminating in an overall pole position at the 2017 ADAC 24 Hours race. RT

Aston Martin Racing partners with PROsport Performance

ABOVE Aston Martin Racing has team up with German team PROSport Performance to contest the ADAC GT Masters

GAYDON, UK: Aston Martin is entering an important new partnership with the successful German racing team PROsport Performance based near the Nürburgring, close to the home of the British brand's AMR Performance Centre in Germany.

The agreement, which features the highest level of partner support from Aston Martin Racing, includes a two-car attack on Germany's leading GT championship – the ADAC GT Masters – in 2019 with the new Aston Martin Vantage GT3. Moreover, one of those two Vantage GT3s will be driven by a pair of Aston Martin Racing works drivers.

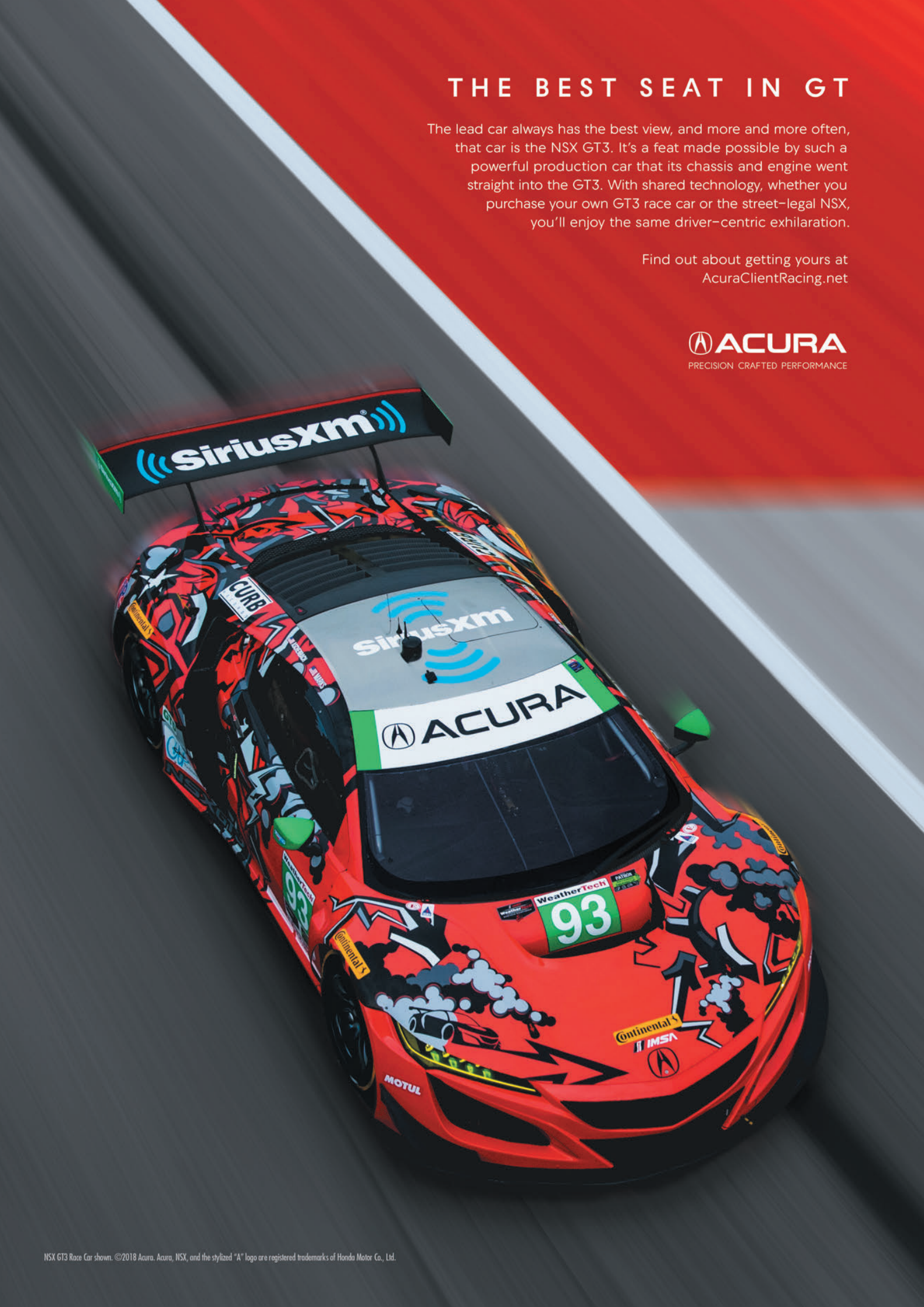
In addition to this, PROsport Performance, the newly-crowned European 24h GT Series Drivers and Teams champion, will enter two Aston Martin Vantage GT4s in the new ADAC GT4 Germany series. It will also enter two in the GT4 European Series – where the team has collected three championship titles (Drivers PRO/AM and Team in 2016 and Drivers AM in 2013). Some of PROsport's younger drivers will also be eligible to be part of the AMR Young Driver Academy. RT

THE BEST SEAT IN GT

The lead car always has the best view, and more and more often, that car is the NSX GT3. It's a feat made possible by such a powerful production car that its chassis and engine went straight into the GT3. With shared technology, whether you purchase your own GT3 race car or the street-legal NSX, you'll enjoy the same driver-centric exhilaration.

Find out about getting yours at
AcuraClientRacing.net

ACURA
PRECISION CRAFTED PERFORMANCE



ABOVE The Ford Mustang is replacing the Falcon in the Australia Supercars Championship

Supercars Mustang begins testing in Australia

Hal Ridge

STAPYLTON, Australia: Ford has begun its testing programme with the Mustang that will compete in the Virgin Australia Supercars Championship next season. The new machine, which uses the control Supercar chassis, completed its first laps at Queensland Raceway in early November. It will be the first coupe to enter Supercars under the current regulations, and the first two-door involved in Australian Touring Car racing for more than two decades.

Developed as a collaboration between DJR Team Penske, Ford Performance, Ford Australia and Tickford Racing, Supercars title-contender Scott McLaughlin and DJR Team Penske team mate Fabian Coulthard undertook initial running in the V8 machine, which continued at Phillip Island soon after the first test. The Mustang will replace Ford's Falcon in the Australian touring car series, which has been used in the championship for over 40 years.

"Today is a significant step towards an exciting 2019 for the Ford Mustang," said Ford Australia and New Zealand CEO Kay Hart after the initial running. "Mustang belongs on the racetrack, and today showed a glimpse of the 2019 car ahead of its first season. The teams are doing a fantastic job in ensuring the Mustang not only makes the grid, but is a competitive, high-performance package."

McLaughlin has praised the balance of the new car. "What an honour to be the guy to drive the very first laps of the new Mustang," he said following the inaugural test. "Not only does it just look right, and sound awesome, but it feels right too – in terms of balance, settings – we're starting off a great base as we develop the car for next year."

Ford Performance aerodynamics lead Sriram Pakkam, who joined the testing team from the US, said it was great to see the hard work done in CFD and CAD come to life on the racetrack. "There's nothing quite like having the Mustang – an actual race car on an actual track – to see the effectiveness of what we've done, and where we need to work on the car," he said. "It's great to be part of such a significant model, and at a great time for Mustang in racing programmes across the globe.

"This is a significant car for Ford, and this is demonstrated in the resources we've put into the project to ensure that we build the best race car possible, within Supercars' regulations. First signs are positive, and we will continue the testing programme over the next few weeks."

The Mustang Supercar will make its debut in the first round of the 2019 season at the Superloop Adelaide 500 at the end of February. RT

Jaguar creates two F-Type Convertible in 70 year celebration

Alan Stoddart

WHITLEY, UK: Jaguar has developed two F-Type Convertible rally cars, with design cues from the F-Type Chequered Flag Limited Edition, to continue its celebration of 70 years of sports car heritage since the XK 120 was revealed in 1948.

The one-off F-Type rally cars also pay homage to the legendary Jaguar XK 120 registered 'NUB 120' which, in the early 1950s in the hands of Ian Appleyard, completed three consecutive Alpine Rallies without incurring a single penalty point, and won the RAC and Tulip.

Both rally-specification F-Type Convertibles are powered by Jaguar's 300 ps 2.0-litre Ingenium 4-cylinder petrol engine. With modifications overseen by Jaguar Design and Engineering, both cars were built to FIA specification, with comprehensively uprated brakes and suspension fitted alongside a protective rollcage, race-seats with six-point harness, bonnet-mounted light pod and fire extinguisher.

ABOVE Jaguar's one-off rally cars pay homage to the Jaguar XK 120, introduced in 1948, which itself achieved competition success in the RAC, Tulip and Alpine rallies

The rally F-Types feature upgrades to the brakes, suspension and drivetrain including the addition of grooved discs with four-piston callipers front and rear. Hand-built competition dampers and softer springs ensure the high-performance cars can be driven flat-out over rough rally stages. Three-way adjustable dampers allow the cars to be tuned for different surfaces and feature spherical bearings for added precision. With motorsport-spec wheels and tyres specifically for use on gravel, a limited-slip differential improves power delivery on loose surfaces while a hydraulic handbrake helps drivers tackle hairpin bends. RT

Quick change artist

SPEED UP DRIVER CHANGES WITH LIFELINE'S NEW HIGH ANGULARITY QUICK RELEASE STEERING WHEEL BOSS

INNOVATION GIVES YOU BACK VALUABLE SECONDS

Pit stop and driver change times are as crucial to the race result as a car's on-track performance but now, with our new high angularity quick release steering boss system, you can win back time lost elsewhere.

- Effortless, rapid and accurate wheel engagement every time.
- Ingenious design allows for up to 100 degrees of mis-alignment.
- Advanced manufacturing makes it the lightest available, at less than 290g.

Champions of Safety

www.lifeline-fire.co.uk

Lifeline Fire & Safety Systems Ltd.

Lifeline UK Tel: +44 (0)24 7671 2999 | **Lifeline Germany** Tel: +49 (0)2234 6972121 | **Lifeline USA** Tel: +1 (540) 251 2724 | Email: sales@lifeline-fire.co.uk

ABOVE The Veloster N TCR has been designed by the same Hyundai Motorsport Customer Racing Team that developed the i30 N TCR

Hyundai launches Veloster TCR

Hal Ridge

INDIANAPOLIS, IN: Bryan Herta Autosport will run new Hyundai Veloster N TCR touring cars next season, joining the Korean marque's existing i30 N TCR.

The 2018 Team and Manufacturer champions in the 2018 Pirelli World Challenge TCR class will compete in the 2019 IMSA Michelin Pilot Challenge. In addition, it will sell Hyundai TCR race cars to customer teams and provide technical and parts support.

The new Veloster N TCR has been designed by the Hyundai Motorsport Customer Racing Team, the same outfit that developed the i30 TCR, and like its predecessor, will be built at Hyundai Motorsport's facility in Alzenau, Germany. The firm's two TCR machines will share approximately 85% of their main components, including the 350 hp 2-litre turbocharged engine.

"Chapter Two is going to be exciting," said Bryan Herta, president and CEO of Bryan Herta Autosport. "We learned so much by racing and winning with the i30 N TCR last season. We know just how excellent the platform is in hard competition. The Veloster N TCR retains everything great about the i30 N and gives us a world-class race car with a direct road-car counterpart that our fans can purchase and drive every day."

The Veloster TCR will be revealed in advance of the US season-opener on 25 January at Daytona International Speedway. "We're absolutely thrilled to have Bryan Herta Autosport back with us, racing the new Veloster N TCR at America's most fabled racing circuits in the IMSA Michelin Pilot Challenge," said Hyundai Motor America's chief marketing officer, Dean Evans. "After their championship run in 2018, we can't wait to see the show they put on for our fans and customers in the Veloster N TCR race cars." RT

Rule changes ratified ahead of 2019 BTCC season

LONDON, UK: British Touring Car Championship organiser TOCA has ratified a number of minor amendments to its regulations following an end-of-season consultation with the championship's teams. In addition to these revisions, it was also decided that the introduction of hybrid power – initially outlined for introduction from the 2022 season – may be brought forward to 2021 if all key parameters relating to the supply, engineering, costs, performance and testing of the hybrid units can be achieved in good time for an earlier launch.

Amongst the regulation changes that will take effect from the opening round of the 2019 campaign at Brands Hatch Indy circuit on 6/7 April is a reduction of the 75 kg success ballast due to the highly closely matched performance of the current cars. The maximum amount of success ballast has therefore been decreased to 54 kg with the remaining increments being adjusted downwards accordingly in 6 kg steps so that eighth place has a 12 kg success ballast and ninth and tenth places both have 6 kg success ballasts.

As before, some on-track driving offences will continue to receive 'reprimands' and from 2019, three reprimands will now constitute a 'Strike'. A Strike will also be automatically applied for a more serious offence, such as when a driver is found to be wholly to blame in an incident that causes another driver to be unable to finish the race. In this case the recipient of the Strike will also receive the additional penalty of a minimum 20 seconds added to their race time.

The current Strike tally-system remains as is, with a third Strike resulting in a driver being demoted to the back of the grid, a fourth resulting in a race ban and so on. A reprimand or Strike remains recorded against a driver for 12 months, as is currently the case.

A driver causing a red flag in qualifying will lose their fastest lap time to that point and take no further part in the session.

It has been agreed that teams will continue to nominate their 'Option' tyre choices prior to Saturday's qualifying session. Teams are still limited to the use of the 'Option' tyre in each of the three races three times during the course of the season – in other words, race three at a maximum of three events, race two at a maximum of three events and so on.

The regulations also specify tyre compounds for the circuits visited and following an extensive testing programme, Dunlop is set to introduce an entirely new wet tyre for the 2019 season. RT

Congratulations to Pratt & Miller Corvette Racing for their third consecutive Championship in the highly competitive IMSA GTLM class

BBS

Technik aus dem Motorsport

Like, Follow, & Share

BBS of America | 800-422-7972 | www.bbs-usa.com #raceproven

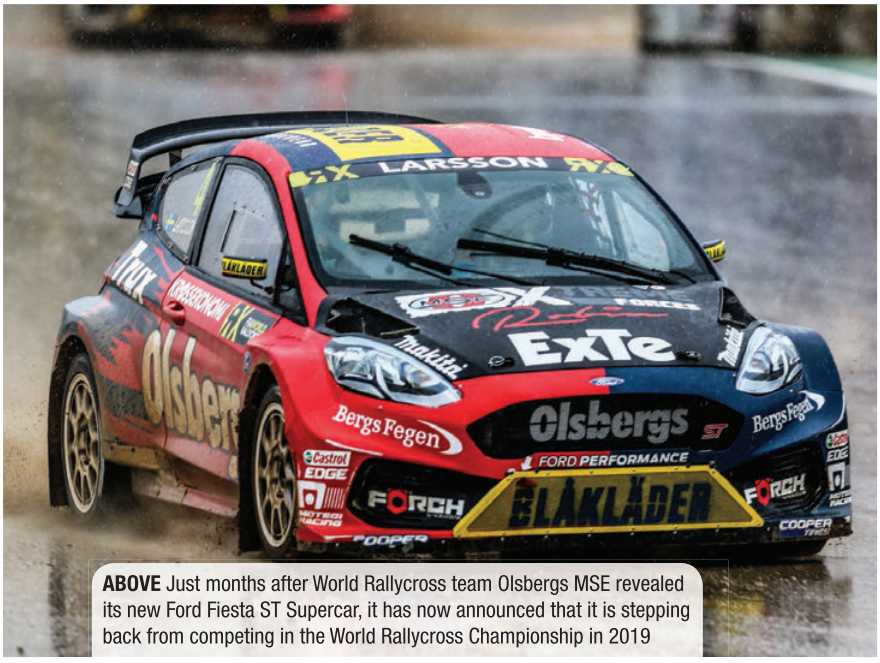
Olsbergs MSE to take sabbatical in 2019

Alan Stoddart

NYNÄSHAMN, Sweden: Former teams' World Champions Olsbergs MSE will not compete in the 2019 FIA World Rallycross Championship, rather focusing its efforts and support on other rallycross series.

In light of World RX's projected switch to electric power in 2021 and the current high cost of technical development for the series, OMSE has elected to take a sabbatical from the World Championship next year as it works hard to attract manufacturer backing and knowledge for the advent of the electric era.

The team will still offer cars for customer programmes and interested team sponsors in the FIA European Rallycross Championship, Americas Rallycross Championship, RallyX Nordic, RX2 and ARX2 in 2019, while simultaneously working to refine further the stability of Supercar regulations for the internal combustion engine formula, with cost savings for customers to operate cars the main goal going forward.



ABOVE Just months after World Rallycross team Olsbergs MSE revealed its new Ford Fiesta ST Supercar, it has now announced that it is stepping back from competing in the World Rallycross Championship in 2019

Olsbergs MSE CEO Andreas Eriksson said: "Today's decision is of course sad, but we have to do this for the company's longer term future as the cost to operate at a competitive level today in World RX is too high for us.

"As a true manufacturer of rallycross cars as well as an operator of rallycross cars all over the world, we encourage everybody involved in this sport to look at the areas of stability and cost reduction in the current Supercar regulations, as well as the affordability and return on investment for running those cars for the next 10 years. Our belief is that with sensible changes to the technical regulations, most of the current Supercars have a long future in the sport and this discipline can continue to grow in a healthy way – as can our company.

"We are also very much looking forward to the arrival of electric rallycross in 2021, and as such will put our efforts next year into securing a manufacturer partner ready for its introduction. We think the electric switch is important for the future of the sport – and for all the young drivers out there dreaming to be the best in the world.

"My job is to prepare our company, our partners and our drivers for the new electric interest, while at the same time understanding the importance of what we have built up over the last 10 years in Olsbergs MSE's young history.

"There are a lot of people and fans out there raising voices both for and against electric rallycross. I personally feel that combustion and electric can work hand-in-hand for many years to come – let's face it, we all love different kinds of music at different concerts!" RT

Clutch choice for IndyCar teams

William Kimberley

NORTHVILLE, MI: ZF Race Engineering has been given the go-ahead by IndyCar to supply IndyCar with its clutches. To date, AP Racing has been the sole supplier.

"We were always looking for something in the US market and started one and a half years ago talking to IndyCar about a clutch," said Patrick Orth, manager, ZF Race Engineering North America. "They told us that while they had an existing contract, it was a good idea to explore further having a second supplier for the clutch. We had a catalogue clutch with an aluminium housing that came quite close to it, but we had to match the AP Racing clutch in terms of weight and moment of inertia, so we developed a steel housing which Is also better for reliability.

"We started testing on the engine manufacturers' dynos in September/October last year before first being tested in a car last February/March. The feedback we got back from the team we were working with was very positive and we also received great support from Ilmor Engineering, which as it so happens is located just down the road from us in Northville, Michigan. We hadn't done any business with them before and I wasn't even aware that they were something like two minutes away from us. We also have a good relationship with the Honda Performance guys who were also supporting us with the clutch."

A few weeks ago IndyCar sent out a letter to the teams informing them that they now have a choice of clutches. "We will be attending the first IndyCar races to give the teams support and then it will be just on demand. There are some races like Long Beach and Detroit where we will be there with our truck." RT

pankl
RACING

High Tech | High Speed | High Quality

Pankl Systems Austria GmbH
Engine Systems

A-8600 Bruck/Mur, Kaltschmidstraße 2-6
Phone: +43(0)3862 51 250 0
Fax: +43(0)3862 51 250 290
e-mail: engine@pankl.com

www.pankl.com

ABOVE Three electric cars will contest the Andros Trophy ice racing series this winter, including the Team Plastic'Up driven by Aurelien Panis

Andros Trophy to mix ICE and electric this winter

Hal Ridge

OBJAT, France: The Andros Trophy ice racing series will amalgamate its headline Elite Pro internal combustion engine category with its new four-wheel drive, four-wheel steer Andros Sport 01 electric cars (featured in RT209) this winter.

Three electric cars will start the series when it gets underway at the traditional season-opener in Val Thorens on 8 December, with at least one more electric car joining the fray in the new year. The first electric cars announced as taking part in the series will be driven by Franck Lagorce and Aurelien Panis, and will be run by constructors Exagon Engineering.

Winner of the single-make electric support category last winter, Panis will contest the full season in the headline category in a Team Plastic'Up branded car, and will be joined in the same machine by his father Olivier, the 1996 Monaco Grand Prix winner, at the season finale at the Stand de France in February.

"I'm very happy to be return to Trophee Andros this winter with Team Plastic'Up," said Aurelien Panis. "A big challenge awaits us this season after our electric championship title last year. We will fight in the top with a brand new 100% electric four-wheel drive Silhouette. It is a very exciting and motivating challenge to take on the best in the discipline. I'm proud to be one of the first drivers to represent this new electric car. On top of that, for the final race at Stade de France it will have a special taste for me because I'll team up with my father Olivier. I can't wait to share this great experience with him!" RT

IN BRIEF

THE PRI will see the new Xceldyne Group that came into being last June following the decision by SV America Holdings to rename CV Products. It incorporates proprietary brands that include Xceldyne, CV Racing Products, Cycra and Advanced Material Coatings (AMC). The name change reflects the company's strategic shift to focus company resources on dynamic precision design and manufacturing. "This is an exciting time for our organisation and our employees," said Steve Lineberger, who at the time was president and CEO of Xceldyne Group, before retiring a month later. "We looked very closely at the marketplace and made a strategic decision to concentrate our team's efforts on what we do best—manufacturing the most technologically advanced precision parts in the industry. This refined approach will allow us to spend more time developing innovative products and value-added services to satisfy our customers' growth objectives and achieve high levels of success."

AN ambitious new phase for motorsport in the United Kingdom has begun, with the Motor Sports Association (MSA) launching a new identity, Motorsport UK, as it transitions from a traditional governance-led association to a modern membership-focused organisation. The rebrand from the MSA to Motorsport UK signals a shift in the governing body's emphasis, putting the promotion of the sport and customer service at the forefront of its mission. This represents a fundamental repurposing of the organisation as it seeks to grow the sport and better serve its members. The new name, Motorsport UK, and the more striking visual identity with its modern typeface and bold colour palette, will make the governing body more identifiable and relevant to new audiences, providing a better platform from which to market and grow the sport. RT

PERSONNEL

Ex-Force India Formula 1 deputy team boss **Bob Fernley** has been appointed president of McLaren's new IndyCar programme ahead of its launch for 2019.He will report directly to **Zak Brown**, CEO of McLaren Racing, and will lead the McLaren 2019 Indianapolis 500 programme, when Fernando Alonso will attempt to secure the Triple Crown of motorsport while helping to evaluate the feasibility of a longer-term McLaren involvement in IndyCar. Fernley spent over a decade with Force India before leaving the team following its takeover by a consortium led by **Lawrence Stroll** in August, playing a key role in its rise from the back of the grid to the head of the midfield. RT

Delivering Excellence Through
Innovation & Technology

RICARDO

Winning with Ricardo

The transmission technology behind a winning partnership across all racing formulas

For decades, Ricardo has designed and delivered transmission solutions in all forms of top level motorsport including Formula 1, sportscar, single seater, rally, and electric race series.

Top tier motorsport customers demand competition-ready, proven transmission systems available in a range of configurations with high levels of reliability.

This is why the world's leading OEM's turn to Ricardo for both their on and off circuit applications. Ricardo's process driven design, manufacture, assembly and end of line testing ensures customer demands are met at every level.

Ricardo are experts at delivering highly effective, low maintenance, winning transmissions.

Delivering the right product, for the right application, first time - every time.

Find out how Ricardo can help with your transmission development

Email: info@ricardo.com Tel: +44 (0)1926 319319

www.**ricardo**.com/motorsport

RACE TECH WMS
World Motorsport Symposium

You are invited to the World Motorsport Symposium
Tuesday 27th and Wednesday 28th November 2018

THIS year's World Motorsport Symposium reflects the growing technology trends and includes discussions on autonomous vehicles, the growing dependence on Artifical Intelligence but above all, environmental topics that have never before been addressed with such intensity at this event. It may therefore well be the most important WMS of the last 14 years if the conclusions reached will be implemented by the sport of tomorrow.

THE CHAIRMEN

ULRICH BARETZKY
Director, Audi Motorsport
Engine Development, Audi AG

JOHN ILEY
Founder and Director,
Iley Design Limited

"The WMS presents a rare opportunity for like-minded engineers to discuss areas of the sport that they may not be so familar with thereby expanding each other's knowledge for mutual benefit. It is also an excellent networking opportunity."

Pat Symonds, Chief Technical Officer,
Motorsport Division | Formula 1

THE CABINET MEMBERS

PAT SYMONDS
Chief Technical Officer Motorsport Division, FORMULA 1®

JASON SOMERVILLE
Head of Aerodynamics, FORMULA 1®

ANDY COWELL
Managing Director, Mercedes AMG High Performance Powertrains Ltd

PASCAL VASSELON
Technical Director, Toyota Motorsport GmbH

DR DAVID SALTERS
Chief Engineer - Engine Technical Leader, Honda Performance Development

SERGIO RINLAND
PED PAT Leader, Jaguar Land Rover/Managing Director, Astauto Limited

THOMAS LAUDENBACH
Director Development HV Storage Systems, Audi AG, Audi Sport

LUCA MARMORINI
CEO Marmotors s.r.l.

THOMAS KRÄMER
Director Motorsport Quality Management, Porsche Motosport

MATTHIAS DANK
Global Business Segment Manager Racing, AVL

RODI BASSO
Motorsport Director, McLaren Applied Technologies

WERNER BRUCK
COO/CTO Pankl Racing Systems AG

DIALMA ZINELLI
Head of Aerodynamics Dallara

THE SPEAKERS

NIKOLAS TOMBAZIS
Head of Singe-Seater Technical Matters, FIA

NICOLAS AUBOURG
Head of Performance & Simulation, FIA

BRYN BALCOMBE
Chief Strategy Officer, ROBORACE

The challenge of Roborace and what it means to the motorsport industry

JOHN GLENN
Retired EPA Official and Founder of U.S. Government's Green Racing Program

How motorsport needs to adapt to fit in a world concerned with climate change

PROF. DR WILLEM TOET
Senior Sales Manager & Aerodynamicist, Sauber Aerodynamics

2020 Hyper Future for the WEC

ELIZABETH DONNELLY
Chief Executive Officer Women's Engineering Society (WES)

She Can Be It if She Can See It

ROB MILLAR
Head of Battery & Electrical Systems, Williams Advanced Engineering

F1 - a counter-intuitive test bed for the Autonomous Car?

M.SC.LEA SCHWARZ
Doctoral candidate responsible for sustainability in motorsports, Audi Sport/University of Stuttgart

The Sustainable Future of Motorsport

ARNAUD MARTIN
Chief Engineer - Motorsport, Integral Powertrain

The Future Direction of Motorsport. A view from an independent eDrive manufacturer

STEVE SAPSFORD
Market Sector Director- High Performance Vehicles, RICARDO

The case for low carbon fuels - as part of a balanced powertrain portfolio

MARC HILBERT
Team Lead and Data Scientist, Volkswagen Data: Lab

Artificial Intelligence and its application in racing

DOUGLAS CAMPLING
Chief Engineer - Motorsport, Williams Advanced Engineering

Electric Rally Cross - Designing a Future Powertrain

EWAN BALDRY
Technical Director, Ginetta Cars

The Challenges of developing and building an independent LMP1 team from scratch

RACE TECH

WMS

World Motorsport Symposium

What do I get out of it?

The World Motorsport Symposium is the only event of its kind where the most senior international motorsport and automotive engineering decision makers get together for two days to discuss how technology will shape the future of their sport and in turn influence and affect engineering sectors across the globe. By listening to the presentations by leading industry experts and also joining the debates where everyone has a voice, attendees will be given a head start in the emerging markets in this fast paced field. Also be the first to hear about new ideas and decisions before they are formally announced and be privy to highly confidential industry information only available due to Chatham House rules. A networking opportunity like no other has also meant that this Symposium has gained a reputation as the 'Davos of Motorsport Engineering'.

Your ticket also includes:

Lunch at the Institution of Mechanical Engineers (IMechE) as well as a Champagne drinks reception followed by a three course meal and wine at the Millennium Gloucester Hotel London Kensington on the evening of Tuesday 27th November if you book the full package.

WHERE

The two day Symposium will take place at:

Institution of Mechanical Engineers (IMechE)

1 Birdcage Walk, Westminster, London, SW1H 9JJ

The Networking Awards champagne drinks reception and dinner will take place at:

Millennium Gloucester Hotel, London Kensington

4-18 Harrington Gardens, London SW7 4LH

TO BOOK TICKETS

www.worldmotorsportsymposium.com

Email: maryam.lamond@kimberleymediagroup.com or call +44 (0) 20 8446 2100

"I was very impressed with the format – it's rare to have an opportunity to openly discuss important matters affecting the future of our sport, from club racing to F1. The mix of industry experts and the next generation of engineers and designers brought a healthy balance to the debates. A very informative and thought-provoking event – keep it up!"

JASON SOMERVILLE, Head of Aerodynamics, Formula One Management

"To shape the future of motorsport – the World Motorsport Symposium is a must for all key people in that business."

THOMAS KRAEMER, Manager Engine Design LMP1, Porsche Motorsport LMP Team

"The WMS offers a fantastic forum to gain opinions from some of the most influential people in the world of motorsport."

JOHN MANCHESTER, Operations Director, Gibson Technology Ltd

FIT ADDITIVE MANUFACTURING GROUP · Bcomp® · rFpro · sharc · ILEY DESIGN · RACE TECH Motorsport Engineering · HISTORIC RACING Technology · TrackCar Performance · Institution of MECHANICAL ENGINEERS · FORMULA STUDENT · MOTORSPORT INDUSTRY ASSOCIATION

Where do we go from here? Our **Expert Witness**, an F1 insider, considers the stand out themes raised by another turbulent season

WE *HAVE* TO GET THE NEXT DECISIONS RIGHT

AS 2018 draws to a close, motorsport's key figures gather at Race Tech's annual World Motorsport Symposium, at the iMechE in London, to review, discuss and look to the future. What are the likely stand out themes from this year and for the years to come?

Let's start with the sport's health. How are the audiences, finances and participation levels? Consensus is that viewers are falling, costs are increasing and participation levels are wobbling. But, as ever, it depends on who you ask, where they sit, their vested interests and perspective of the battlefield.

F1's new owners, Liberty Media, have inherited some legacy issues involving historic pay per view deals in a couple of countries that have hurt numbers, but there was actually a title contest this season which normally helps get the public's attention. Yes, there will also be the case for the defence that TV is not the way we view anymore, so streaming and other forms of viewing need to be taken into account. Okay, but for that to happen you need commercial rights holders that will embrace the multiple new media formats.

Lewis Hamilton sealed his fifth title, an incredible achievement, but in no small way linked to a single team's continuing domination, despite Ferrari's resurgence this season. This fell away all too rapidly though, and yet another championship felt like a case of when and not if. The emergence in Formula 1 of 'Class B', and who could win best of the rest, is a concern. Teams in the second half of the grid continue to stare down the financial barrel, the good news of Force India's survival simply moving the problem to somewhere else.

POSITIVE SIGNS FOR INDYCAR

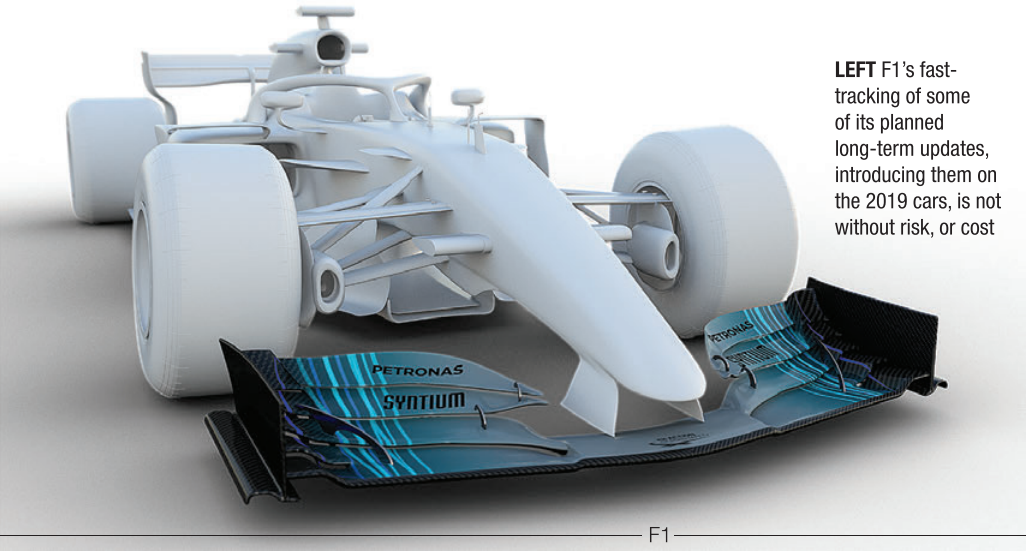
F1's struggles served to highlight the fact that IndyCar's new universal aero package has moved some distance to encouraging decent racing again, cars that require driving and can run in proximity in most circumstances, although superspeedways definitely still need some tuning. Scott Dixon's triumph this year owed much to his remarkable phoenix-like resurrection from beneath the multi-car lap 1 accident at Portland to what would prove an absolutely crucial fifth place.

It also helps when a pilot of Fernando Alonso's calibre, understandably disillusioned with his F1 circumstances, decides he would like to try and complete the historic triple crown for drivers. It's a decision that has spread interest and focus to other series.

"Is Formula E a genuine threat to F1? Yes, definitely"

FIA Formula E

ABOVE With Formula E's Gen2 racecar addressing its predecessor's shortcomings, the series continues to attract the manufacturers – and headlines – that would normally go elsewhere



F1

LEFT F1's fast-tracking of some of its planned long-term updates, introducing them on the 2019 cars, is not without risk, or cost

Last year we followed his exceptional first attempt at the Indy 500, ironically curtailed by a Honda issue. This season his focus switched to Le Mans with Toyota. Even though they had no real opposition, you still have to get the job done. As the closing minutes ticked by you saw the nerves on the faces in the garage and really hoped, this time, the Japanese marque would finally succeed. For me it was one of the truly feel-good stories of the year. Another Indy 500 attempt for Fernando now beckons.

Hypercar, an ultimate GT class to replace LMP1, is scheduled for 2020/21, with a concerted effort to lure as many as possible of the manufacturers back. With BOP and capped downforce, it sounds promising, but will need great care in implementing and policing.

FORMULA E PHENOMENON

Audi, the former WEC stalwart, found new team championship success amongst an ever-increasing list of manufacturers in Formula E, while F1 refugee Jean-Eric Vergne ('JEV') celebrated the drivers' title in his Renault. Viewing figures and demographics continue to improve for this full electric series and it feels like its very updated, faster, longer range, much better-looking new car is arriving at a perfect time for this series.

Is Formula E a genuine threat to F1? Yes, now, definitely.

For proof you need to look no further than an exchange between Ross Brawn (Liberty F1's Managing & Technical Director) and Alejandro Agag (Formula E founder and CEO) in August.

Given the context that governments are increasingly looking to ban new road cars with petrol or diesel powertrains from 2030, Ross quite rightly did not rule out "F1 being full electric in five to 10 years' time".

Alejandro's response was both swift and interesting. "We have an exclusive licence with the FIA for 25 seasons and we have only done four, so the earliest F1 could do this would be 2039," he insisted. "[That's] if we don't renew our agreement with the FIA then, but I don't see any reason why we wouldn't renew for longer.

"We have exclusivity until at least 2039," he continued, "so no electric F1 until then at least. If they want to talk to me then of course that is a different question – I am always open to talk to people. But without talking to me there is no way they can do anything fully electric."

Some perceptive comments followed about their respective views of each other's series, but it is clear that with the future powertrain, manufacturer involvement, cost controls, technology relevance, new forward-looking image and demographic already in place, plus low-profile road tyres, the ability to race, different winners, etc, etc, etc, Formula E is presenting a genuine alternative series. The irony that it also may have locked down some of the rights to the format would not be lost on those in F1 or FOM.

Leaked and then official images of F1's progress on their proposed changes for 2021 at this year's Singapore Grand Prix are encouraging. As is the long overdue thorough research in producing cars that do not just look good, but have an aerodynamic signature that allows them to race and run in close proximity to each other.

This is partially wake management, ensuring the energy and position of that airflow at set distances and at lateral positions behind a car is far better than today. It is also about ensuring that specific geometries or car areas do not become overly critical, thus avoiding the trait that in clean air they work, but with small flow changes the performance degrades too dramatically.

However, the early implementation of some of the findings for 2019 is a risk. Equally, there is a growing sense of impatience to get F1 back to a show that everyone would like to watch again. Changes also directly imply cost – a process the teams have endured in 2014, 2017, for 2019 and a proposed upheaval in 2021, particularly if a powertrain change is again involved.

It really feels like we are reaching a critical point for the sport and the industry where we have to get our next decisions right: too much time and investment is being spent to come up with the wrong direction. I just hope we know what we are doing. Fingers crossed.

IndyCar

ABOVE Scott Dixon's miraculous escape from this Portland carnage was a pivotal point in the chase for the IndyCar title

A TO Z OF F1 2018

Craig Scarborough guides us through an F1 season packed with developments and controversy


Daimler AG

A vintage F1 season? It wasn't bad, was it? In design terms, teams congregated on similar concepts, copying other people's best ideas. With rules changes for next year and more coming in 2021, F1 cars might well have reached their zenith in aero complexity and resistance to overtaking.

With fine margins between the top teams, and a hyper-competitive midfield battle, everyone was at each other's throat. That spawned the usual Machiavellian ruses, with each arguing their rivals' legality. Remarkably, this led to only one disqualification!

Aero – rake

Aerodynamics remain one of the largest performance differentiators, as evidenced from the variation in performance between teams with the same power unit. After a major evolution to the aerodynamic rules in 2017, the new, more complex bargeboard rules saw a convergence in philosophies as 2018 progressed. Front wing design also converged further and grew ever more sophisticated.

This coming together of ideas makes it hard to separate the teams' strengths and weaknesses, but one major difference emerged between the all-conquering Mercedes and the rear of the field: the rake angle the car is set up with. Mercedes uniquely runs a much flatter ride height setup front to rear, while Ferrari and, to an even greater degree, Red Bull run a much more pronounced nose down, tail up attitude.

At the Mercedes W09 launch there was much speculation that the team would start along the steeply raked setup route, but by the season's end no visible change had been made to the car's ride height. Red Bull may be running over 140 mm of rear ride height and under 25 mm at the front (measured on the car's reference plane), allowing the airflow to expand under the floor and thus lower the pressure below it. Mercedes runs a flatter floor, but the car's extremely long wheelbase, lack of pitch sensitivity and precise ride height control from its suspension allow it to create downforce without the trade-offs (mainly a raised CofG).

Bargeboards

Part of the 2017 aero revamp in search of a two-seconds-per-lap performance gain was created by freeing up the bargeboard area, which had been severely restricted since 2009. The volume in which to fit the bargeboards ahead of the sidepods was increased and even the 'enclosed hole' regulations towards the front of the floor were relaxed. This has led to a dramatic increase in the detail geometries used for the bargeboards.

With functions to control airflow over the central bodywork, under the floor and the outwash formed behind the front wheels, bargeboards serve a multitude of uses. This has been compounded by the Mercedes-led philosophy of splitting aero surfaces to form multiple sharp edges, resulting in increasing amounts of slots, fins and serrations. Best viewed from above to see the sophistication of the floor-level footplates, the explosion in front wing architecture has now been caught up by the bargeboard design.

Clutch

Despite the 1,000 hp high torque power unit outputs, the humble clutch remains an area of consistent performance and reliability. The 100 mm carbon multiplate ▶

ABOVE & BELOW Sparks flew, both on and off the circuit

Etherington/LAT

Technical photos: Craig Scarborough

ABOVE Aerio philosophies converged, with elaborate front wing designs reaching their zenith before the FIA's intervention for 2019

units sit at the back of the IC engine on the tail of the crank. Weighing just 1,200g, it can transmit a torque of up to 1,000 Nm, and withstand temperatures of up to 1,200°C.

Diffuser outboard treatment

Many teams converged on similar design treatments to the outboard area of the diffuser. After the variety of designs witnessed in 2017, the current trend is to power the outboard vortex-entraining airflow through the diffuser, with a squared-off upper-corner. This is formed by the 2-3 flaps around the diffuser exit. With this exit area maxed out, the teams are now fitting fins and vanes ahead of this area on top of the diffuser to create a contra-rotating airflow to further drive the effect of the inner vortex.

Exhaust-blown rear wing

Most teams reluctantly accepted the loss of performance when this practice was banned. They kept the exhaust tailpipe mounted low and near-horizontal, producing little aerodynamic benefit from the energy of the exhaust plume. Renault, however, found a different route, mounting the exhaust tailpipes as high and angled as the rules allow. This directed the plume under the centre of the rear wing, to gain a small aerodynamic benefit.

There was some consternation among rivals that the team might exploit extreme engine mappings to blow the wing harder. This would be akin to the blown diffuser period in the early 2010s, that increasingly used engine mappings to keep the exhaust blowing on the overrun to give extra downforce on corner entry. An FIA investigation did not find anything untoward with the engine mappings, however, and Renault retained the exhaust/wing interaction throughout the season.

Ferrari trialled a similar exhaust setup briefly mid-season, with the turbo tailpipe mounted at a high angled position, then the two wastegate pipes mounted vertically below it. However, the idea was not pursued further.

ABOVE Bargeboard design was a big area of innovation

Floor slots

Along with the front wing and bargeboards, the edge of the floor is also key to the aerodynamic outwash pushing the front tyre wake away from the central bodywork. The floor extending from the flanks of the sidepods was widened in 2017; up until that point any slots in the floor tended to be just ahead of the rear tyres, to prevent aerodynamic inwash from the tyres squirting into the diffuser. Now teams are using longitudinal slots along the edge of the floor to turn the airflow above the floor into a series of vortices that create more outwash to direct front tyre wake away from the centreline of the car.

This flow structure contra-rotates with the Y250 vortex set off by the front wing, increasing the strength of the outwash effect. What had first started with a modest single slot, soon ballooned into slots the full length of the floor edge, then multiple slots. Latterly Ferrari added fins on top of the floor to further drive the vortices, an idea copied ▶

XCELDYNE™ VALVETRAIN

We depend on Xceldyne for all of our valvetrain needs."

GM POWERTRAIN PERFORMANCE & RACING CENTER

Titanium & Steel Valves | Lash Caps | Retainers | Spring Locators
Valve Guides | Valve Locks | Valve Seats | Roller Lifters | Custom Manufacturing

Visit Us at PRI
BOOTH #1325

& Autosport
BOOTH #E414

XCELDYNE™
ACCELERATED DYNAMICS

800-448-1223
www.xceldyne.com
37 High Tech Boulevard | Thomasville, NC 27360

almost immediately by Red Bull, which rapid prototyped parts for the next GP to test the effectiveness of the idea.

THINNER GAUGE PIRELLI TYRES

Pirelli ran thinner gauge tyres at a number of races this year (Barcelona, Paul Ricard and Silverstone), after it was found the greater cornering speeds could lead to issues at faster tracks that had new surfaces.

HALO

The FIA specification Halo was going to ruin Formula 1, wasn't it?

The early concerns of reduced visibility and slowed driver egress from the car were soon discounted, while several near-misses in F1 and F2 showed the potential safety benefit of the frontal crash structure.

While the same spec Halo was adopted by F2, it is solely the F1 cars that have been allowed to add aerodynamic bodywork around it. Every team immediately faired the entire titanium Halo with bodywork made from FIA-prescribed lightweight/non-structural lay-up. Early aero tests showed the front hoop redirected airflow away from the roll hoop inlet, upsetting the power ▶

BELOW Renault raised the spectre of exhaust-blowing the rear wing

ABOVE Ferrari was one of the more aggressive teams with its floor treatment

ABOVE The Halo became a new aero battlefield. Oh yes, it probably saved some lives too…

ABOVE The Halo threatened to destroy the very DNA of the sport but the din abated after Alonso's McLaren vaulted across Leclerc's cockpit at Spa

Tee/LAT

unit's cooling and air feed. So, while the Halo's effect was negative in this regard, teams soon found that fitting bodywork to the front edge created downwash, aiding both the roll hoop inlet airflow and general airflow towards the rear wing. As a result, by the season's end most teams had fitted a stack of three boomerang-shaped winglets on the top of the Halo, within the 20 mm allowable area, to turn the airflow down over the cockpit.

Likewise, the rear legs extending back from the front hoop towards the headrest were a new area to exploit. Teams shaped these sections to straighten airflow along the side of the top bodywork.

HIGH SIDEPOD INLETS

Ferrari had stolen a march on the opposition with its sidepod design in 2017. By moving the side impact structures to a lower position and forming the sidepod inlet in the allowable space above, it was able to create a large undercut in the sidepod shape, improving airflow over the diffuser.

Unable to respond with the major change to the chassis structure mid-season, it was only this year that other teams were able to copy the idea. Red Bull, Williams and Haas all adopted this philosophy. Mercedes, notably, didn't change its setup, but a mid-season update saw it modify its inlet to create some of the benefits of the winged inlet design exploited on rival cars.

Sauber, meanwhile, started the season with a hybrid sidepod design, using the normal side impact structure position, but adding a small separate inlet over the top of it to feed oil coolers stacked above the main radiators. Its mid-season update was to extend the inlet for these oil coolers forwards to form a single semi-circular inlet at the front of the sidepod.

JOULES – SECOND BATTERY AND SENSOR

From the start of the year, the Ferrari power unit could be heard under acceleration to have a whistling sound, not simply the usual turbo noise. As with many technical anomalies, explanations varied wildly, especially as the Ferrari power unit appears to finally be a match for the Mercedes.

Electric supercharging, the MGU-H blowing the rear wing through the turbo, and even excessive MGU-K energy release were suspected. The FIA spent a lot of time monitoring the Ferrari PU and especially the hybrid systems to understand what was going on.

ABOVE Mysterious paddles and hidden buttons: F1 loves a bit of intrigue

While any real explanation is still lacking, one oddity that was revealed was that Ferrari employed two batteries within its energy store. Still within the same capacity as other teams, this prompted speculation that Ferrari was somehow able to recover or deploy more than the allowed energy each lap. The FIA confirmed at Monaco that, although complex, there was nothing untoward within the Ferrari hybrid system.

This issue was subsequently revisited when it was reported that a second sensor was added to the Ferrari battery mid-season, leading to a loss in performance. The FIA denied any second sensor, while Ferrari appeared to confirm it! No further clarity has emerged on the subject, but Ferrari has been free to run its power unit without penalty or protest.

KINETIC

Now some 10 years since hybrid technology (KERS) was introduced into F1 and after five years of the current double hybrid (ERS-K and ERS-H) set up, the current 160 kW cap on kinetic power remains. While future power unit regulations appear uncertain and race fuel allowance increased for the IC engine for 2018 and 2019, it seems strange that a jump to greater power outputs is not being adopted with greater ERS-K power.

LIGHTS OUT: STARTLINE PERFORMANCE PADDLES & HIDDEN BUTTONS

With the margins between the top three teams so small, track position has been all-important in the tyre-limited races. Improved track position can be gained from better qualifying pace or superior startline performance. Despite such stability with gearbox and power unit design, there is still a quantifiable difference in different teams' ability to get off the line better or more consistently than their rivals.

This performance is a mix of power curve characteristics, clutch setup and control strategy. Some interesting developments have evolved over the years in this area, many of which are subsequently banned. Launch control is now very much in the driver's hands – a single clutch paddle must move the clutch in proportion to the paddle movement – while parade lap test launches and clutch bite point finds to set up the launch characteristics are now disallowed.

Ferrari's solutions drew the most interest early this season, as one driver had a different paddle setup to the other: Sebastian Vettel had an additional paddle mounted high up behind the steering wheel. Its use remains a mystery, but startline control was strongly rumoured to be an explanation; furthermore, a rotary control named 'grip' on the steering wheel perhaps ▶

A NEW DIMENSION

IN TRANSMISSION TECHNOLOGY

Our motorsport and automotive customers constantly push the boundaries of high performance with more complex and demanding loads on the transmission. Demands which we match and exceed by investing in the finest talent and technology available.

XTRAC

TRANSMISSION TECHNOLOGY

#thinkitmakeit

THATCHAM, UK • INDIANAPOLIS AND MOORESVILLE, USA

www.xtrac.com

Mauger/LAT

ABOVE Ferrari's Halo-mounted mirrors were among a sudden burst of innovation in this area

informs the clutch control software of the likely conditions off the grid.

More mystery around Ferrari resulted from the onboard footage, when buttons hidden under the silicone hand grips on the steering wheel were seen being used off the start. Again, their function remains secret. No accusations of improper use have stuck, but it's clear Ferrari remains consistently one of the fastest starters.

Mirrors

Aside from the size of the mirror 'glass' and position relative to the cockpit, there are few rules controlling the mirror pods or their mountings. As the season commenced, several teams were exploiting some fairly broad interpretations of the mirror mountings. While for decades the structural engineers in F1 have managed to support the few grammes of mirror with a single support, Mercedes and Red Bull suddenly required two and Force India three! It would be naïve to think these supports were structural, so they were clearly there for aerodynamic reasons.

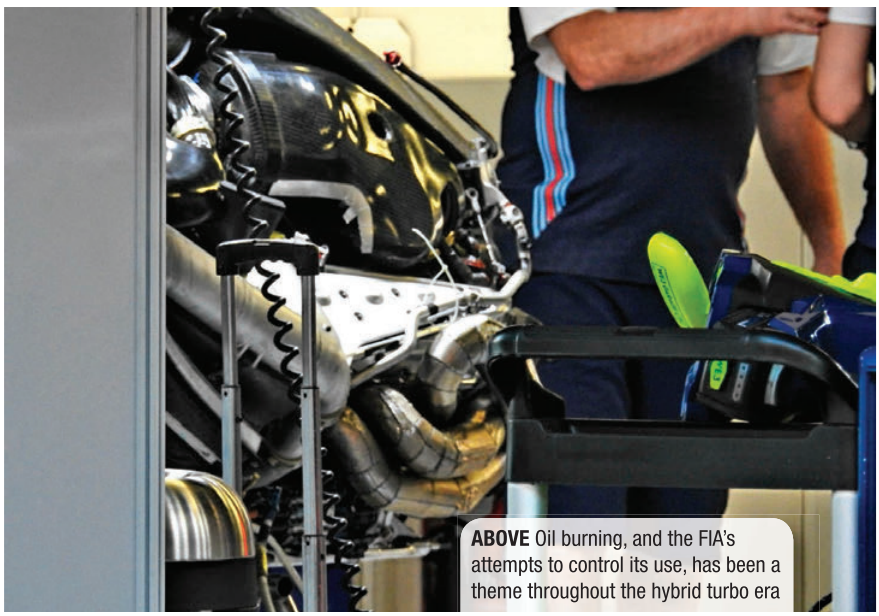
At the Monaco GP the FIA loosened the mirror regulations to allow the mounting to be attached to the Halo rather than the chassis, but not both. Ferrari immediately created a Halo-mounted mirror, with a fin sprouting off it and joined to the mirror pod with a small support. The Halo mounting was not argued, but the fin joined into this mount was considered excessive, albeit only a subversion of the same multiple mount designs adopted by other teams.

Not allowed – turbo oil supply

One suspicion of illegal oil burning that warranted an FIA response, with a technical directive distributed to the teams, was that the turbocharger oil supply and use must be included in the main engine oil regulations. It was believed this was a Ferrari ruse to circumvent the oil burning rules, perhaps highlighted by the smoky start up of the Ferrari in the pits. It should be noted that this sight has not been confined exclusively to Ferrari since 2014.

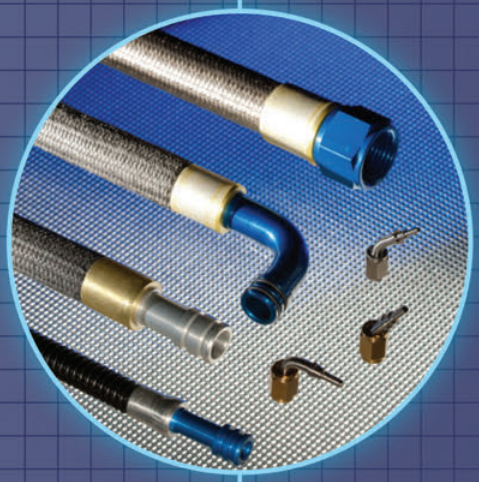
Oil burn

In the battle for power unit performance within the fuel specifications, many accusations of illegal oil-burning have been levelled at both Ferrari and Mercedes. Since the new power units were introduced in 2014, the use of oil being introduced ▶

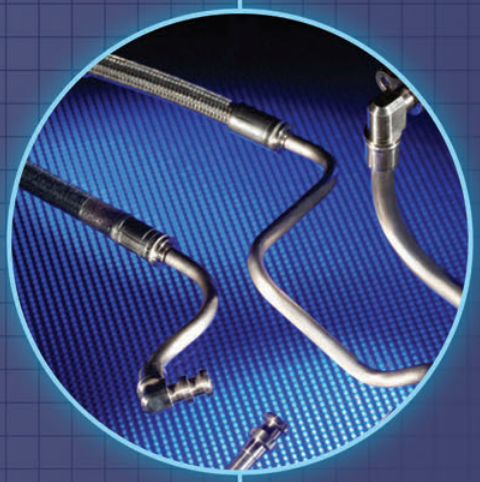


ABOVE Oil burning, and the FIA's attempts to control its use, has been a theme throughout the hybrid turbo era

INTELLIGENCE CONNECTED



Flexible Hose and Fittings



Rigid Lines and Swagetite

Filtration

It's not by accident that, over the years, we have developed many successful partnerships with customers throughout motorsport – particularly in F1, endurance racing and WRC.

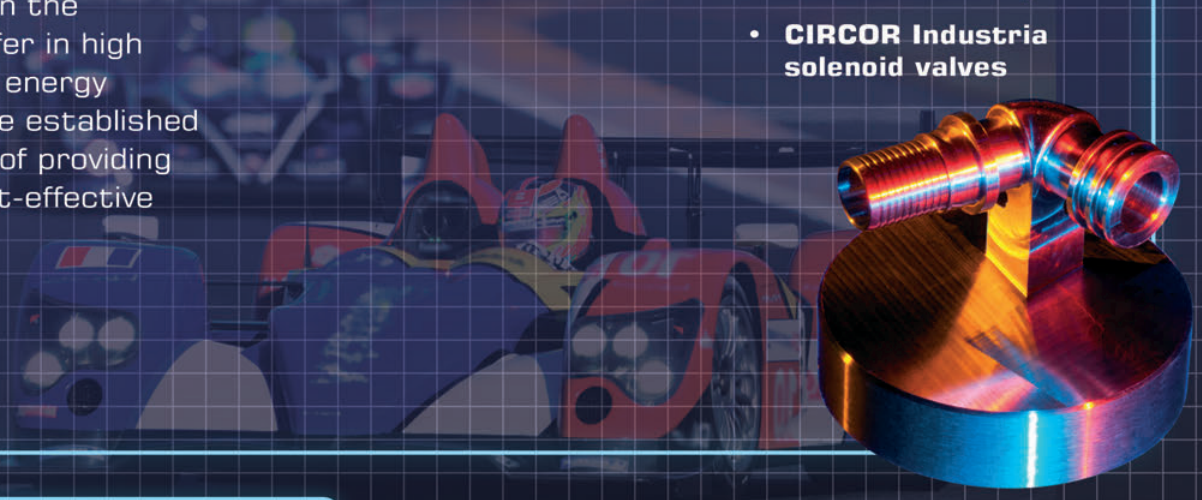
By applying intelligent analysis of their problems in the area of fluid transfer in high performance, high energy situations, we have established ourselves capable of providing innovative and cost-effective solutions.

SERVICES:

- 3D cad design service
- hose assembly
- hard-line manufacture
- cnc machining
- filtration design
- laser marking

PRODUCTS:

- **Titeflex smoothbore and convoluted hose products and fittings**
- **Swagetite fittings and hard-line system solutions**
- **Pall Filtration systems**
- **CIRCOR Industria solenoid valves**



FHS
MOTOR RACING

INTELLIGENT CONNECTIONS

Maintain system integrity, save weight, cut costs.
Make the connection now.

To find out how the quality of your own fluid transfer requirements can be improved, call our Technical Sales Team on

+44 (0) 1753 513080

FHS Motor Racing Ltd | 656 Ajax Avenue | Slough, Berkshire | SL1 4BG UK Tel: +44 (0)1753 513080
Fax: +44 (0)1753 513099 Email: info@fhsracing.co.uk Web: www.fhsracing.co.uk

to the combustion process, to bring in combustion additives not allowed within the fuel itself, has been commonplace for the manufacturers. These rules were tightened up for 2018, but loopholes still existed.

Pirelli hypersoft tyre

To spice up the 'show' and create even faster qualifying times, Pirelli introduced a new even softer tyre. With its bubble gum pink lettering, the Hypersoft tyre – named by fans following a social media survey – was not quite the one-lap qualifier that many expected, as at many tracks it was used at, it was durable enough to last a qualifying run and over 10 laps into the race.

Rear wing endplate slots

In the same vein as other aerodynamic surfaces, the rear wing endplate is increasingly being slotted to create a more 3D flow through the wing. McLaren struck upon a unique idea with the dog-leg shape of the endplate being opened up and vanes formed in the resulting opening. Later in the season Ferrari and Mercedes also copied this idea. It demonstrated that even a poorly-performing car can still showcase valid ideas.

ABOVE Jacks drop by a signal sent from the pit light system

ABOVE Teams were quick to react to the new freedom that permitted a sequence of sidepod vanes

Questions over unsafe release

The early races highlighted the consequences of unsafe pitstop releases, with the Haas cars being stranded with loose wheel nuts and a Ferrari mechanic injured. This underlined the danger of the semi-automated pit stop light systems.

One aspect of these systems, used to speed up the pitstop to a potential sub-two seconds, is the jack release. Jacks are not allowed to lift the car with powered systems, but other powered systems are permitted. This is used by many teams as a quick release system: the mechanic raises the car on the jack with a strong pull, then the release of the jack is under the control of the chief mechanic and pit light system. When the signal is given for the green light to release the car, the jacks drop by a signal sent from the pit light system to a powered release mechanism. Thus, the mechanic has no role in the car being dropped from the jack unless they override the release mechanism.

This is how the Ferrari ran over its mechanic, even though the rear jack man had full sight of the car without the rear wheel being fitted properly: as the pit lights were switched to green, the car dropped, and the car released from the pit stop.

Shark fin

The proportions of the cars were returned to a better balance with the ban on the shark fin for 2018. Every team was forced to run bodywork along the spine of the engine cover, up to the regulatory limit. Aside from the reduction in advertising space, the performance effect of their loss was limited, and any talk of their return has abated.

T-wings

As with the shark fin and monkey seat, the T-wings fitted on the tail of the shark fin in 2017 were cleaned up, but an area for a smaller, lower T-wing remained. Teams exploited these devices to a lesser extent than in 2017, although even a four-element version was shoehorned into the limited space for high-downforce tracks!

Underfloor – Haas legality

Even though many legality arguments raged throughout the year, only one actually resulted in a disqualification: Haas at Monza.

The area in question was the shape of the tea-tray front splitter in plan view, where rules demand the corners of the leading edge are radiused. But the rules are open to interpretation, as they define the radius on a specific plane and other bodywork regulations affect the same area. Haas had joined the front edge of its bargeboards to the splitter's leading edge, which meant the radius wasn't fully defined to the entire area. Renault, its nearest rival, queried the matter with the FIA.

With a technical directive issued, ahead of the summer shut down, to clarify the rules, Monza was targeted as the race where the floor had to meet the new interpretation. Haas was disqualified after post-race scrutineering and lost valuable points in the Constructors' Championship when the ruling was upheld at Appeal.

Sidepod vanes

Just as the bargeboard region was freed up in 2017, so too was the area adjacent to the sidepod inlet. Few teams exploited this area to any great degree initially. Mercedes, however, immediately realised it could fill the area with a series of vanes to help tidy the airflow along the flanks of the car. The three-vane idea was soon exploited in 2018, many teams running a near-picket fence setup.

The airflow splitting to either side of the car ahead of the sidepods travels sideways rather than lengthwise in this area. The vanes help redirect the airflow along the car but opening up a slot to form a wing profile on these vanes can actually create some local load to add downforce. Haas forms this entire area from a stack of wing profiles to gain this extra downforce.

Wheel rim venting

For many years teams have attempted to influence tyre temperatures by using the brake duct bodywork and wheel spec to control the amount of heat that is conducted from the brakes through the wheel. With the

AMG Mercedes F1

ABOVE Mercedes took wheel rim venting to new levels

carbon brakes operating at a peak of over 1,000 degrees C, and almost always above 500 deg C, the hot air exiting the brake discs can be used to heat the wheel and thus the tyre, or ducted away from the wheel to reduce tyre temperature.

Mercedes introduced a mid-season update to the rear of the car, affecting brake ducts and the rear wheel design. The wheel had obvious fins cast into the outer rim. Depending on the boundary conditions, the fins could either absorb brake heat or be cooled by airflow that's avoided the brakes. Less visible, there were further changes to the interface between the wheel and rear hub. There were drillings in the wheel which resulted in less metal to conduct heat, whilst allowing airflow to pass through. Again, the boundary conditions could either heat or cool the wheel, relative to the brakes.

With high rear tyre temperatures frequently causing race pace issues, it's been assumed that the changes in the wheel rim and brake ducting pass cool air through these areas to reduce tyre temperature.

AUXILIARY OIL TANK

The oil consumption rules rewritten for 2018 were still quite open to interpretation, as the main oil tank was the reservoir mentioned in the rules. F1 cars have run auxiliary oil tanks (AOT) for decades, the tank being used to add extra oil to the main oil circuit during the race. As it's the main oil circuit that's measured, the AOT could be used to add oil to the main tank to hide the measured oil use. From 2019 the AOT will not be allowed to be used in qualifying.

ABOVE The FIA has acted to simplify front wings next season to improve the harmful wake that makes it hard for cars to follow

Y100 WINGLET – MONKEY SEAT

One detail change in the 2018 rules was restriction of the so-called "monkey seat" fitted aft of the exhaust tailpipe. More technically, they are known as the Y100 winglet due to the 100 mm width allowed each side of the car's centreline for the wing. These 200 mm-wide winglets were mated to the exhaust plume to create upwash through the rear wing/diffuser. This blown aerodynamic effect was frowned upon by the FIA technical department, as a result of which the 2018 monkey seat volume was reduced to just a small flap behind the exhaust outlet.

ZZZZZZ... NO OVERTAKING. 2019-2021 RULES

It's arguable whether the F1 spectacle has been improved by the aero changes made to speed up the cars in 2017. While Ross Brawn is now working with a technical design team behind the scenes at the FIA to look at the rules for 2021, there was a fear that the intervening period may be dulled by poor racing and a lack of overtaking. Thus, the FIA acted to bring in revised aero rules for 2019, fast-tracking some of those long-term changes. There will be new front wings next year, wider, with just five elements and no complex add-ons. This aims to reduce the outwash created by the front wing and the turbulence affecting the following car.

PEAK PERFORMANCE

The mission to smash the Pikes Peak hillclimb record carried VW and its powertrain partners at Integral e-Drive into new territory, as **Chris Pickering** explains

PIKES Peak is an event like no other. A 102-year-old race to the clouds, where images of good old boys in monstrous V8 open-wheelers go hand-in-hand with cutting-edge innovation. The first electric car to race here did so in 1981, long before the likes of Formula E emerged. In 2015, the eO PP03 driven by Rhys Millen became the first electric vehicle to win the event outright. And this year the Volkswagen I.D. R Pikes Peak became the first to set a new course record – shaving more than 15 seconds off Sébastien Loeb's seemingly unbeatable (combustion-powered) time set in 2013.

Of course, Pikes Peak plays to the strengths of electric cars. The altitude means that combustion engines and spectators alike are gasping for air at the top of the 4,300-metre (14,110 ft) summit. The relatively short length and comparatively low average speeds of the course mean that energy density is less of an issue than it is in circuit racing. And the torque-rich characteristics of electric motors mean they're ideal for blasting out of each of the 156 turns.

But none of this makes engineering a car for Pikes Peak easy, especially when you only have a matter of months to do it. That was the challenge facing the engineers at Volkswagen Motorsport and their powertrain partners at Integral e-Drive (the e-drive division of Integral Powertrain) when work on the project officially began on 18th October 2017.

The majority of the car was to be built in-house at Volkswagen Motorsport by a small team led by technical director François-Xavier 'FX' Demaison. The supply of the motors and inverters, however, was put out to tender in the summer of 2017, which is where Integral e-Drive comes into the equation. You may not have heard of the Bletchley-based company, but it has a behind-the-scenes presence in just about all forms of electric and hybrid motorsport. It's backed up by some serious heavyweight talent too, with all four directors being ex-Cosworth, including Roger Duckworth, son of legendary F1 engine designer Keith.

The company's chief engineer, Arnaud Martin, is no stranger to innovative projects, either. Having cut his teeth in Formula 1 engine design at (you guessed it…) Cosworth he moved to RML, where he went on to become the powertrain director, overseeing the development of the Nissan ZEOD's hybrid system.

ABOVE Although the motor and inverter are extremely efficient – above 98 per cent – the driving factor was actually the weight. The rear motor, complete with inverter, came to just 30 kg, while the front tipped the scales at 25 kg

Integral e-Drive's proposal for the I.D. R majored on lightweight technology. In the end, the rear motor, complete with its inverter, came to just 30 kg, while the equivalent package on the front tipped the scales at 25 kg.

"Pikes Peak is not quite the same as Formula E where you're energy limited. Here, you can design a car with the energy required to get you to the top as fast as possible. Although the motor and inverter are extremely efficient – above 98 per cent – the driving factor was actually the weight," explains Martin.

Volkswagen had already determined that the best configuration would be to use two motors, so the tender went out for one on the front and one on the rear, giving the I.D. R four-wheel drive. Running one motor for each wheel would also have been a possibility, but it was discounted on the grounds of weight, with conventional mechanical differentials used instead to distribute the torque across the vehicle.

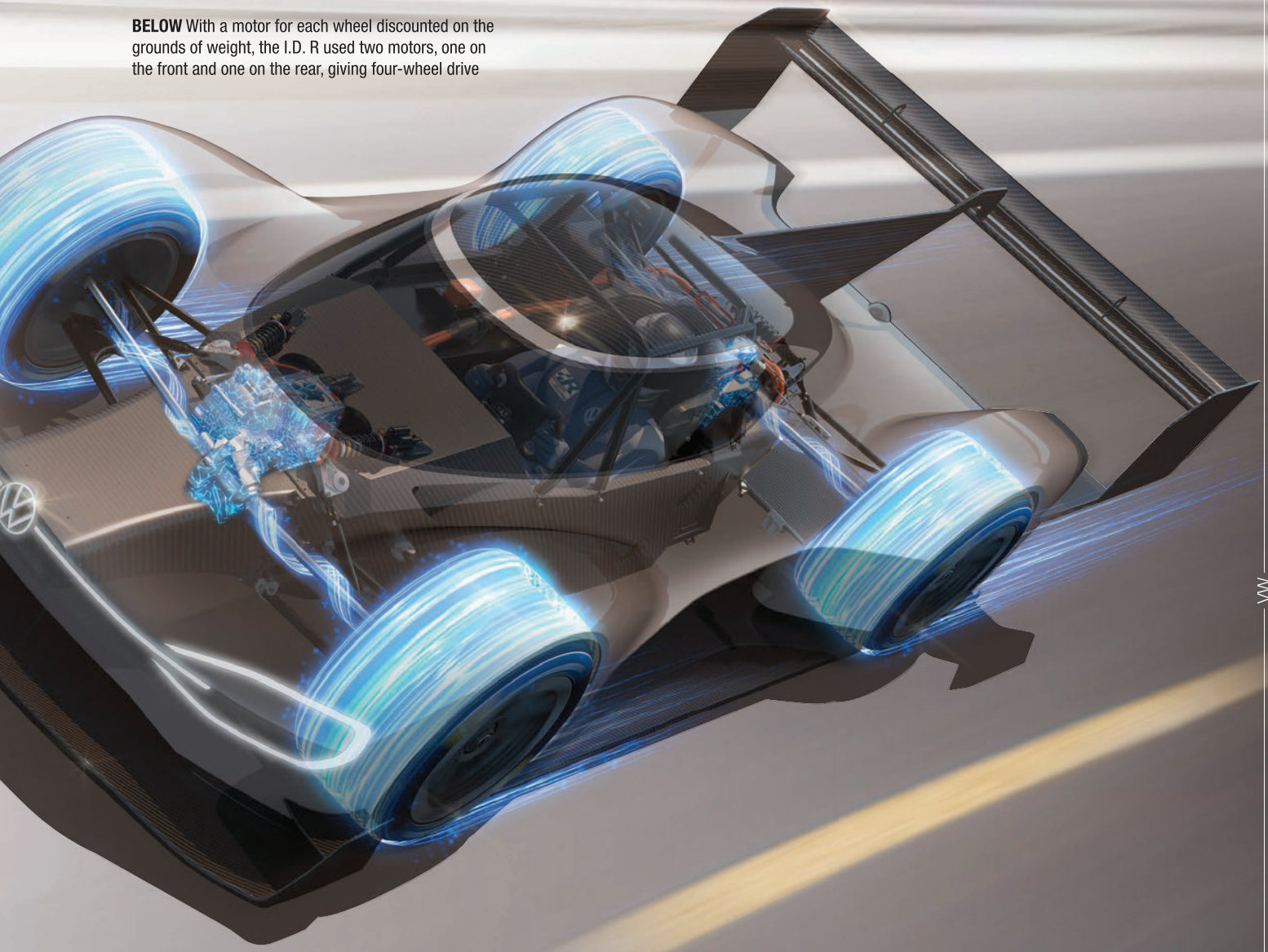
> *"You have a device that needs to be electrically insulated at the same time as providing heat transfer out to the coolant. That can be very difficult"*

"You could have made the motors even smaller if you had one on each corner, but the weight of the inverters wouldn't have gone down that much and it would have required four gearboxes rather than two," notes Martin. "At 5.5 kg, the inverter is starting to become a significant portion of the mass of the motor, so you would have needed to virtually double that to run two motors on each axle. Ultimately, Pikes Peak is all about acceleration out of the corner, so you want the lightest possible car. Specifically, you also want the lightest possible motor and inverter, so you can maximise the battery energy."

Basic calculations showed that motors revving to around 17,000 rpm through a single-speed gearbox, would be enough to give a top speed of around 245 kph (152 mph). Meanwhile a rear motor producing circa 280 Nm would already be traction-limited through the same gearbox.

"For us, the main things to consider were the characteristics of the motor and the inverter – both front and rear," comments Martin. "With the weight transfer under acceleration – particularly at Pikes Peak ▶

BELOW With a motor for each wheel discounted on the grounds of weight, the I.D. R used two motors, one on the front and one on the rear, giving four-wheel drive



where you're usually climbing quite a steep gradient at the same time – you can put a lot more torque to the rear wheels than you can to the front wheels. We set about optimising the size of the motor to the torque requirements and the grip available at the wheels."

From that point on, it was all about delivering those targets in the lightest possible package. As is often the case in motorsport, the deadlines were tight, with the motors and inverters required for testing in March, less than four months after the contract had been awarded. With the clock ticking, it was decided that the most effective solution would be to use the same basic motor architecture on both ends and simply scale it up or down as required. To that end, the motors look exactly the same in cross section, but the axial length of the rear unit has been extended slightly at 75 mm in length as opposed to 55 mm on the front. This provides a stronger magnetic field, thanks to a longer rotor and stator, which translates to increased torque.

"Electric motor technology is inherently scalable," comments Martin. "One thing we couldn't do in that timescale was get it wrong. We went for a tooth shape that we had used previously, but we improved the motor by choosing the best possible materials. The benefit of using this proven technology was that it worked first time."

The material upgrades included a reduced lamination thickness on the rotor, increased use of cobalt and higher specification magnets. In particular, the laminate construction of the teeth on the rotor allows designers to carefully direct the magnetic flux for maximum efficiency; by increasing the density of the laminate structure it's possible to increase this effect while reducing weight.

KEEPING COOL

Volkswagen had calculated projected times, based on a full simulation of the course. During the development process, Integral Powertrain used this simulated duty cycle to test the motor's thermal performance. In reality, the motors ended up well within their thermal operating range, but this is by no means a given at Pikes Peak.

Even at the Pikes Peak's 2,862-metre (9,390 ft) start line the air density is 28 per cent lower than it is at sea level. By the time the cars reach the finishing line, some 1,438 metres (4,718 ft) further up, they are scything through air that is just 60 per cent of the density of that found at sea level. Clearly, this gives electric motors a huge benefit over combustion engines, but it still presents similar issues in terms of cooling, with the I.D. R's motors, inverters and battery all using water cooling via a set of radiators. (Although, ironically, the situation was reversed during the warm-up sequence, where the batteries were fed externally-heated fluid to bring them up to temperature.)

"There is a fundamental challenge when it comes to cooling electric machines," Martin points out. "You have a device that needs to be electrically insulated at the same time as providing heat transfer out to the coolant. That can be very difficult – it's a question of carefully choosing a material with the best properties and then optimising the design to maximise the heat transfer. That said, the heat rejection of the motor and inverter at peak power is around 2 per cent. So at 250 kW you only have to deal with 5 kW of heat rejection [per axle]. An internal combustion engine of the same output might reject 45 to 50 kW so despite the loss of cooling at ▶

ABOVE The inverters' semiconductors are based on silicon carbide, which is resistant to high temperatures and offers very high electrical conductivity

LifeRacing

Professional engine, chassis and gearbox control electronics

Providing control solutions for Le Mans LMP1, WRC, WTCC, Indy Lights plus many production formulas.

Direct injection, stand-alone or integrated paddle shift systems, drive-by-wire, intelligent power distribution, electronic fusing and high reliability wiring systems are all manufactured for the most demanding applications. Life Racing has extensive experience developing turbocharged and normally aspirated engines and supporting diverse racing series including F1, WRC, WEC and Le Mans, WTCC and more…

Contact us to find out more about our products…

Life Racing Ltd
6 Repton Close , Basildon, Essex, SS13 1LE, UK
Tel: +44 (0) 1268 904124 Email: info@liferacing.com
www.liferacing.com

altitude the car was still able to run very small radiators."

So confident were the Integral e-Drive engineers in their simulation capabilities that they were able to carry out the thermal development entirely in a virtual environment, using a model that had been extensively validated in the past.

INVERTERS

The I.D. R powertrain featured Integral Powertrain's first in-house inverters, which use an identical design front and rear. Inside, the semiconductors are based on silicon carbide – a highly durable crystalline compound of silicon and carbon, which is resistant to high temperatures and offers very high electrical conductivity. This reduced sensitivity to heat allows silicon carbide-based systems to operate at higher switching frequencies, up to 75 kHz in this case, which reduces the energy losses.

"If anything, the inverters were a bigger challenge than the motors on this project," comments Martin. "The control needs to be very fast and very precise. If you're operating at 75 kHz that means you need to switch once every 75-thousandths of a second. If you don't time things absolutely perfectly it's possible for two switches to overlap each other and the inverter can short circuit – at which point things can go very badly wrong indeed. We're talking milliseconds."

Martin and his colleagues set about designing a very compact housing, but this produces its own challenges. Electricity is capable of jumping gaps. And the higher the voltage the further the safe distance typically becomes, so creating a small, lightweight casing is by no means trivial. What's more, the effectiveness of electrical insulation decreases with air pressure, so the safe clearance distances have effectively increased by the time the car reaches the top of the course. It's a challenge that's virtually unique in motorsport, with only the Dakar Rally going higher.

The control systems need to be fast too. Field programmable gate array (FPGA) controllers are used, which contain an array of logic blocks, capable of breaking the operations down into separate tasks to process very ▶

> *"You need to switch once every 75-thousandths of a second. If you don't time things absolutely perfectly, the inverter can short circuit"*

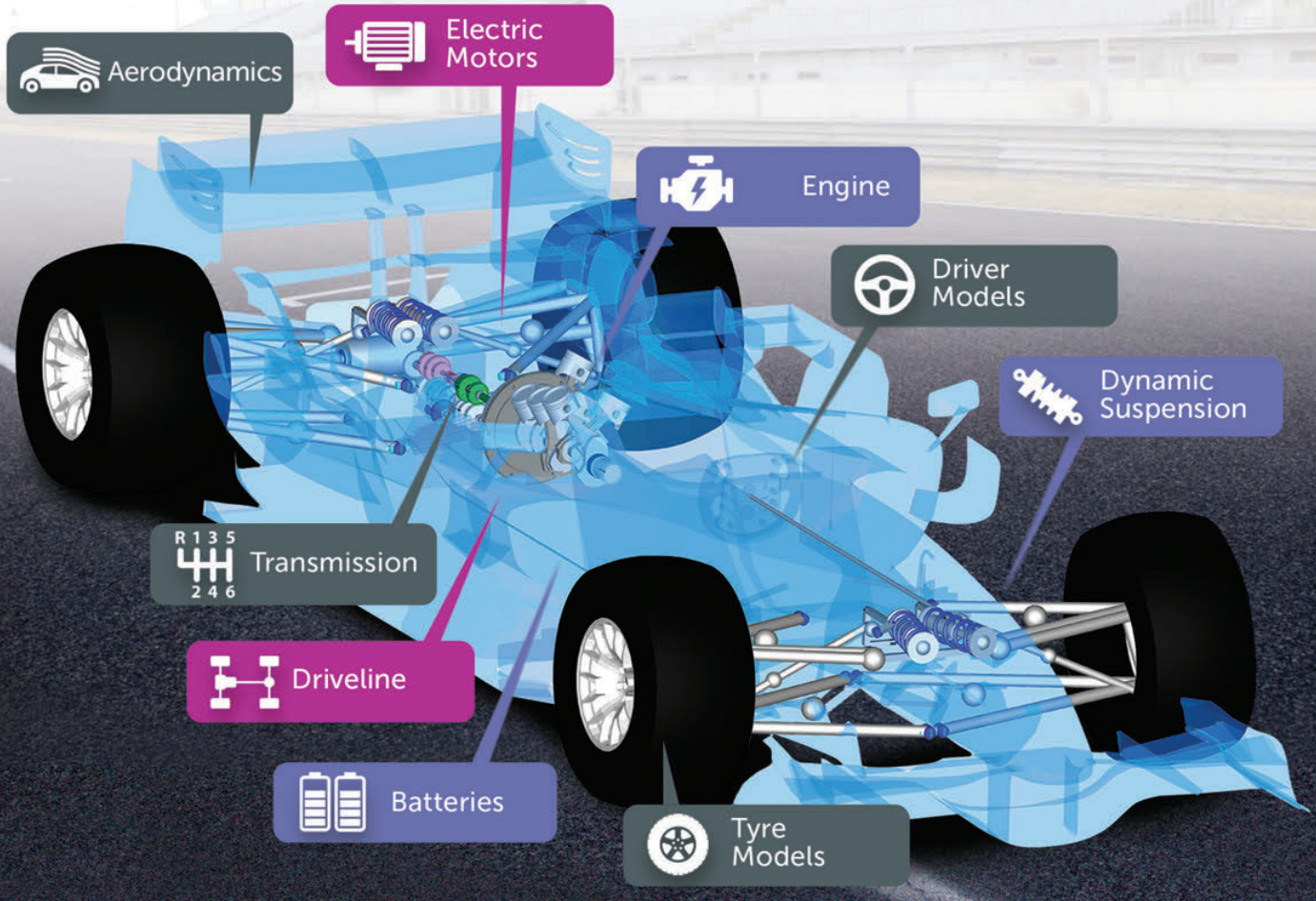
ABOVE "Holy smoke! I'm not sure if the helicopter can keep up with this guy!" Commentators were impressed at the I.D. R's speed

Simulation and Virtual Testing of the Complete Vehicle

Dymola | rFpro | VeSyMA

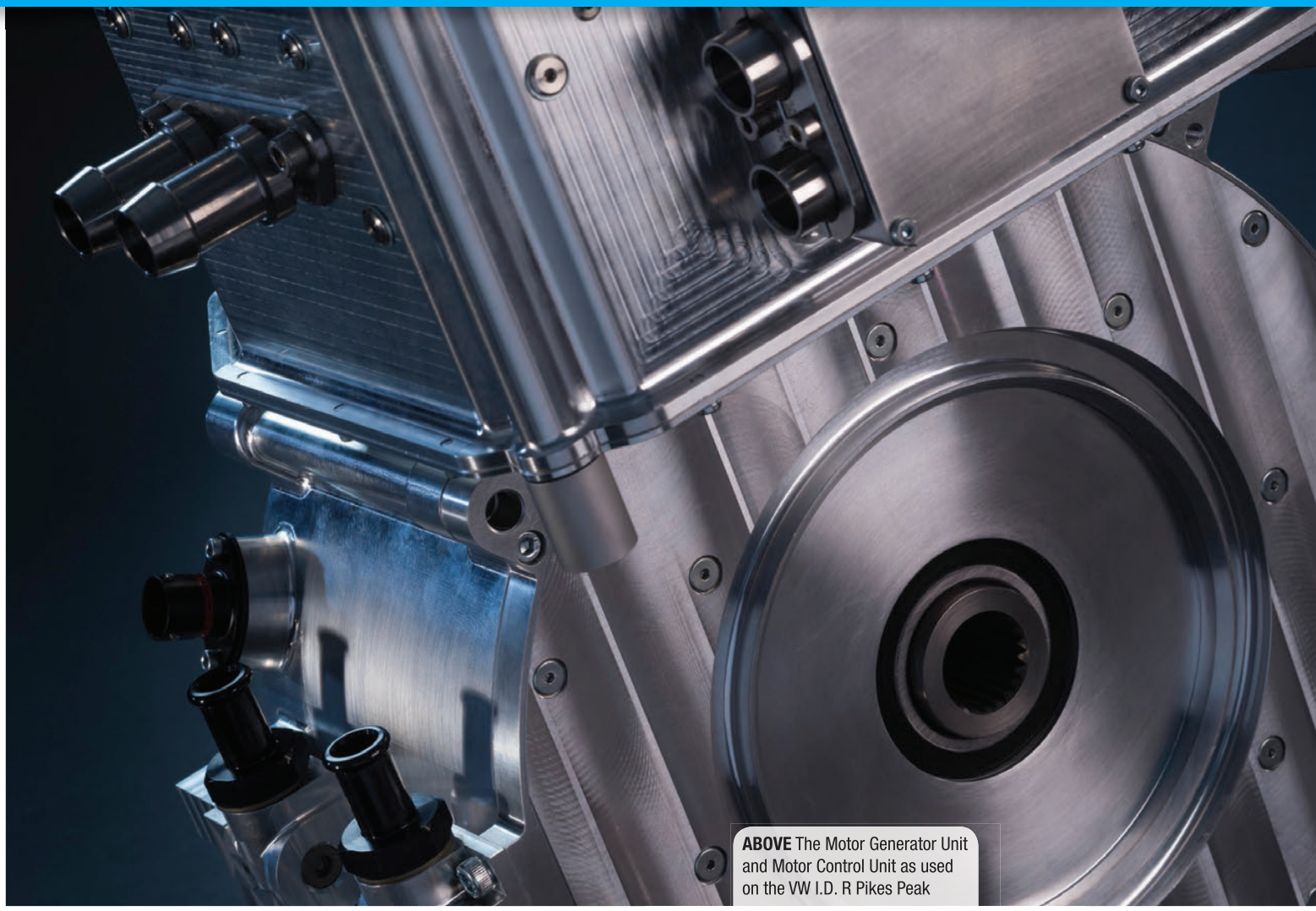
CELEBRATING TWENTY YEARS OF INNOVATION 1998-2018

Virtual testing delivers cost reduction and accelerates development by addressing the challenging systems integration tasks arising from high levels of complexity.



Edmund House | Rugby Road | Leamington Spa | CV32 6EL | UK
Telephone **+44 1926 885900** Email **sales@claytex.com**
www.claytex.com

CLAYTEX



ABOVE The Motor Generator Unit and Motor Control Unit as used on the VW I.D. R Pikes Peak

quickly in parallel. At a higher level, the software also needs to be as processor-efficient as possible to maximise speed.

"Motor design has a big impact on the efficiency, but by combining a very low-loss inverter with your own software you can improve that even further. To do that, though, you need a very good understanding of physics and control systems. It's not easy," comments Martin. "The hardest thing was getting the software to work. We have a very good software team in-house, but developing an inverter in two and a half months was still a real challenge."

Great attention was paid to the thermal management by both the Volkswagen Motorsport engineers and their colleagues at Integral e-Drive. The powertrain components and the cooling system were carefully sized to ensure that the entire 20 km (12.42-mile) course could be taken flat out without the need to de-rate at any stage.

Confidence was reasonably high by the time the car arrived in Colorado at the beginning of June 2018, but the success of the project would depend on the time that driver Romain Dumas could coax out of the car on the day.

"It became clear during testing that the car would be fast enough to take the outright record, but there's a big difference between being fast on three individual sectors and actually setting the quickest time on a complete climb. The only time the car did the full 20 km was on the day of the event, so you can imagine the level of expectation," comments Martin.

MOMENT OF TRUTH

The motorcycles went first. Then, as the fastest qualifier, Dumas was the first of the cars to go up the hill. The weather was still changeable, with clouds encircling the upper sections of the course. His early sector times looked encouraging and then the news came through that Dumas had crossed the line in 7:57.148. That meant he'd not just set a new course record, but smashed the previous electric record by well over a minute.

Dumas later estimated that damp conditions on the middle part of the course had cost him four to five seconds, while Martin believes there is the potential to push the electric powertrain technology yet further.

"On a personal note, I'd love to go back to Pikes Peak," he says, "Hillclimbing was really big when I was growing up in France. In particular, Pikes Peak was a big deal for the French manufacturers. FX [Demaison], Romain [Dumas] and myself were all watching people like Michele Mouton setting records there when we were kids. Three decades later we all ended up at Pikes Peak and I think it was a bit of a dream come true for all of us."

So what next for the Race to The Clouds? Well, it took the might of a major manufacturer, the driving talent of Sébastien Loeb and access to an LMP1 team's parts bin to set the previous record, which remains nearly 25 seconds clear of any other combustion-engined vehicle. The chances of anyone significantly bettering that with conventional powertrain technology are pretty remote – especially when the big manufacturers are now pouring so much of their marketing budgets into electric vehicles. In the rarefied world of Pikes Peak, that might mean that the days of combustion-engined cars taking outright wins are now over. The electric cars, on the other hand, look like they're only just getting started. RT

VBOX VIDEO

VBOX VIDEO HD2 captures stunning video in full 1080p HD with real-time graphical overlay.

Supplied in a rugged, water resistant case, with two cameras, internal GPS logger, backup battery supply, up to 30s video pre-buffer and real-time graphical overlay, **VBOX VIDEO HD2** represents the ultimate in tough, reliable motorsport video loggers.

VBOX VIDEO HD2 comes with **CIRCUIT TOOLS**, an intuitive analysis software package designed to help drivers improve their track performance and accelerate the learning process, ultimately leading to better lap times.

- Synchronised video and data
- Dual camera 1080p
- Heart rate monitor
- Class leading driver training software (Windows, macOS & iOS versions)
- Configurable pre-record buffer
- Camera preview over WiFi
- CAN interface
- CAN signal database

Professional racing drivers share their experience on advanced circuit driving techniques in our FREE eBook: www.vboxmotorsport.co.uk/ebook

www.vboxmotorsport.co.uk

The withdrawal of Mercedes leaves the DTM at a crossroads. **Dominic Harlow**, who works in the series as an engineer, assesses the championship's options

THE ELEPHANT IN THE ROOM

Photos: DTM

ABOVE Timo Glock's epic duel with Gary Paffett's Mercedes at Hockenheimring made for impressive viewing – and uncomfortable listening!

ENTHUSIASTS branded it 'the best team radio celebration ever'. But for those on the pitwall, Timo Glock's expletive-laden outburst as he crossed the line to win an epic duel at Hockenheim made for uncomfortable listening.

"The best f****** racing," he bellowed, adrenaline flowing. "F****** hell Mercedes, this is why you should not leave this championship, you f****** idiots."

This year's on-track action was as memorable as that message, for the series once again generated an incredible touring car racing spectacle. But there is an elephant in the room – although that wasn't quite how Glock phrased it – for the DTM now stands at another crossroads after the withdrawal of the six Mercedes cars, to be replaced by a number of privately-run Astons and Audis.

The last turning point in its more than 30-year history came recently when Race Tech explored the apparent contradictions between the route taken for the 2017 Formula 1 technical regulations and that for the DTM [RT197]. Although each series was heading in a different direction, they shared a common objective: improving the racing spectacle for fans and becoming more appealing to those who only occasionally watch motorsport.

While Formula 1 increased downforce enormously for 2017 and has since begun intensive research into, amongst other things, the effect of aerodynamics on close racing, it seems that DTM was vindicated in some of its decisions, namely lowering downforce and banning tyre blankets. This year it went even further in reducing downforce, whilst also being able to eliminate the unpopular (and confusingly named) 'performance ballast'. Costs are down and the competition remains just as heated.

Another area where the series scored is in the removal of aerodynamic 'furniture' around the front splitter. Parts that previously lost tens of points of downforce if damaged were deleted and replaced with simpler, more robust devices. Aerodynamic performance suffered of course – as well as improving body downforce, flicks usually add a bit of local load that is also likely to be helpful in close following in the 'wake' – but the drivers seemed willing to exploit the additional potential for riskier overtakes or more robust

BELOW HWA AG, a long-term Mercedes partner in the DTM, will be responsible for the development, building and running of the DTM Astons

defence, knowing there was less chance of destroying their race along with the carbon. In 2019 Formula 1 front wings will also be simplified. The reasons are far more complex but one of the effects may also be the same.

Since the start of the 2017 season, despite a grid of only 18 cars, the racing in DTM has been closer than ever. During that season 16 different drivers scored podiums and 12 recorded race wins. It was, and continues to be, predictably unpredictable. In 2018 again all bar two drivers (excluding the guest drivers, of whom Alex Zanardi was undoubtedly the star) scored podiums and almost half, eight, won races. This tally was all the more impressive given Rene Rast's unprecedented record-breaking sequence of six straight victories for Audi.

IDEAL SCENARIO

Despite Glock's protestations, Mercedes still withdrew from DTM. During a press conference at its Norisring event, the series instead announced its own vision for an exciting new chapter. Gerhard Berger, Chairman of the ITR, and Masaaki Bando, Chairman of the GT Association (GTA), confirmed a unification of their respective series, the DTM and the GT500 class of the Autobacs Super GT series. From 2019 we will see the German machines change from the venerable 4.0-litre restricted V8s to an I4 2.0-litre turbo, with a fuel flow limit, much more in line with the rapid moves towards low displacement pressure charging as the future of the internal combustion engine. ▶

Audi AG

BELOW New era: Audi's new RS 5 DTM, modified to comply with Class 1 regulations and powered by the newly-developed two-litre turbo engine, impressed its drivers with its "terrific muscle and momentum" on its first test last month

There will be greater regulatory alignment through a joint set of Technical Regulations known as "Class 1" and the two championships will come together for two events from 2019 onward, one in Germany and one in Japan. From 2020 Super GT will fully adopt the regulations with adaptions for the race format given by its sporting regulations. It is interesting as well that there does not seem to be a big push towards hybrid technology.

There is no doubt that DTM is currently the premier touring car category in the world. That accolade is a result of the international field of drivers, the quality of engineering and, until now, premium automotive brand participation.

Losing Mercedes is a blip, but the goal has to be taking the series to the world stage. That would finally confirm its status as the de-facto top level global motorsport series for 'cars with roofs' that, at least partially, resemble a road -going vehicle. (I would include GT and endurance categories within this.)

This new set of regulations, it is said, now enables teams and manufacturers to compete in an international series on two continents with the targets of no extra costs, plus safety and equality.

To be truly global the only logical further step would be events in the Americas. It's certainly possible, for the market to attract the manufacturers is clearly there. In South America the Brazilian Stock Car series is, in concept, already quite similar, making a tripartite or more adoption of "Class 1" entirely plausible.

REGULATIONS COMPARISON

The precise details of the new technical regulations are sparse, perhaps because the bulk of them did not fully exist when the announcement was made. Nevertheless, a simple comparison of the current similarities and differences can be made that begins to shed light on the new direction (see Figure 1).

There is a lot of detail missing. Standard parts will feature heavily, and aero development will be curtailed by limited wind-tunnel sessions. But what can be expected in terms of performance is difficult to quantify. Super GT derives a lot from the tyre competition, but this is tricky for a series hoping for close competition to manage.

It's difficult to imagine anything other than a single supplier scenario for more than one-off events or appearances. This might, after all, ▶

FIGURE 1

2018	DTM	Super GT
Chassis	GERG GmbH carbon monocoque (introduced 2012)	Same GERG monocoque as DTM (exception for Honda's mid-engine layout)
Engine 2018	Front-mounted restricted V8	Various. Front-mounted except Honda's mid-engine layout (no longer eligible under Class 1 rules)
Engine 2019	2.0-litre turbo with fuel flow restrictor	2.0-litre turbo with fuel flow restrictor
Tyre	Hankook (one compound only). Front: 300/680 R18; rear: 320/710 R18	Four manufacturers (Bridgestone, Yokohama, Michelin and Dunlop), with multiple products
Wheels	BBS 18" EB parts	18" (same widths 12" front and 13" rear)
Aerodynamics	Prescriptive aerodynamics with homologated contour (30% reduction of Cz for 2018)	Greater freedom for development of aerodynamic performance (very different cooling package required for Honda layout)
Suspension	Standard (EB) components	Bespoke designs (for example to accommodate front engine layout), standard dampers
Weight Dist (%Frt)	48–53%	46–53%
Min. Weight	1115 kg (driver & car)	1020 kg
Constructors	Audi, BMW, Mercedes (outgoing)	Honda, Nissan, Toyota
Race format	55 mins + 1 lap (typically 190 km) sprint format	250, 300, 500 km or 500 miles endurance format (inc. driver changes)
Refuelling	No in-race refuelling in 'new DTM' since 2012	Gravity-fed race refuelling
DRS	Rearward uppermost element or moveable monoplane	None in Super GT

HIGH-VALUE MANUFACTURING TECHNOLOGIES THAT MAKE HISTORY IN MOTORSPORTS

Ph: Energica Ego Corsa testing bike
The FIM Enel MotoE™ World Cup Official testing bike

courtesy of
ENERGICA

FIM Enel MotoE™ World Cup
ENERGICA
SINGLE MANUFACTURER
MotoE

WINDFORM ADVANCED 3D PRINTING

Functional prototypes and end-use parts using Laser Sintering and Windform composite materials

HIGH PRECISION CNC MACHINING

Processing machined parts with high-tech metals, challenging geometries, tight tolerances

info@crp-usa.net | ww.crp-usa.net | phone: +1 704-660-0258

PUSHING HIGH-TECH INSIDE & OUTSIDE OF THE RACE TRACK

American craftsmanship and professional skills make CRP USA the choice partner for:

- **Advanced 3D printing** with Windform composite materials
- **High Precision CNC Machining**

Quality, reliability, innovative and customized solutions are our distinguished features.

CRP USA is partnered with the CRP Group, the Italian-based company dealing in the motorsports industry and other high-performance sectors for over 45 years.

CRP USA

WE ARE AT **PRI SHOW** WITH PRO-SYSTEM - **BOOTH 413, GREEN HALL**

be the only way to achieve the levels of degradation that are required to create overtaking opportunities through race strategy.

It is also said that power will increase by another 100 bhp. That will be impressive, and DTM won't particularly suffer from the change in engine note that comes with the turbo unit provided that the noise levels can remain high enough.

Performance potential is an important consideration for a series with such driver quality and where lap times used to be, until recently, between LMP2 and LMP1 and faster than F3.

Of course, little in the way of data exists on this point: although Super GT cars did run demonstration laps in Hockenheim last year, it was 'untimed'. Trying to extract some clues from relative differences at circuits with a common reference is one possibility.

- Using Hockenheim Qualifying laps in 2018, DTM pole time was 1m 32.2s and Formula 1 was 1m 11.2s (77%).

- Using Suzuka Qualifying laps in 2017, Super GT pole time was 1m 44.3s and Formula 1 was 1m 27.3s (84%).

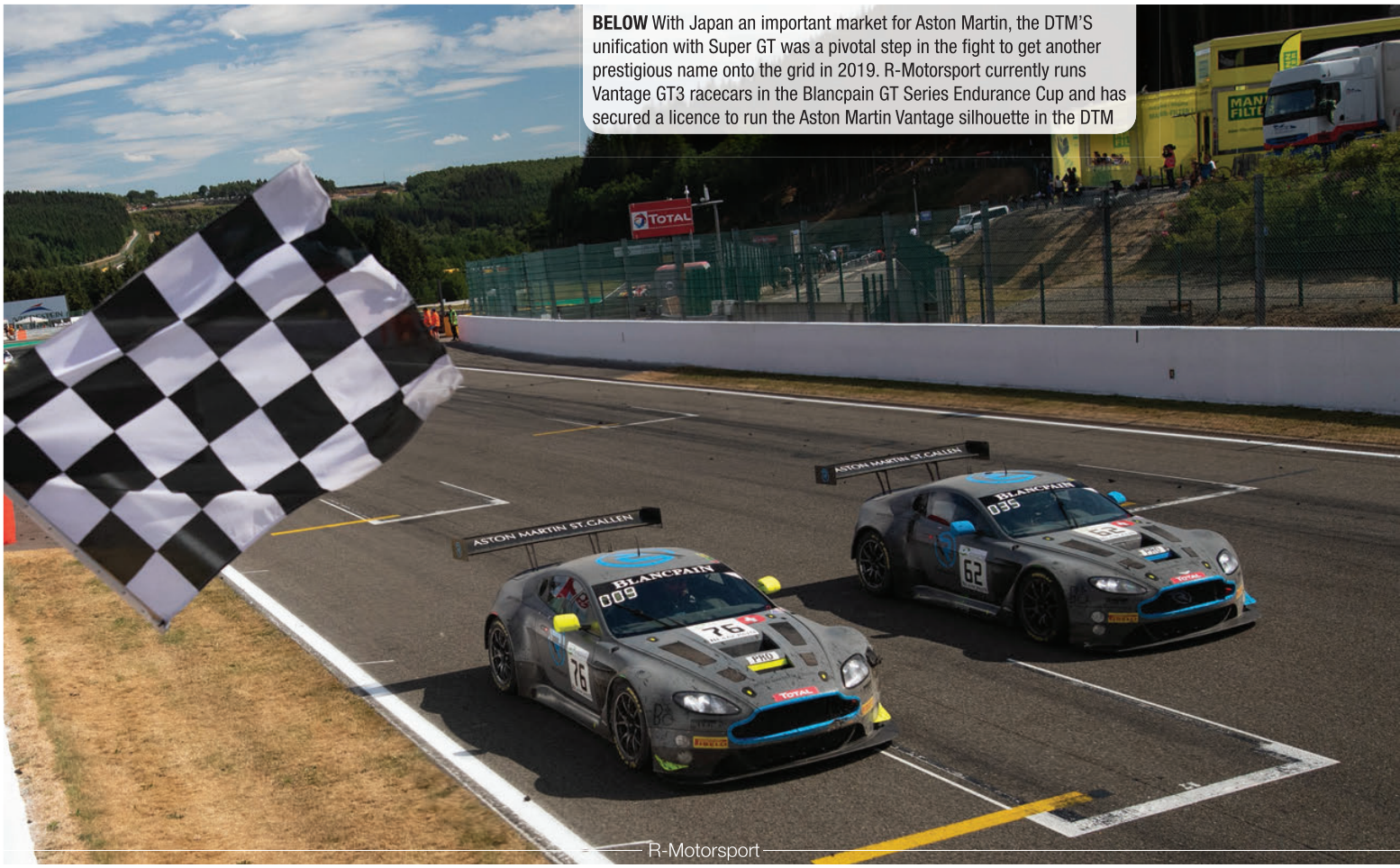
ABOVE The way ahead? The DTM/Super GT alliance builds on this early meeting of BMW, Audi and Mercedes with the Honda NSX-GT, Lexus LC500 and Nismo GT-R Super GT cars at Motegi in Japan last year

Continuing this comparison we can use 2018 F1 data from FP1 in Suzuka (when it was dry) and compare with the same session in 2017. The result is a 0.5s improvement, that means pole in 2018 had it been dry conditions would have been 1m 26.8s or 83% of a Super GT laptime. In Hockenheim the 2018 F1 pole time was 78% of the DTM pole time and so again the 5% difference.

It is interesting also to consider Stock Car Brasil as, if not a clone, certainly a none-too-distant relation of these two series.

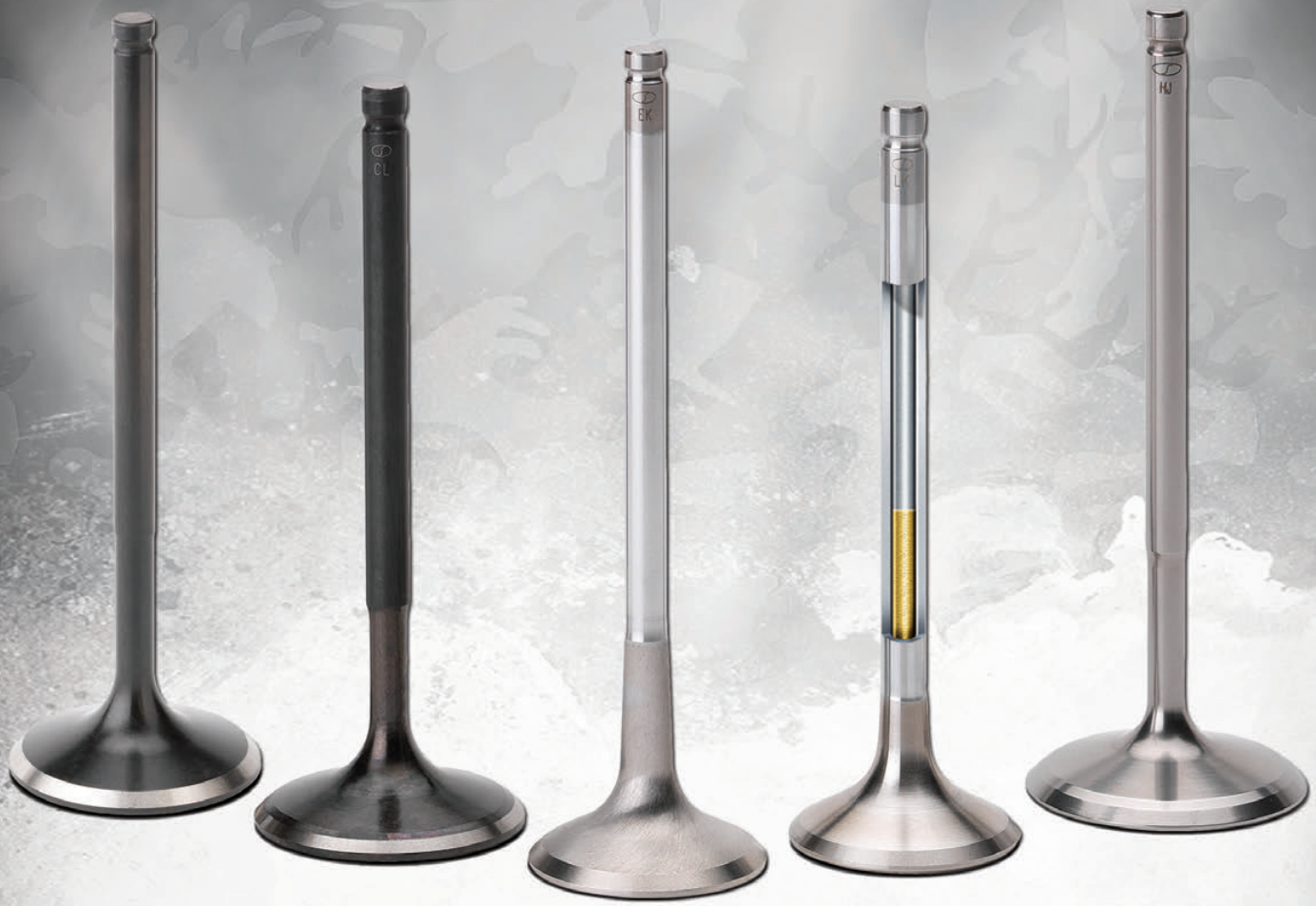
Stock Car Brasil, also known as Stock Car V8, is considered as the premier South American motorsport series. Without the financial muscle of the European or Japanese OEMs, costs are kept a notch lower. The main technology supplier to the series is JL Motorsport. JL's Chief Designer, Gustavo Lehto, has experience with Dallara products ▶

BELOW With Japan an important market for Aston Martin, the DTM'S unification with Super GT was a pivotal step in the fight to get another prestigious name onto the grid in 2019. R-Motorsport currently runs Vantage GT3 racecars in the Blancpain GT Series Endurance Cup and has secured a licence to run the Aston Martin Vantage silhouette in the DTM



R-Motorsport

SUPERTECH



CHOOSE YOUR

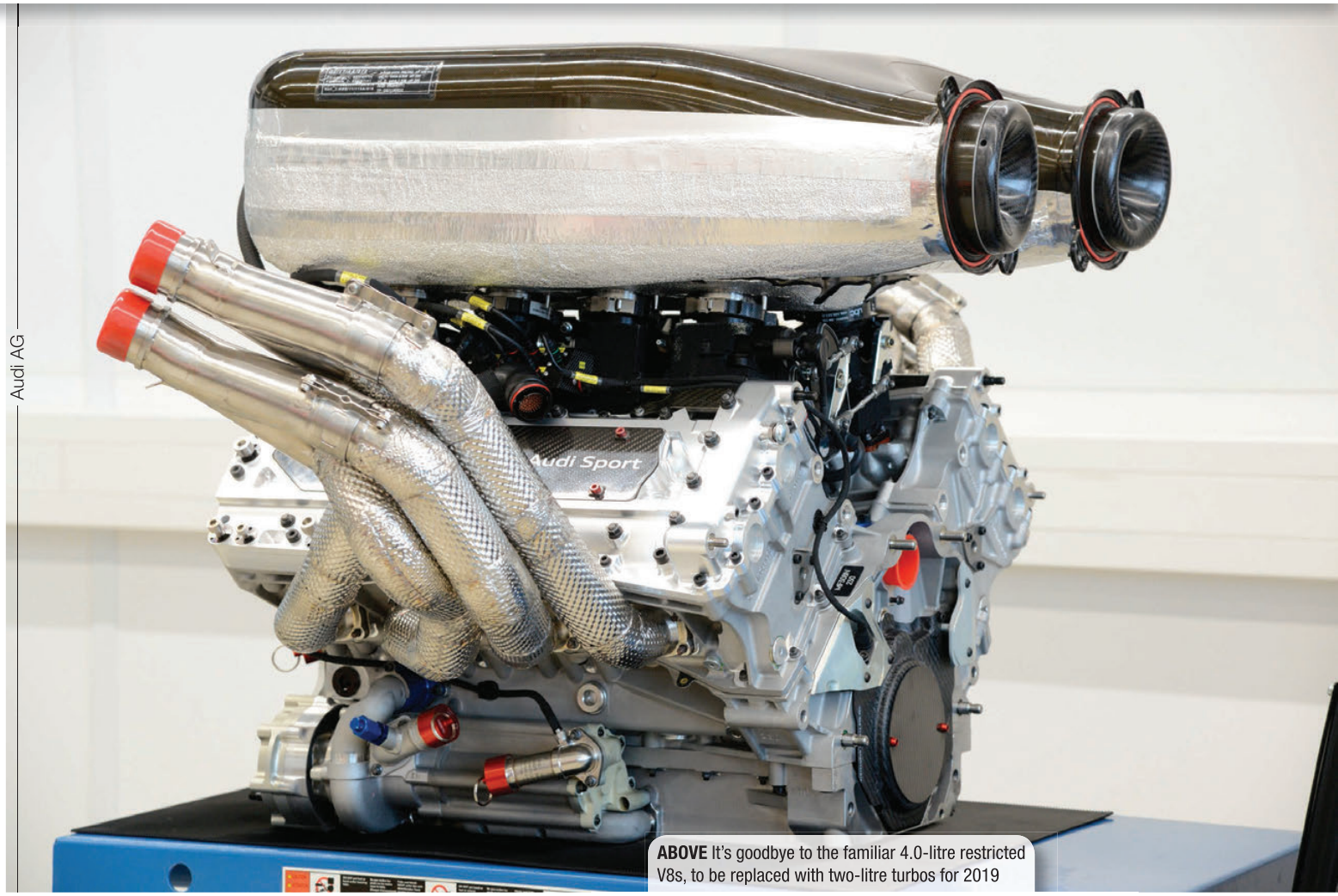
WEAPON

STREET PERFORMANCE / HIGH PERFORMANCE / INCONEL / SODIUM FILLED / TITANIUM VALVE

FUSING PERFORMANCE, DURABILITY, AND SUPERIOR CRAFTSMANSHIP THERE ISN'T A BETTER CHOICE FOR PERFORMANCE VALVE TRAIN COMPONENTS. CHOOSE YOUR WEAPON AND DESTROY THE COMPETITION.

WWW.SUPERTECHPERFORMANCE.COM

SUPERTECH



Audi AG

ABOVE It's goodbye to the familiar 4.0-litre restricted V8s, to be replaced with two-litre turbos for 2019

and, more distantly, several Audi DTM projects. "Because we are here in Brazil, the car needs to last forever," he notes. "It takes too long to ship parts from Europe all the time and costs too much. We don't care if the car is 50 kg overweight or not, and if the parts are bigger and tougher, they should last – we don't have to replace wishbones or similar things every three or four races."

The car lacks the carbon tub of the DTM or Super GT equivalents, using instead tubular steel and placing it in a somewhat historic (although fully recyclable!) world with NASCAR and XFinity in this respect.

Several car components are bought and imported. The bodywork is designed by JL Motorsport. First studies were carried out at extremely modest scale in a 25% scale wind tunnel but the main work was done on a track for cost reasons. JL apparently did a lot of straight-line testing, including wool tuft work on a development car at the Londrina circuit, 50 km from its facility in Sao Paolo. This was seen as a cheap way to get the results desired and to check, for example, if the cooling ducts all worked, an important aspect for Brazil! The design of the wetted surfaces is different for Chevrolet and Peugeot but the aerodynamic performance is claimed to be "almost identical".

All the cars have the same engine: a low-tech Dodge-based, 350 cu in V8, prepared by JL Motorsport.

The formula seems to work, creating a successful championship that at one point had 52 cars. Now there is a limit of 32, with the creation of a second championship where you must win in the second tier to compete in the first. Every season, two teams are relegated and two are promoted, in a format mirroring professional soccer.

Interestingly, there is also a GPS tracker in the car to prevent any testing or R&D events as a barrier to cost escalation. In a somewhat protectionist move, teams are only permitted to hire Brazilian engineers (although several nationalities of drivers do compete)!

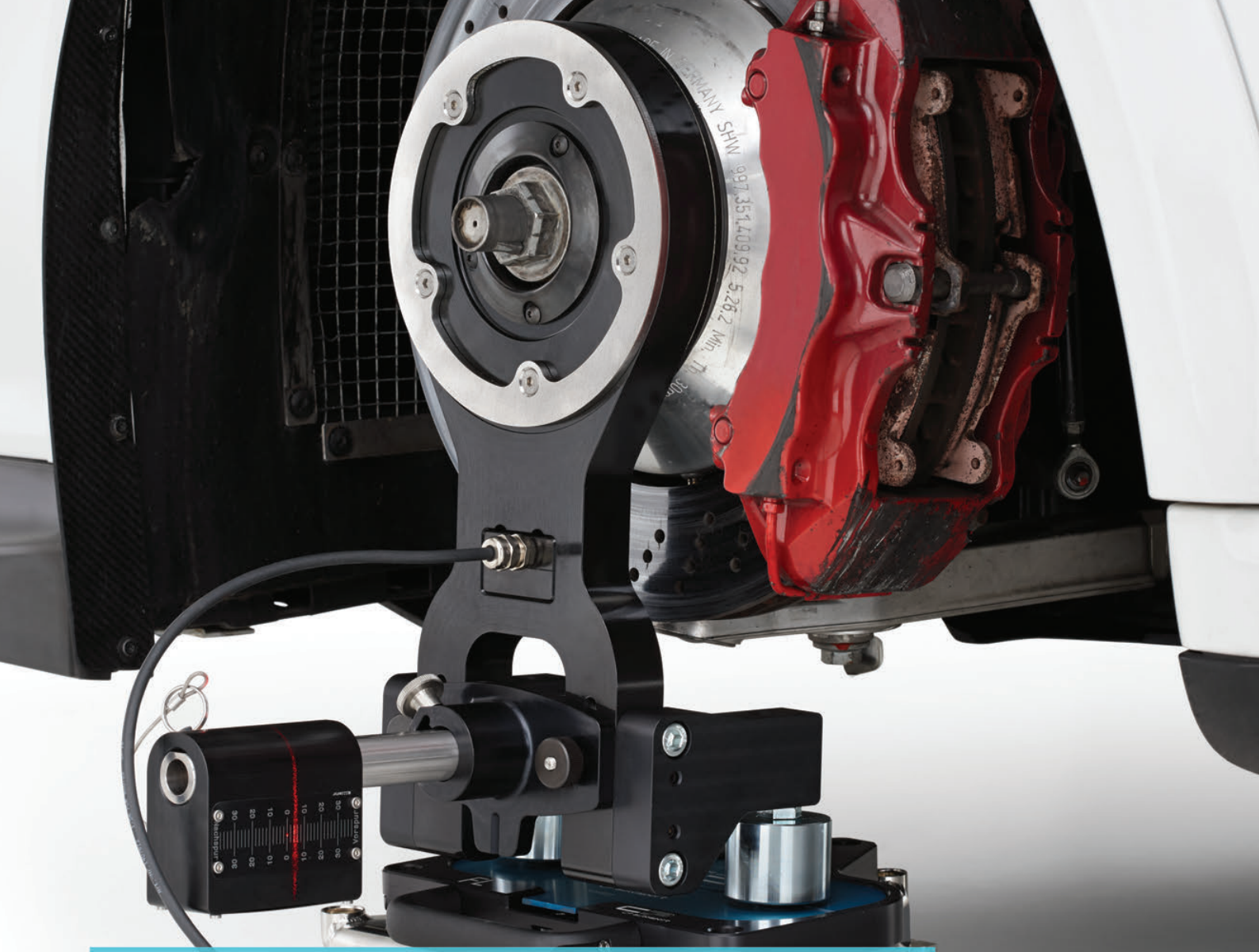
PRACTICAL CONSIDERATIONS

The potential and possibility for a series that can bring together these different branches is clear. There are issues that are clearly challenging for the DTM and its future partners, however.

Over the past two seasons there has been a quite dramatic war on costs. So much so that technological development has all but evaporated from the discipline, leaving only operational aspects at a high level but also under pressure. Cars have got slower, while recent bans on radio, the display of tyre pressure information and even the humble lap time delta – which has been removed from the dash in the hope that drivers won't try to manage pace or tyres using the data they provide – all seem rather knee-jerk and anachronistic 'tweaks' to the show without really studying or addressing issues of the interplay between business, engineering and sport which all together make up modern motor racing.

> *"A dramatic war on costs has seen technological development all but evaporate"*

The risk is of course that with the technological edge will go the engineering talent and that any series will no longer be able to lay claim to being truly world class. To quote Benjamin Franklin: "We are all born ignorant, but one must ▶



Prepare to win

Enter a new era of measurement technology

Racing is full of surprises. Your wheel alignment doesn't have to be one of them. Take control by choosing Setup Wizzard, the innovative vehicle measuring tool developed by motorsport specialist CP Tech (formerly known as CP autosport).

With Setup Wizzard, suspension measurement and adjustment are taken to a whole new level. Time is of the essence, not only on the track, but in every aspect of motorsports. Setup Wizzard is easy, precise and delivers results in just minutes.

SetupWizzard

a Nedschroef company

CP Tech
Dornierstraße 7
33142 Büren
Germany

Phone +49 2955 4849 500
Fax +49 2955 4849 950
Email info@cp-tech.com
Website cp-tech.com

Stock Car Brasil

ABOVE The success of Stock Car Brasil, a none-too-distant relation of Super GT and DTM, could raise the intriguing possibility of a three-way alignment

work hard to remain stupid." In the context of containing technological development within Technical Regulations ("unlearning"), this is never truer!

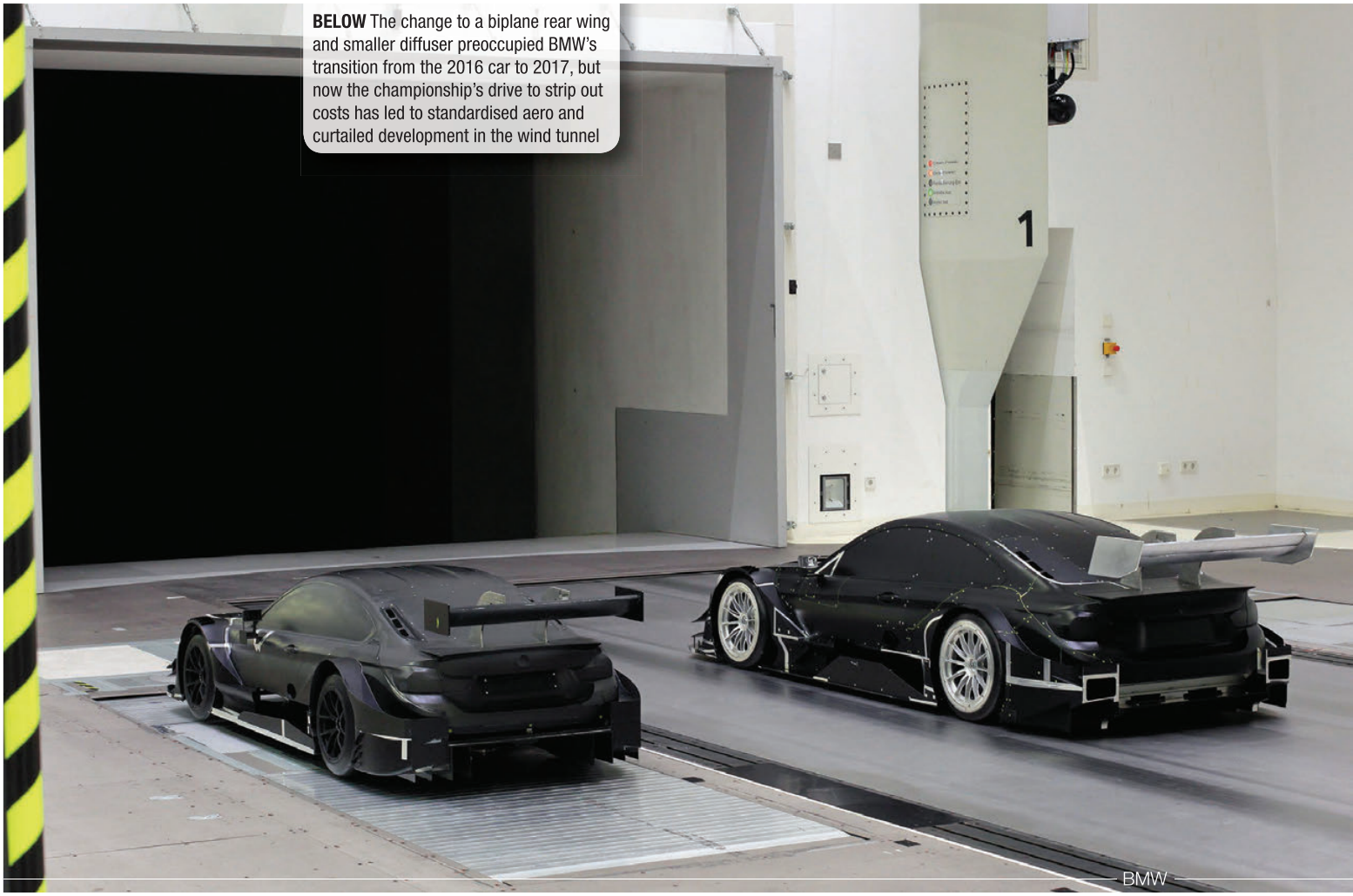
One of the drivers for cost reduction is obviously to maintain participation levels. Recent talk has even mentioned a minimum grid of just 16 cars, so this is a harsh reality. From 2006-2011 only Mercedes and Audi kept the DTM faith and this time around it could be Audi and BMW, but it's not an attractive prospect to have so few cars.

The recent revelation that a new protagonist will join the series in the shape of Aston Martin is a huge boost and certainly takes some of the pressure off the hunt to find another manufacturer. Tellingly, the opportunity to showcase products in Japan was cited as one of the major attractions for the venture.

On the other side of the coin, the series must also pursue the idea that privateers might wish to come in and run cars, as Belgium's WRT will do with Audis in 2019. After all, it should be possible with the right level of support, but one has to ask how the attraction is greater than, for example, GT3 which offers variety and only a few percent less performance now. Drivers have, in the recent past, graduated through DTM to F1, but the Super Licence system does not weight it as heavily as single-seater activity and without a manufacturer with an obvious connection to the top of the single-seater tree, it does seem rather less appealing for those on the way up in their career.

CHALLENGES

These issues aside, it is worth remembering the history of the current DTM which emerged from at least some of the legacy of the ITC of the mid-nineties. This championship styled itself as a clear 'F1 with a roof', both technologically and with the ▶



BMW

BELOW The change to a biplane rear wing and smaller diffuser preoccupied BMW's transition from the 2016 car to 2017, but now the championship's drive to strip out costs has led to standardised aero and curtailed development in the wind tunnel

Audi AG

BELOW Audi has become the first manufacturer to present a customer team for the new era of the DTM. Next season WRT, known for its GT exploits and, recently, WTCR entry (below),will run two new Audi RS 5 DTM cars

drivers it attracted and events that it held.

We should also note that DTM is not alone in aiming for a global touring car platform. WTCR is also offering races in this space, albeit with a lower level of technology and a slightly more family orientated vehicle segment. It has to be asked if there is room for both and also the successful domestic series such as BTCC (which lacks true manufacturer involvement but recently announced it will adopt hybrid powertrains in 2020).

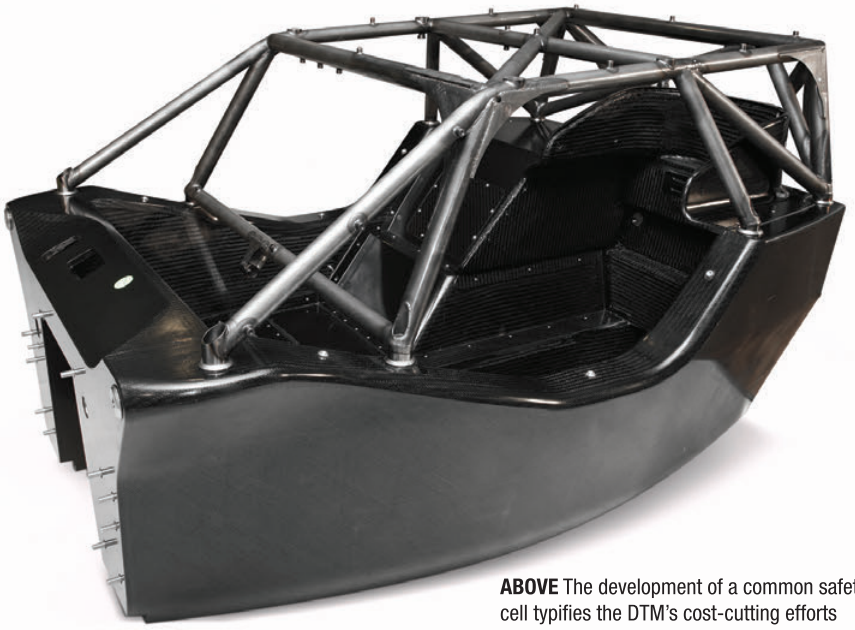
David Coulthard, with experience of DTM himself, offered an interesting insight on the potential popularity in the UK. "I've always thought it was a shame [the DTM] hasn't had more of a foothold in the UK," he said. "Many drivers in the DTM are serving F1 teams [as test or simulator drivers] or have raced with F1 teams. That tells you everything you need to know about the standard of driving.

"It just needs that promotion. People need to know about it; it needs to be accessible. Not many fans [from the UK] will go over to watch Hockenheim, to watch DTM instead of going to Spa to watch F1.

"With the greatest respect to World Touring Cars [WTCR], those drivers would enjoy driving DTM because it's faster. Anything faster and with more performance is more fun."

So, is it a simple task to reimagine and reinvigorate the championship? Surely not, as the points raised above have demonstrated. The start of 2019 will be a very important time for the future of top-level touring car racing.

- The author wishes to thank Thomas Leroy for extensive research and input for this article.



ABOVE The development of a common safety cell typifies the DTM's cost-cutting efforts

EPARTRADE.com

The Global Platform for the Performance and Racing Industry

JOIN FOR FREE! SIGN UP NOW!

Connecting Manufacturers and Buyers Worldwide, 24/7.

ONE CLICK AWAY

The SmartSourcing Revolution:
14,000+ racing organizations at your fingertips!
www.epartrade.com

WHY OUR HEADS ARE IN THE CLOUD!

Photos by Boyd

ABOVE An experimental programme has confirmed that simulation can improve Dirt Late Model performance

How and when will top-tier simulation tools filter down to mid-tier professional series and even through to grassroots-level? **William Kimberley** says a forthcoming cloud-based simulation suite offers a few clues

As competition in mid-tier professional race series continues to increase, pursuit of the next performance improvement gets even more fierce. While physical track testing is undeniably one of the most valuable methods to increase the performance of a racing programme, relying entirely on physical testing is inefficient from both a time and money perspective.

On top of the cost of fuel, tyres, track preparation, and the associated wear and tear on components, experimental uncertainty due to ever-changing conditions can disguise or at times even mislead teams on perceived performance gains. Physical testing strategies such as returning to a baseline setup multiple times throughout a test can quantify some of the experimental noise in the test results but changes in ambient temperature, wind, driver adaptation, tyre wear, tyre temperature, and other factors are often nearly impossible to quantify.

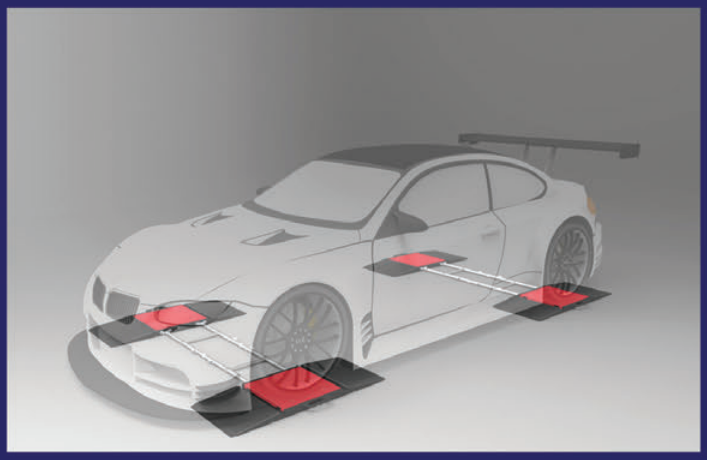
Many of the factors that create this uncertainty (or noise) during a physical test can be all but eliminated in simulation. Thus, simulation plays a pivotal role in efficient utilisation of physical track test time. Simulations in Formula 1, NASCAR, the World Rally Championship, and IndyCar have been used to complement physical testing and increase team performance for decades.

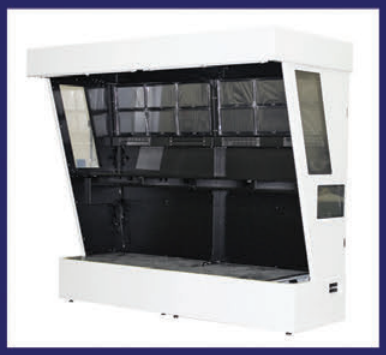
Quasi-static simulations are one type of simulation that fall into this category. They can be used to predict body attitude, suspension alignment, internal component and tyre loading under a prescribed vehicle speed and acceleration state. This type of simulation has been a staple to teams in all top tier professional series over the years.

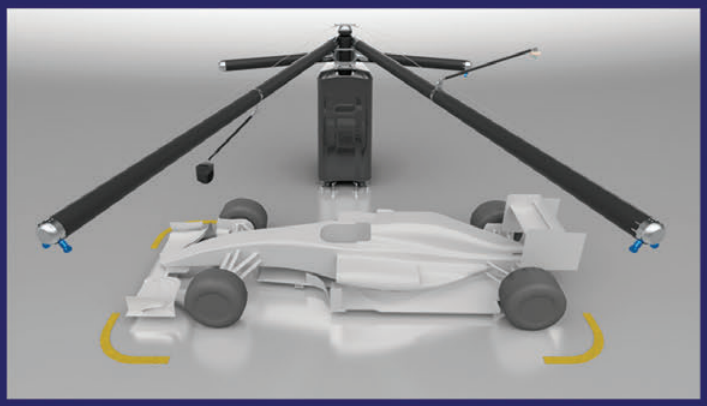
> *"The first 80% of what a Dirt Late Model team needs to make their cars faster"*

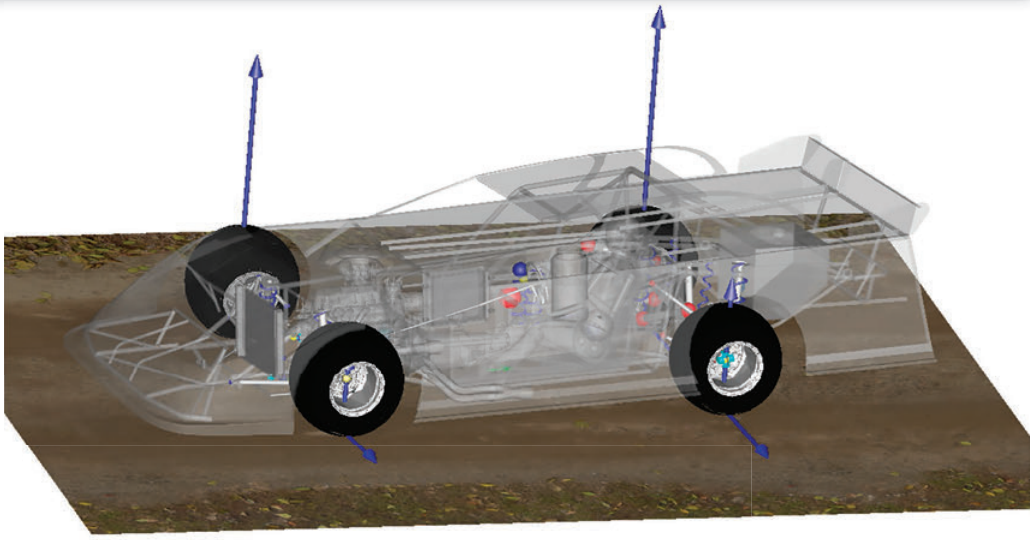
Quasi-static simulations can be used to study many things related to Dirt Late Model racing. For example, an initial setup versus a planned setup at an identical acceleration state can predict expected ride height, axle steer, and tyre loading differences. Pre-simulating changes prior to a physical track test will allow the team to confidently hit their ride height targets and other on-track targets without having to make multiple runs and re-tune their cars. The results of these simulations not only help utilise track time efficiently, they play a crucial role in calibrating one's intuitive understanding of vehicle behaviour.

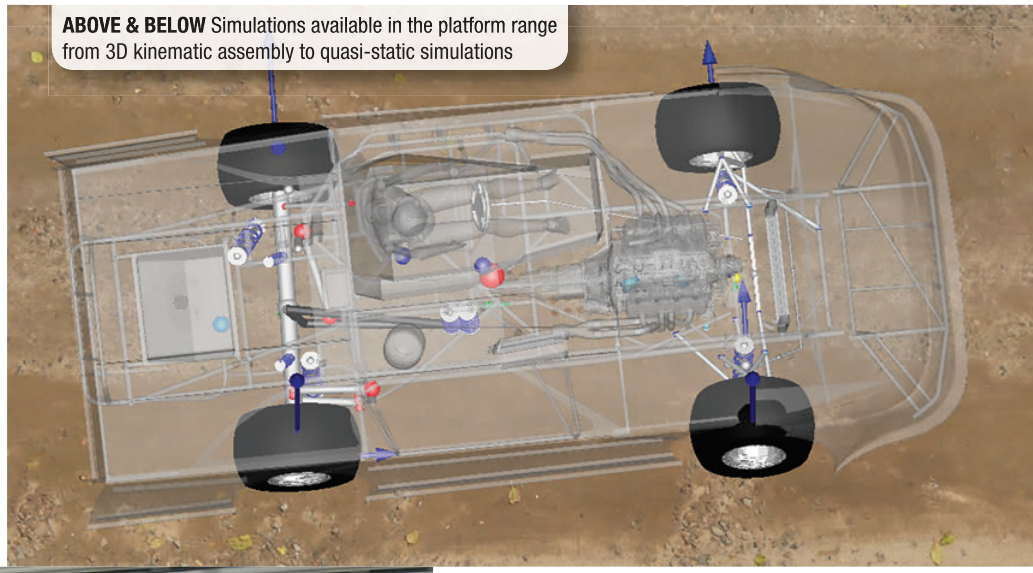
Another quasi-static use-case would be to analyse the impact of laptime falloff on vehicle handling. Dirt Late Models commonly encounter three seconds of laptime change (18-second total laptime) throughout the course of an event. Such a large laptime change has an appreciable impact on vehicle handling and overall performance. Dirt Late ▶











ABOVE & BELOW Simulations available in the platform range from 3D kinematic assembly to quasi-static simulations

Model teams need to be able to adjust their cars to maintain peak performance across this range of laptime. If a team expects two seconds of laptime fall-off for the feature race, this type of simulation can help them determine the changes necessary to achieve their desired targets.

There is little question that professional-level simulation tools can be utilised to help make Dirt Late Models faster. The real question is how and when they will make their way to these mid-tier professional series. As more and better tools become available to these levels of racing, how valuable and integral will these simulations become? It will be interesting to see what the next years will hold in terms of even grassroots-level racing simulations.

A year ago, a case study was presented in this PRI issue of Race Tech reporting on an exploration of the usefulness of simulation to a few Late Model Dirt racing teams. The level of utility found in those simulations

> *"Playing a crucial role in calibrating our intuitive understanding of vehicle behaviour"*

brought up even more questions which led to further development of the Dirt Late Model simulation package.

Based on feedback from this case study and Claytex's extensive motorsports experience, construction of a web-based setup management and simulation platform for Dirt Late Model racers has commenced. The first version of this tool will soon be available at www.myracesims.com. The cloud-based simulation suite will allow simulations to be run in the cloud and the results overlaid in a web browser. The subscription-based simulation platform has a database back end which allows you to create and store events, parts and setups, as well as run simulations and analyze results.

This tool is similar in architecture to those that racing personnel at the top tier racing series use to document builds and run simulations day in and day out. The simulations available in the platform range from 3D kinematic assembly to quasi-static simulations and cover the first 80% of what a Dirt Late Model team needs to make their cars faster. RT

Photos by Boyd

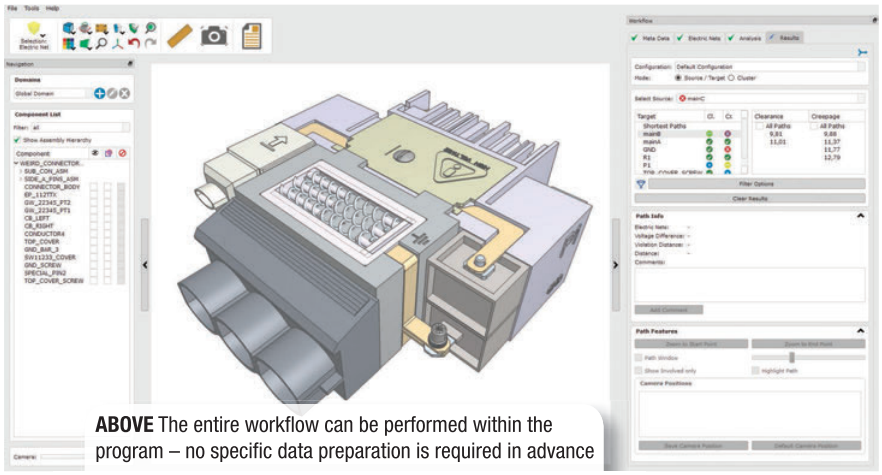
ABOVE Feedback from the Dirt Late Model case study, allied to Claytex's extensive racing experience, underpins the development of a new subscription-based simulation platform

A CURRENT CONCERN

Motorsport needs parts to be made ever more compactly, but, as **Alan Stoddart** discovers, this can cause problems when electricity is involved

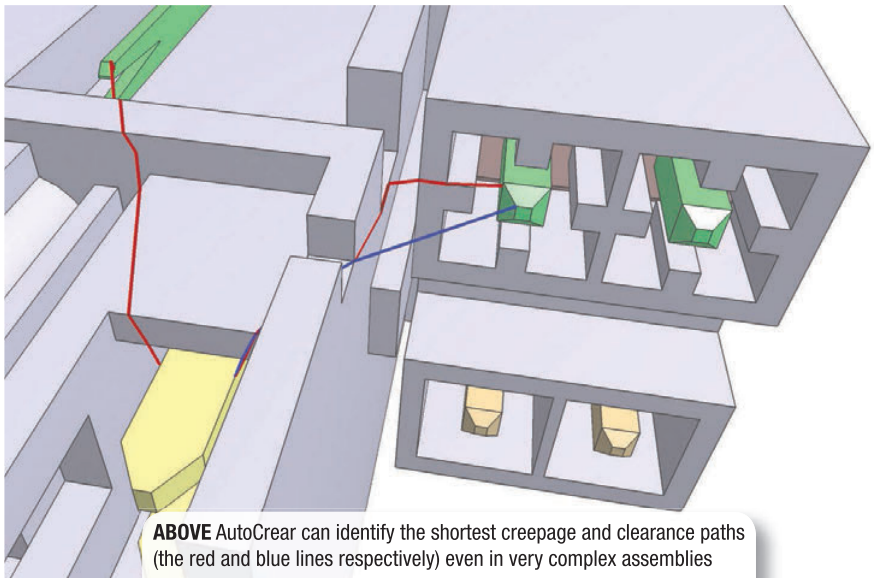
ONE of motorsport's biggest developments, which for various practical, political and commercial reasons is growing in importance and gaining momentum each new season, is increased electrification and hybridisation. Along with the obvious candidates like Formula E, Formula 1 and LMP1, this electrification and hybridisation is trickling down into other series like WRX and the BTCC, while yet more still are considering the switch, with even stalwarts such as Australian Supercars weighing the move.

The ability of racing car makers to electrify their cars, is somewhat at odds with another of their eternal considerations however; packaging.



ABOVE The entire workflow can be performed within the program – no specific data preparation is required in advance

Electric and hybridisation systems in cars often utilise high voltages. The Porsche 919 Hybrid for example uses an 800 volt system to rapidly charge and discharge at very high power levels, bringing benefits to rapid regeneration and deployment. This however causes problems when designers are trying to make components as small as possible, because at any given voltage a specified gap is necessary to ensure the current only flows where it is designed to, and at higher voltages these distances increase. The real difficulty though comes when trying to measure the gap between different electrical nets deep inside complex assemblies and components, which is where e-laborate's AutoCrear software can help.



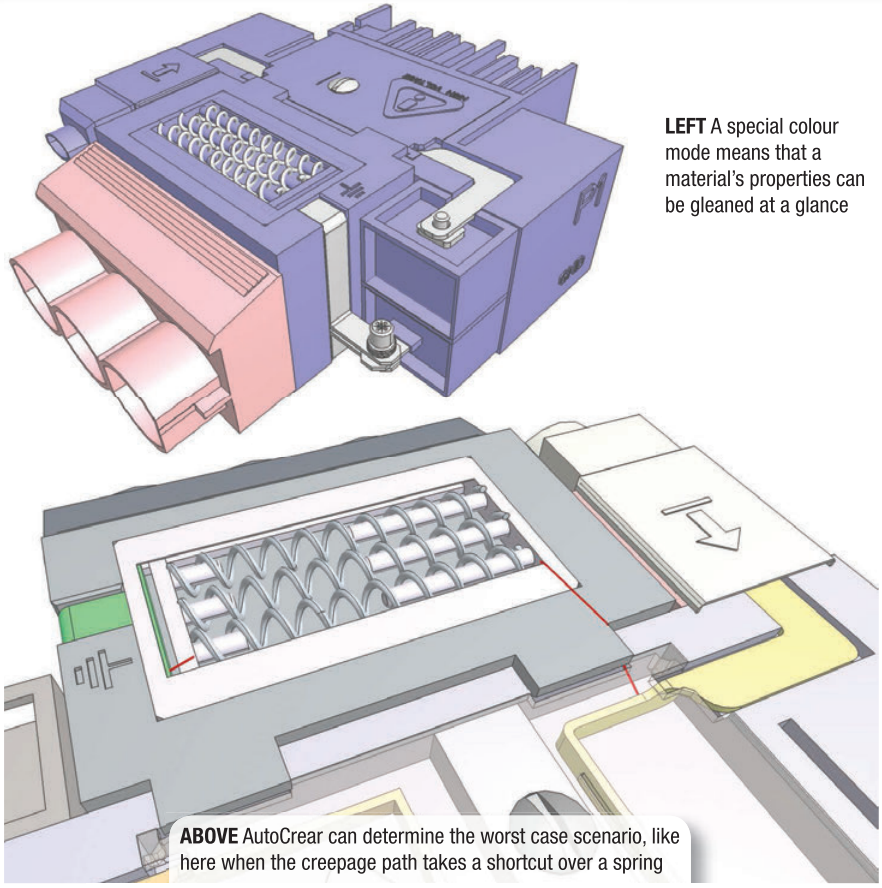
ABOVE AutoCrear can identify the shortest creepage and clearance paths (the red and blue lines respectively) even in very complex assemblies

"Suppose you are designing an electric assembly," suggests e-laborate's founder and chief executive Dr. Michael Martinek, "and assume you have two electric nets with a voltage difference of 800 volts. An industry table might tell you that you need to fulfil 12 mm of creepage, but without a tool working out the shortest creepage or clearance path, this is a big question.

"It might be somewhere deep within the assembly so there is no chance you can guess the exact paths, all you could do is just apply the rule of thumb, but you'll never get the exact path.

"This means that what you'd end up doing is you'd build things further away from each other than necessary. You could build them more closely but you are not sure whether this is a violation or not, and you'd better be safe, so you build more space between them. But this is a problem when you are trying to make your components as compactly as possible, and this is where our software helps a lot."

The necessary sizes of these gaps designed into electric assemblies are governed by industry standards, in the form of minimum creepage and clearance distances. The size of the gaps needed for any particular voltage vary because of both different kinds of materials, which exhibit different insulating properties, but also because of environmental factors. Volkswagen's I.D. R Pikes Peak challenger for example would need to adhere to a different set of specifications if it was designed to race around Daytona International Speedway, because the tolerances above 2,000 m are different than they are at sea level. Similarly, levels of pollutants in the air (in this sense dust or ▶



LEFT A special colour mode means that a material's properties can be gleaned at a glance

ABOVE AutoCrear can determine the worst case scenario, like here when the creepage path takes a shortcut over a spring

sand, rather than chemical pollutants) also affect conductivity, so a hybrid Rally Raid car might have to adhere to different tolerances compared with a hybrid BTCC challenger.

These necessary gaps, for creepage, which is current travelling along the surface of an insulator, as well as clearance, which is the airspace required between two points to stop the current jumping, can all be inputted into the software. So when an engineer loads a CAD model from SolidWorks, CATIA or a number of other common programs, it is easy to check whether a component is suitable for a particular environment, or indeed, adheres to different countries' standards.

AutoCrear also enables the analysis to take into account shortcuts over potential-free nets. A component or assembly might work perfectly in isolation but conductive mounting bracketry or other hardware such as screws could enable the current to travel further than anticipated because travel through a conductive element is 'free', and does not count towards the total creepage or clearance distance.

This also hints at another of the software's ingenious abilities, which Martinek says is very easy to overlook when trying to measure these gaps manually. "So with a metal spring, for example," Martinek explains, "current can go through the springs to make the shortest path between two nets.

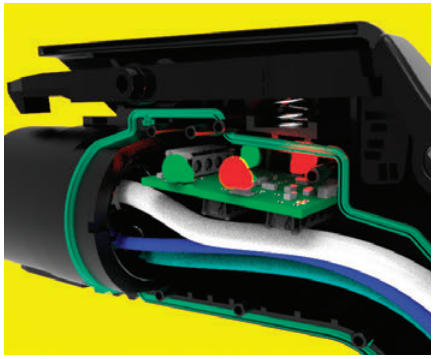
WORST CASE SCENARIO

"However, consider that the spring has a degree of freedom along its main rotational axis. So although it is modelled in one certain position it can be arbitrarily rotated around that axis. To account for this, the software replaces the spring with a shape which simultaneously represents all possible positions the spring can take along its degree of freedom.

"This makes the analysis much more robust, and far safer, because you are effectively doing an analysis of the worst case scenario. If you just did the computation with one specific position of the spring, the path might be longer than the worst case scenario, which could be dangerous."

The software was originally created when one of Germany's biggest engineering companies approached Erlangen University, where Martinek was researching, asking for a tool that would be able to calculate these creepage and clearance distances. This industrial history is one of the reasons that AutoCrear has a number of features that facilitate efficient workflow built in. One of these is the ability for engineers working in different offices or on different shifts being able to work collaboratively. By using the same file, different individual users are able to make amendments, and query and comment on parts of the analysis under their own name, so when another engineer opens the file she can respond or suggest changes for example.

Another of the important aspects is the reporting of the analysis, so for a company which provides electric systems for external customers, like McLaren Applied Technologies or Bosch, it could use AutoCrear to conduct the analysis, and then use the software to automatically generate a report, which highlights and illustrates any infractions, as well as including all comments and queries added by engineers, so the customer can see it has been properly tested. What's more, a company can also save the AutoCrear analysis, which can then be opened using a free, read-only version of the software, so other parties can see the violations in the CAD model and make necessary design changes, without requiring the full AutoCrear package themselves.

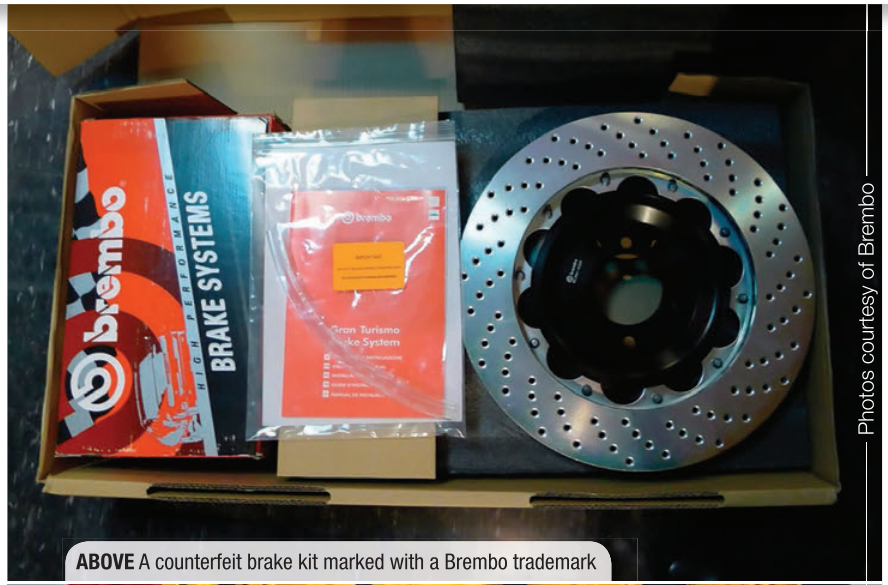


ABOVE An EV Charger Plug, which TE Connectivity investigates with AutoCrear. Sensitive circuit board parts (low voltage) are up very close to HV AC delivery lines

Martinek says that all this brings around four main benefits. "Firstly you save a lot of time compared to doing manual measurements, which could take days or weeks. Then you have greater safety because you have the guarantee that you don't miss any safety violations. This of course saves you money, because if you were to miss a violation, then at a later stage such as prototype, or worse still if it was already in use by a customer, really bad things can happen – the assembly could be destroyed or an entire car could catch fire because of a single violation.

"Finally, AutoCrear offers the possibility of building as compactly as possibly, because you can build parts as close together as possible without violating the necessary clearance and creepage distances thanks to having an accurate analysis, instead of erring on the safe side and building it bigger as you might have done previously.

"Basically, you can find the perfect compromise between compactness and safety." RT



Photos courtesy of Brembo

ABOVE A counterfeit brake kit marked with a Brembo trademark

ABOVE Counterfeit brake callipers produced in Hong Kong

FAKE NEWS!

Fake goods are increasingly a problem in motorsport, so what can be done? **Alex Bone** and **Stuart Greenwood**, Patent Attorneys for intellectual property law firm AA Thornton, offer their advice on how to counter the counterfeiters

WHEN you think of counterfeit products, you think primarily of the luxury goods market: fake "Gucci" handbags and cheap "Rolex" watches – the value of an otherwise average product significantly increased by mimicking the style and look, if not the quality, of a prestigious brand. Counterfeits are still a significant issue for that sector, but advances in manufacturing technology mean the problem of fakes is now impacting the motorsport industry.

PUTTING THE BRAKES ON

The motorsport segment of the automotive market includes a lot of high value components and prestigious manufacturers and this has proved too tempting for counterfeiters. Many of those high value components are safety-critical and, although the counterfeit products might look like the real thing on the outside, they will often be of lower quality materials and are very unlikely to have been made and tested to the same standards.

The UK Government has recognised that counterfeiting in the automotive, and motorsport, sector is an increasing problem. In February this year it released guidance to the public about how to spot, and avoid using, counterfeit parts. This guidance can be found at: *https://www.gov.uk/government/publications/counterfeit-vehicle-parts/counterfeit-vehicle-parts.*

This advice was compiled by bringing together a range of key players, including major automotive manufacturers and suppliers, the Motor Sport Association UK (MSA) and the International Automobile Federation (FIA).

A MATTER OF LIFE OR DEATH

The potentially deadly consequences of this counterfeit trade are perhaps best demonstrated by a test conducted for Carmarthenshire Trading Standards. They tested some counterfeit race harnesses bearing the Sabelt, Sparco and Takata brand names which were amongst a range of car accessories and clothing being sold on eBay and Facebook. In one of the tests the waist restraints failed at just 50 mph and the test dummy was thrown forward from the seat, only to be caught around the neck by the shoulder restraints. A video of one of the tests can be found at: *https://vimeo.com/142522011.*

Many manufacturers, for example Brembo, OMP, Sabelt and Harwin, include information on their websites providing details of how to avoid counterfeits. However, there is a danger of putting too much information in the public domain regarding features that the counterfeiters are getting wrong, as it can simply help them to make a better fake.

Harwin, a manufacturer of electronic components which find use in many sectors, including motorsport, has indicated that its customers should focus on ensuring the security of their supply chain. Harwin mentions that its products are too small to mark in any meaningful way, but that its packaging does include the company logo. However, it goes on to say that such markings can be easily copied, so security of supply chain is crucial.

WHAT IS BEING DONE?

Manufacturers are already putting information into the public domain about how buyers can protect themselves from buying or using counterfeit products, so a buyer can potentially avoid counterfeits by ensuring a trustworthy supply chain, using common sense and using


Ebrey/LAT

ABOVE When things go wrong, you want to know that your safety equipment is genuine!

the guidance from the manufacturer. If a deal looks too good to be true, or the presentation is not as expected, then it should be a warning.

But what can manufacturers do to help protect their customers from being exposed to counterfeits in the first place?

Stopping counterfeit products from making their way onto the market can be tricky. You can try to stop the manufacture at source, or you can stop the manufactured products from making it to the market. Both approaches can be very successful at preventing unauthorised products from reaching the market.

WHAT RIGHTS ARE THE RIGHT RIGHTS?

In order to stop a third party manufacturer, importer or vendor, an originator must possess and enforce one or more rights against the third party. The rights that a manufacturer could have in a product are referred to as Intellectual Property (IP) rights and these include trade marks, designs (registered and unregistered), patents, copyright and trade secrets. These rights are territorial, so the most effective approach will depend upon the country in which the manufacture is happening, where the products are being sold and the rights owned.

Any company involved in the creation of new motorsport products will almost certainly have the potential to own all of these types of IP. The company name, product brands, tag line and any logos can all be protected by trade mark registrations. The aesthetic appearance of any product or component that will be visible in use, and whose appearance is not dictated solely by technical function, can be protected by a registered design. Examples of potential registered designs include race helmets, wheel designs and instrument clusters.

The innovative technical aspects of products can be protected by patents provided that those aspects satisfy certain requirements. Examples of potentially patentable innovations include new brake calliper designs, electronic engine management systems, fire suppression compositions and hybrid/electric drive systems. Even new manufacturing processes can be protected.

If products are being imported into a territory, border controls can act to stop infringing products from entering. Border controls will take action if they spot infringing products, but in order to assist the border force, an application for action (AFA) can be filed which identifies particular IP rights and provides details of how border officials can identify infringing products. The rights that can be registered with border controls can vary between territories, but in the UK it is possible to register any IP right with Her Majesty's Revenue and Customs (HMRC). An updated process for filing an AFA was provided by the UKIPO in October 2018: *https://www.gov.uk/government/publications/notice-34-intellectual-property-rights/notice-34-intellectual-property-rights.*

The guidance sets out what information should be provided and also the undertakings that might have to be provided. These can include accepting liability towards the goods owner should the goods be found not to infringe and agreeing to pay some of HMRC's costs in taking action.

This process lends itself most readily to preventing products which use an unauthorised trade mark, as determining whether a particular product bears a trade mark which is the same as (or confusingly similar to) a registered mark should be fairly straightforward, based on detailed guidance provided by the right owner. The process also works reasonably well for registered designs.

NO-ENTRY

Once HMRC identifies suspect products it will detain them at the port of entry and notify the product owner and rights holder. The parties will be given 10 working days to respond to the seizure. The rights holder can inspect the goods, request their destruction, initiate court proceedings, or allow them to be released. Further details are provided in the guidance referenced above.

Using the border force can prevent infringing goods from entering a territory and provide additional information to rights holders. Preventing goods from entering a territory requires an IP right in that territory, but ultimately the goal is likely to be to prevent the goods from being manufactured in the first place. In order to do this, court action must be taken to obtain an injunction against the manufacturer. This requires the rights holder to have rights covering the product in the country in which the goods are being manufactured.

WINNING THE RACE

Although motorsport is a highly technical contest, and innovative solutions to problems are found quite frequently, patent litigation is quite rare. For pure racing innovations (for example bodywork on a Formula 1 car) this is most likely due to the fact that regulations can be changed to avoid one team exploiting a monopoly for a particular solution for too long. Also, obtaining patent rights is not an instant process so the technology may have moved on before the patent can be granted.

However, for commercially exploitable innovations, patents can be a useful commercial tool for protecting investment in innovation as those IP rights can be used to prevent unauthorised use of a technology by a third party. A third party making unauthorised use of a patented innovation may be less likely to be producing a product of dubious quality than one making unauthorised use of a trade mark, but they are still gaining a commercial advantage to which they are not entitled.

The most relevant patent infringement example in the motorsport arena is probably the litigation between Alcon and AP Racing in relation to callipers for disc brakes. In the first of two actions AP Racing was awarded damages in the region of £500,000 as a result of infringement by Alcon.

For engineers in the fast-moving world of motorsport, legal protection of the products they create may not seem as important as striving to gain that edge in performance through new and improved products. However, the protection of those products is not only a commercially sensible way to profit from all that R&D effort, but the rights obtained also help to protect customers from unscrupulous third parties selling products of a dubious, and sometimes simply dangerous, quality.

The prestige of a brand takes years to build up and can be eroded instantly by a counterfeit product. Intellectual property rights are there to help the genuine manufacturers stay ahead and leave the counterfeiters trailing behind.

- If you would like further detail on any of the above, or would like to discuss IP developments in the automotive world, you can contact Alex or Stuart via *www.aathornton.com*

Getty Images/Red Bull

ABOVE PWR's F1 involvement has propelled the company to new heights

COOL CUSTOMERS

Formula 1 suppliers are driven hard by their customers, but if they get it right, the technology spin-offs they benefit from are huge. **William Kimberley** talks to Kees Weel, co-founder and managing director of PWR Performance Products

WHILE it may not have a large domestic market, Australia is home to a number of incredibly high-tech companies that have become dominant in the motorsport sector. Once such is PWR Performance Products that has become the industry leader in high-performance aluminium radiators, intercoolers and oil coolers. It supplies products to teams in Formula 1, NASCAR, V8 Supercars, Deutsche Tourenwagen Masters and the World Rally Championship amongst others.

Its start in 1987 was in modest surroundings with PWR co-owner Kees Weel manufacturing automotive radiators in a small factory on Queensland's Gold Coast in Australia. With demand for his radiators growing, he formed the K&J Thermal Products company. Within 10 years it had grown to be the leading manufacturer and supplier of automotive cooling products in the country, employing over 120 staff with offices in every major city and region of Australia.

In 1996, Kees with his son Paul Weel saw an opportunity to invest in a new segment of the automotive cooling market. The demand for high quality, lightweight, performance aluminium cooling products was growing and Paul Weel Radiators, better known today as PWR Performance Products, was created to fulfill this need. The market was ready for a product that was measured by its performance, backed up by a flexible manufacturing facility capable of designing and adapting configurations of coolers to custom specifications.

Its manufacturing facility in Australia today includes a controlled atmosphere brazing furnace, 16 CNC machines with four running 24 hours a day, an R&D and design department and large fabrication capabilities.

ABOVE Kees Weel, co-founder and MD, is looking to the future

In 2012, a full-size wind tunnel testing facility was also commissioned. Measuring 30 metres long by two metres wide, virtually all cooling systems – from water radiators, to engine oil coolers, to transmission oil coolers, to intercoolers and more – can be tested in a real-world environment.

"Every step of the manufacturing process is done in-house," says Kees Weel. "We braze all our own cores and carry out our own fabrication. As far as I'm aware, we are the only dedicated competition radiator manufacturer that produces all aspects of our own heat exchangers, from core manufacture right through to complete assembly fabrication. This gives us flexibility of design while maintaining quick turnaround to our customers all over the world."

The company has also recently spent close on Aus $10 million for a capital expenditure of new CNC machines with CT scanner, laser cutter and a couple of 3D printers. "The expansion of all this future technology is very important to us. We want to keep in front of the curve and protect our business," says Weel.

In March 2015, PWR acquired US-based C&R to expand its footprint strategically and gain further traction in the US market. Founded by Chris Paulsen in 1988, C&R is a widely known cooling products manufacturer and fabrication business that services the US race markets including NASCAR, IndyCar, NHRA drag racing and IMSA sports cars. It also supplies products to niche automotive OEMs and military markets.

PWR has expanded production capability at the C&R Indianapolis factory. It has made significant investments in the development of next-generation cooling technology and in the capability of its engineering and production people and plant with five CNC machines. In August 2017, it also installed a new aluminium heat exchanger core production line, increasing the production capability in Indianapolis to deliver Original Equipment Manufacturer (OEM) programmes.

"C&R Racing is now a very well-equipped plant with CNC machining availability along with fabrication and welding," says Weel, "so it's capable of manufacturing full custom radiators as well as getting into the niche OEM programme runs. We also back that up with all our engineering and technology from Australia so that the wheel doesn't have to be reinvented each time.

"We have over 24 engineers in Australia and six or seven in the US amongst a

ABOVE The full-size wind tunnel at PWR's Australian facility has added an important extra dimension to its testing

workforce of around 250 between Australia and the US. That includes five people in an office and warehouse in Europe, which is going to increase with some further engineering capacity."

While PWR's roots are in motorsport, it was an approach from Pat Symonds, then with the Renault F1 team, that consequently massively boosted the company's revenues and prestige. "We had set up a small booth at the PMW Expo in Cologne in 2009 when we were visited by Pat who asked us whether we could make an F1 core," recalls Weel. "They subsequently became our first customer.

"Two or three weeks later we got approached by Red Bull Racing that wanted everything the world could offer, but we turned them down. However, they didn't give up and came again and again, telling us that they had signed this new young kid who they believed was going to be World Champion. I've been in motorsport for around 30 years and every parent swears that their kid is going to be a champion, but Red Bull was insistent that in Sebastian Vettel they had the real deal, so I weakened. We supplied the team commencing with the 2010 season. Vettel won the World Championship that year, the first of four in a row. We said it was our radiators and they said it was their driver! It led to a great relationship with Formula 1."

Weel says that PWR's Formula 1 experience has really propelled his business: "We have been fortunate enough to be working with Formula 1 teams for 10 years and that's what pushes us as a supplier. The technology and IP we are collecting and producing collectively with F1 teams has been a great story for PWR.

"For example, there's been a lot of push, particularly in the last 12 months, to electronic cooling which has come off the back of F1 battery cooling back in the day that's still very good for us. However, cold plate electronic cooling is a new part of our business that we've been doing for a while, but which is spinning off into the automotive industry with the advent of electric and autonomous cars. We've also just released a new form of cooling, that we call internally micro matrix, that we've been working on for nearly two years."

Weel also says how Formula 1 teams are quick to respond to new ideas and if accepted, how the technology is adopted in other series. "Three years ago we went to a couple of F1 teams with our new idea of a billet tank machined out of a sold billet as a value-add to our core products. As a result of the concept being quickly taken up by them and other F1 teams, nearly every World Rally Championship team that we supply now also have billet tanks, as do some NASCAR teams."

While motorsport remains at the core of the company's business, it is also growing in other areas. "By 2021 we will have around seven OE programmes on the go worldwide," Weel reveals. "We are also doing some aerospace and high-end military programmes which is all the flow-on effect from motorsport that comes from the technology push that we've had from the F1 teams that push us damn hard." RT

ABOVE The acquisition of C&R was a key strategic move, offering further traction in the US market

AUTOSPORT
INTERNATIONAL

THE RACING CAR SHOW

NEC, BIRMINGHAM, UK

10-13 JANUARY 2019

10-11 STRICTLY TRADE-ONLY DAYS

REGISTER NOW
AUTOSPORTINTERNATIONAL.COM

AUTOSPORT INTERNATIONAL IS PART OF: motorsport NETWORK

INCORPORATING PERFORMANCE & TUNING CAR SHOW

AUTOSPORT ENGINEERING SHOW

LAS VEGAS LAUNCHPAD

William Kimberley walked the show at SEMA in Las Vegas and gives a hint of what to watch out for at the PRI Show in Indianapolis

THE SEMA Show in Las Vegas, the home of the V8 and a homage to high-performance street and racing cars and engines, is not a place an electric car enthusiast would think of visiting, but there it was in its full glory, the Chevrolet eCOPO, a 700 volt drag car.

Developed by General Motors and built in partnership with the pioneering electric drag racing team Hancock and Lane Racing, the concept race car – based on the 2019 COPO Camaro – is entirely electric powered, driven by an electric motor providing the equivalent of more than 700 horsepower and 600 lb-ft of torque. The company says that it should be able to cover the standing quarter mile in about nine seconds. It uses what GM terms is next-gen 800v technology, twice what today's electric cars use, to enable charging in as little as 10 to 15 minutes.

"The partnership with Hancock and Lane Racing is not only because of the team's success in NHRA drag racing, but also its involvement with Patrick McCue, the driving force behind the record-holding 'Shock and Awe' electric drag racing car, and his Seattle-area Bothell High School automotive technology programme," said Russ O'Blenes, director, Performance Variants, Parts and Motorsports at General Motors. "With the racing team's assistance, more than a dozen students participated in the development and assembly of the electrified drag car.

"This project exemplifies Chevrolet and General Motors' commitment to engaging young minds in STEM education. It also represents our goal of a world with zero emissions, with the next generation of engineers and scientists who will help us get there."

The battery pack is composed of four 200v modules, each weighing approximately 175 lb. Two are located in the rear seat area and the other two in the boot, one in the spare tyre well and the other in the area over the rear axle, that together give a greater than 56 per cent rear weight bias, which helps launch the car more efficiently. The batteries are sealed off from the interior and an integrated driveshaft tunnel has been added between the modules for increased protection. Additionally, the roll cage in the boot area has been expanded to provide extra protection for the rear-mounted modules.

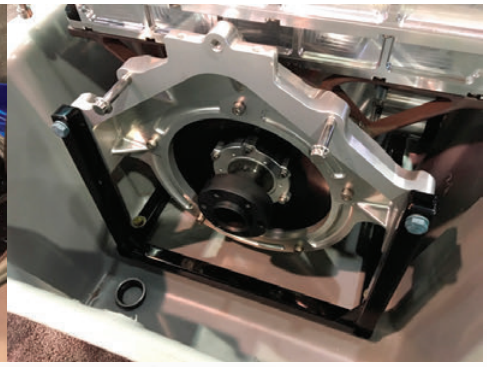
A full battery management system monitors all critical voltages and temperatures within the pack. It ties into a comprehensive safety system that continuously evaluates all vehicle electrical components for proper function and safe operation.

The electric motor is based on a pair of BorgWarner HVH 250-150 motor assemblies, each generating 300 lb-ft of torque, and is connected to a conventional race-prepared 'Turbo 400' automatic transmission that channels the torque to the same solid rear axle used in the production COPO Camaro race cars. It has the same bellhouse mounting pattern and crankshaft flange as the popular LS-family engines in Chevrolet's crate engine portfolio that allows it to bolt up to just about any GM transmission. In fact, the transmission, driveshaft and other drivetrain components remain in the same locations as in a gasoline-powered COPO Camaro

race car, meaning the electric motor simply bolts into the engine compartment in place of the gas engine.

"The possibilities are intriguing and suggest a whole new world for racers," said O'Blenes. "Chevrolet pioneered the concept of the high-performance crate engine right around the time the original COPO Camaro models were created, and the eCOPO project points to a future that could include electric crate motors for racing, or even your street rod. We're not there yet, but it's something we're exploring."

Although GM is planning to offer 20 electric cars by 2023, it is not putting the eCOPO on sale, but hints that a crate electric motor kit like it could be offered as off-the-shelf parts for would-be electric racers in the coming years. In the meantime, Chevrolet and Hancock and Lane Racing will continue to develop the eCOPO Camaro and test it on the drag strip, seeking quicker elapsed times with all-new technology.



While the eCOPO Camaro was breaking new ground at SEMA, 99 per cent of the exhibitors were concentrating on displaying products for current technologies, one such being **Mahle Motorsports**. While it is a subsidiary of the mighty Mahle Group in Germany, it is given a fairly free hand to develop products for its domestic market, and as such has come up with an ever-growing product range. This includes its PowerPak Plus pistons that helped propel a Nissan Skyline GT-R to reach record-breaking milestones, including the current fastest ¼ mile, and the fastest standing ½ mile records as of September 2018.

> *"A whole new world that could include electric crate motors for racing"*

The GT-R PowerPak Plus pistons start the production process with an ultra-strong, low drag, lightweight 2618 alloy Mahle slipper skirt forging, which is precision machined to exacting tolerances. The pistons are then coated with a phosphate dry lubricant to guard against galling in the pin bores and add lubricity in the second and third ring grooves. The top ring groove is hard anodised to protect against micro-welding, ensuring optimum ring seal over the life of the engine. Finally, the piston skirts are treated with Mahle's proprietary Grafal anti-friction coating which has a cushioning property that greatly reduces wear for both the piston and the bore as well as a substantial reduction in noise.

"On the motorsport side, we introduced a couple of years ago a shelf stock big block Chevy programme that had mainly been custom pistons until that time," said Trey McFarland, sales & marketing manager at Mahle Motorsports. "However, it had become challenged for time and it was getting frustrating for the sportsmen customers as it was tough for them to get the parts. We therefore went ahead and had a shelf stock part that had all the custom features, but with just some small compromises. We do a commonised dome that will fit all the popular cylinder ▶

LEFT & TOP Show-goers got a closer look under the bonnet of the Chevrolet eCOPO Camaro Concept, an electrified vision for drag racing

ABOVE & BELOW Mahle Motorsports' PowerPak Plus pistons help power the fastest GT-R in the world

heads and while we may need to give up half a point of compression because it's not made specifically for that cylinder head, it's on the shelf, singles are available and they're more affordable and easy to get.

"Last year we did the 24 and 25 degree conventional big block Chevy cylinder head and added the 20 degree heads this year, which are very popular. We are working right now on an 18 to 16 degree and with the big pro-team guys down to 9 to 13, we'll begin working on those as well.

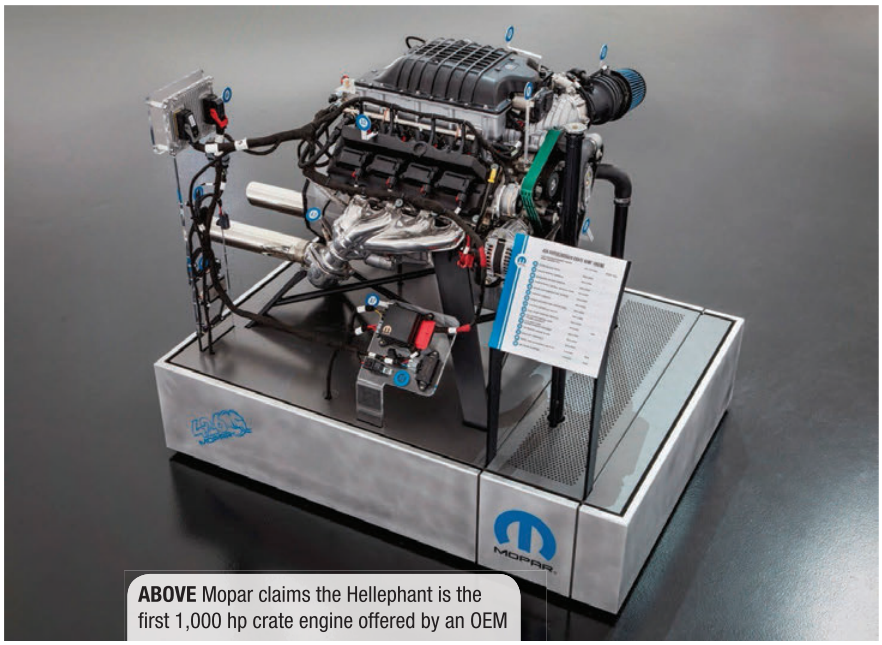
"We've also taken some of what were the popular custom combinations for some of the circle track classes and put them into the shelf stock programme as well. The super track guys are usually trying to get as much life out of the block as they can so we put the parts in incremental bore sizes so they can get a lot of rebuilds on the block. It's an inventory commitment, but it's proven to be really beneficial for the racers as the parts are readily available and are on the shelf."

Mahle Motorsports has also produced some more of the concept pistons that have become quite popular for crate engines as racers are looking for something a little racier, said McFarland. "Crate engines are very affordable, they're very easy to get in and if the guys want to run something a little more aggressive, an open motor is pretty expensive and more labour-intensive, so we've worked with some of the sanctioning bodies to come up with something in between with what they coin a concept or spec engine. It's got parts numbers that have got to be used, there might be two or three different pistons, one cylinder head, but they will leave a few things open such as camshafts within a range. There might also be a little more weight on the car than the spec engine, but the guy gets to work with professional engine builders and learn what it's all about. We've built these parts to be on the shelf and readily available for the engine builders. Again, it's about keeping more cars on the track."

One of the big announcements at SEMA this year was the "Hellephant", a 1,000 hp crate engine from **Mopar**. Last year it introduced the Hellcrate, a 707 hp supercharged V8 from the Dodge Charger and Challenger Hellcat, but this year it upped the ante with the 1,000 hp, 950 lb-ft torque Hellephant. It is loosely based on a standard Hellcat engine, but a bigger bore and stroke bring displacement up from 6.2 to 7.0 litres. It also features the all-aluminium block used in the Dodge Challenger Drag Pak race car rather than the Hellcrate's iron block. The valvetrain is borrowed from the 840 hp V8 used in the Dodge Challenger Demon.

Mopar claims the Hellephant is the first 1,000 hp crate engine offered by an OEM, and amazingly, it plans on selling it as part of a plug-and-play kit for pre-1976 vehicles. On top of that, Mopar will offer a 'Front End Accessory Drive' kit, which includes an alternator, power steering pump and all the belts and pulleys that may be needed.

It is already attracting the interest of the aftermarket specialists such as **Isky Racing Cams** which was exhibiting at SEMA for the first time in 15 years. "We are already making the parts for it," said Nolan Jamora, Isky's R&D director. "We got an early copy of the architecture and did a lot of 3D printing in preparation so we're now ▶



ABOVE Mopar claims the Hellephant is the first 1,000 hp crate engine offered by an OEM

doing springs and lifters. Materials are the biggest thing, as is clean metal."

While Isky is well known for its bushing roller lifters, it's not a question of resting on its laurels with its patented designs. "We have an improvement coming out. It's a different material and chemicals because it used to be 1,500 lb open pressure at about 10,000 rpm, but we're now getting about a third more just from the material change and design tweaks. We are also sourcing our materials a little bit better as well as a little bit more nano technology, so under that high squish rate the oil isn't squeezed out, and that's the trick because it just runs on a bed of oil.

"This development has come about through learning from the race teams which are always pushing for increased performance."

The proof of concept was at Le Mans this year when a team that was running it was first to the chequered flag, although it was subsequently disqualified for transgressing the regulations in other areas. "It's trickling down," said Jamora, "because we're even going to do it for the street even though we don't necessarily cater for that market, but it's a massively growing one that we need to address."

A newcomer to SEMA was Californian company **Supertech** as part of its policy of becoming better known in this market. "We are always trying to develop new engines that are coming out such as the Mini Cooper B48 that's also in some of the BMW applications," said Supertech director Martin Tagliavini.

ABOVE Revotec exhibited at SEMA for the first time, showcasing its adjustable electric fan controller

"We are also coming out with the 5.0-litre Coyota engine which is our first foray into the V8 world. However, it has an overhead cam so it's in the realm of the small, compact European market that we are in so is not too much of a transition for us."

Tagliavini said that Supertech has also come out with a new connecting rod line that the company has been developing for the last three years: "We now have a full line up and stock in our warehouse and ready to ship that complements our pistons and overhead gasket components, giving us the ultimate package. From connecting rods, pistons, head gaskets and the whole valvetrain line up, it's more like a one-stop shop for all our customers' internal engine needs for a very wide range of engines."

All these products will be on display at the PRI where Supertech always has a car that's much admired and photographed, although Tagliavini was very coy about saying what it would be this year, except for mentioning that it was a drag car coming from "Down Under".

ABOVE Supertech's new line of conrods made a debut at SEMA and will attract attention at PRI

Another newcomer to the show was UK company **Revotec**, owner William Bartlett using it as part of an extensive tour of the country that included a visit to Moss, the classic car parts supplier. He was at SEMA exhibiting his new adjustable electric fan controller that is found in an increasing number of vehicles in the UK and Europe.

The aluminium inline sensor is available in various sizes that splices in-line into a top or bottom coolant hose with no chance of leaks. The controller is always in contact with the water, without restriction and avoids the problems associated with capillary/clip-on devices. ▶

mountune RACING

PRI DECEMBER 6-8, 2018

EXHIBITOR BOOTH # 4042

As used on 2.5 Duratec Engine Builds

Lightweight Flywheeel

Machined Billet Steel

- Features an integral ring gear.
- Lighter than the original equipment flywheel.
- Can be used in conjunction with the OE Ford clutch pressure.

World class range of components designed & engineered by mountune Racing, as used by championship-winning race teams across the globe.

mountuneracing.com

CARTEK MOTORSPORT ELECTRONICS

NEW! POWER DISTRIBUTION PANEL

CARTEK are pleased to announce the new Power Distribution Panel is now available. This product is a full redesign of their successful but bespoke, Power Control Panels, with the main aim of allowing the user to customise and configure it themselves

The CARTEK Power Distribution Panel is a fully integrated, fully electronic solution to power distribution in race and rally cars. Designed to replace 16 Fuses, Relays and Switches as well as a variety of control systems, these units therefore greatly simplify the wiring, reducing build time, saving weight and maximising reliability.

The 140x195mm panel only weighs 625g and is enabled with short circuit and over-current protection.

2 x Multicoloured Sticker Packs Included

Key features:

-16 User Configurable Channels (no Laptop required)
-7 Selectable Amperage Settings: (0A, 5A, 10A, 15A, 20A, 25A, 30A)
-Choice of Functions such as: Momentary, Latching, Flashing etc
-2 Backlight Settings
-Status LED for each Channel
-ECU and Switch Inputs available
-Dedicated Wiper Control Module

BATTERY ISOLATOR XR

The new Battery Isolator XR can output a signal to shut down the CARTEK Power Distribution Panel as well as isolate the Battery.

WIRELESS CONTROL SYSTEM

Use the Wireless Control System to communicate with the CARTEK Power Distribution Panel or ECU/Dashboard

For more information go to www.CARTEKMOTORSPORT.com

It's available as either negative or positive earth and will work with any DC fan currently on the market.

"We're looking for distributors in the US as well as trade customers for this and some of our other products," said Bartlett. "We believe our adjustable electric fan controller is superior to anything else on the market because it's a bespoke machined part that actually does the job of switching and controlling an electric fan as opposed to a part that's made for something else that's modified to do the job. It's also better than the competition because it correctly picks up the temperature."

Last year, we reported on the **Racepak** Vantage CL1 data kit that merges the power of Racepak's exclusive D3 App mobile technology with a vehicle-mounted CL1 data box which won the SEMA awards for the Best New Performance Racing Product and the Best Engineered New Product. This year it was showing the CL2 OBD2/EFI data logger that it claims is the smallest and yet most powerful data system available for late model track day, circuit, autocross and drag race competitors.

"Having released the CL1, what we've done is now make it smaller and a lot more user-friendly for 2008 and later drag and other such cars, so the CL2 has the same features and functions as the CL1 in terms of using the cloud service, mobile phone and D3 App, but it's much easier to plug in," reported Racepak president Tim Anderson. "There's also the option of buying the EFI OBD2 cable that allows a connection between the CL2 to an aftermarket EFI. I call it the gateway to the cloud with this little module and so is a good way for users of EFI systems to access live data. The CL1 still has a place for anyone running external sensors, but I think the CL2 will find a home in a lot for circuit cars."

As the official fuel supplier and sponsor of IMSA, **VP Racing Fuels** was very much in evidence at SEMA exhibiting its new range of lubricants. "We now have a new classic line that comes in a straight SAE 10W-30 and 20W-50 that contain approximately 1760 parts per million (ppm) zinc and 1650 ppm phosphorous and is a great oil for flat tappet roller cams," said Richard Glady, national sales manager lubricants. "They're also very good for protecting engines, especially with alcohol and methanol-type applications.

"We've also introduced our line of traditional oils that come in SAE 50 and 60 straight weights. They also contain approximately 1760 parts per million (ppm) zinc and 1650 ppm phosphorous and they also use that same base oil cut that gives the oil tremendous wettability. They're good for customers that want a straight weight oil for drag racing applications. Also part of the new range is the Nitro SAE 70 oil aimed at the Top Fuel dragsters as it has much wider clearances in the engine itself.

"We've also added in the range our new Ex HP SAE 0W-50 lubricant that we call a fast-flow formula because of the lower viscosity, but which still gives a 50W protection at 300°F. It's a full synthetic, PAO Group 4 base stock and is a good choice for circle track competitors who want the advantages of the low temperature performance along with that of the upper end. We had a number of engine builders that told us that they wanted a 0W-50 or something like that for ▶

ABOVE Racepak's CL2 kit builds on the success of its award-winning predecessor

low temperature applications where they don't have to heat the oil up. They want to put it in the engine and just let it run and get it to the upper end of the engine."

Glady also pointed out the rest of the new range that included VP Racing's new diesel SAE 5W-40 lubricant for the smaller diesel racing engines that uses the latest API CK4 chemistry for diesel-type applications. VP Racing's Classic SAE 80W-90 gear oil, meanwhile, has been designed to be used with yellow metals such as bronze, brass and copper and with soft metals used in components found in classic manual transmissions and transaxles. Alongside it are the new SAE 80W-140LS and a full synthetic 75W-140LS (limited slip) gear oils.

BRAKE INNOVATION

While overall speed, acceleration and cornering capabilities are all top priorities in making a racing and performance car go as fast as possible, at the other end of the scale, but just as important, are decelerating and stopping the thing. As such, every component that makes up a brake system is always under scrutiny and under constant development. That much was evidenced by the plethora of brake manufacturers busily showing off their latest products at SEMA.

One such was **Brembo** that was using the exhibition to launch the B-M6 calliper, of which Race Tech had a sneak preview when visiting the Italian company earlier in October. Available in five colours – black, red, yellow, white and fluorescent yellow – it is designed for a disc that measures from 350 to 405 mm, with a thickness of 32 to 34 mm.

It is the third member of Brembo's innovative 4D-Cast process, introduced at SEMA in 2015, where everything is cast except for the inside link between the pistons. Where applicable, it can also be paired with the B-M4 calliper on the rear axle.

Technology transfer is very much in evidence with this new family of callipers, Brembo's long history as the supplier of motorsport brake systems quite apparent. Hard anodised for longevity and resistance to corrosion at high temperatures, the B-M6 shares the same design characteristics – such as the integral bridges for exceptional stiffness, internal fluid passages, and a single concealed bleed screw on the inside face providing greater safety and resistance to damage – that have been proven in motorsport for over 40 years. Although more aimed for the performance aftermarket, this new calliper is nonetheless perfect for the club racer or weekend trackday enthusiast who wants to take that next step in braking.

ABOVE & BELOW Race Tech editor William Kimberley was, quite literally, among the first people to see Brembo's B-M6, getting his hands on it shortly after its arrival from the foundry. The calliper is the product of Brembo's innovative 4D-Cast process

"It's part of our new family of callipers that are a completely new design," said Luca Battistella, Brembo's market manager – BU Performance. "Except for the inside, nothing is machined, so it meant we needed to invent a new way of casting the calliper with a front insert. The standard way of casting is two-way, but we have developed one-way casting for this calliper from the back which has enabled us to make a unique shape at the front. This is important as style influences the buying decision as much as any performance upgrade in the street aftermarket.

"Not closing the bridge means a big development in the stress of the calliper, but it's the most rigid one we have in our range. It was a big job for the development team, who spent over two years to set up the first prototype for casting, because the fastening is very difficult. The result is having something that is completely different at a cost that's not crazy."

Another important feature of this new calliper is that it's not just designed for the cast-iron disc but also for the CCM-R disc. This is a new carbon-ceramic disc that Brembo considers is the future of high-performance discs, and maybe even OE. It's a material that's between carbon-carbon and carbon-ceramic. It has the same matrix ▶

Intelligent Fully Featured Battery Power Control Systems

POWERBOX
HP 8441
NEW

Cost Effective
Practical
Incredibly Versatile

Fully programmable power control in a user friendly package.

Future Upgrade Path to *HP8440*.

Main Features:
- 180 Ampere continuous.
- 34 Output channels controlled as a function of conventional switches, CAN inputs or Virtual channels. With wiper Park on dedicated channels.
- Weight 496 gr.

MEMBRANE PANEL

CAN Controlled Membrane Switch Panel.
Tactile Operator Feedback.
Multi Tap Capability.
Warning LED's.
Available With Your Custom Design.

POWERBOX
HP 8440

Main Features:
- 200 Ampere continuous.
- Programmable Inrush Currents
- 34 Individually Programmable Output Channels
- 11 Conventional Switched Inputs
- 32 CAN Input Channels
- 20 Virtual Logic Channels
- CAN Export Facility
- Weight 680 gr.

Future Proof With Firmware upgrades

OVER 1000 UNITS SOLD WITH PROVEN RELIABILITY
ENGINEERED & PRODUCED WITH OUR EXPERTISE IN HOUSE. LEARN MORE AT HPELEC.DK

HP ELECTRONIK

Lundvej 17-19, Lund
7400 Herning · Denmark

Tel. +45 9626 4333
Fax +45 9626 4233

info@hpelec.dk
www.hpelec.dk

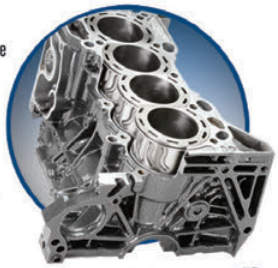
L.A. SLEEVE
Since 1945

ENGINE SLEEVE SOLUTION SPECIALISTS

IRON & ALUMINUM BLOCKS
STREET - DRAG - ROAD RACE - F1 - CUSTOM

Saving Cylinders for 70 Years.

- Maintain aluminum block integrity. Boost ranges up to 92lbs. Horsepower rated up to 1,800hp. Ideal for boosted Turbo and Nitrous motor builds.
- Our Amphibious ProCross – ProCool design feature will dry press in securely, prevent sleeve movement and leakage, and sustain the proper cooling flow.
- American Made Since 1945 – our sleeves are created from our proprietary MOLY2000 centrifugally spun-cast ductile, providing greater micro-structural density than our competitors.



SCAN THE CODE TO LEARN MORE & SEE THE VIDEO

12051 Rivera Road, Santa Fe Springs, CA 90670
562.945.7578 Toll Free: 800.822.6005
www.lasleeve.com • info@lasleeve.com

twitter.com/LA_Sleeve facebook.com/LA.Sleeve

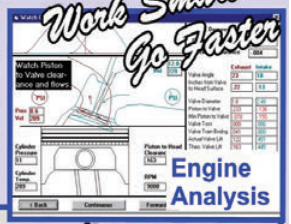
Performance Trends

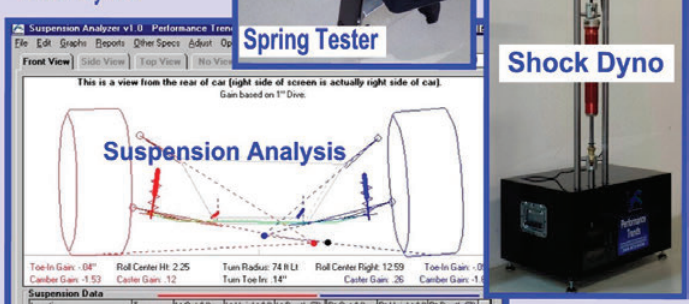
www.performancetrends.com

Visit our website for more info, to download FREE demos, or call... 248-473-9230

Software and electronics for all types of racing and engine building, including:

- Suspension Analysis Software
- Engine Performance Simulation
- Cam Measurement & Analysis
- Manual & Automatic Spring Testers
- Flow Bench Electonics & Software
- Race Car Simulation
- Swirl & Tumble Meters
- Dyno Software, Data Acquisition & Control
- Shock Dynos





as the carbon-carbon but with a ceramic finish, so is similar to carbon-carbon but can be used on the road as it doesn't have its temperature issues. It has also been designed to be specifically used on the new generation of disc.

"Although it would be easier for us, we are not going to sell this calliper as a standalone product, but as a complete kit that has been specifically designed for each car," says Battistella. "So there are four versions of the calliper with different piston diameters for different disc diameters and thicknesses.

"While this kit does improve the braking capabilities, it doesn't double the braking force because that isn't possible as the limit is driven by the car's electronics, but what it does offer is a different feeling for racing and a longer life for the braking system in racing. In other words, more stiffness, more feeling and a longer life."

StopTech was also busy introducing new products. They included the C60 calliper that was designed and developed with the highly successful Real-Time Honda TLX GT race team.

"The C43 capped out with 13-inch rotors (discs) and we needed something that could go to a larger system, so the C60 was developed to offer a lightweight calliper to be used in a lighter weight, higher powered sprint-type vehicle," said StopTech engineer Erik Steinkamp. "The C43 starts as an ST43 forging with the option for dust boots, radial or axial mounts, but the C60 is fully billet although we are going to go to forging."

"When you design a calliper you start with the tag, that's the base, so we selected the pad shape that has a lot of different race friction formulations and you design from there," said Tyler Hauptman, the StopTech design engineer who worked on the C60. "What we wanted to do was to take a different approach to what we usually do. We've learned from the development of earlier generation callipers that by making the piston force concentration spread out as far as possible, it's possible to moderate deflection greatly, thereby giving a lot of stiffness advantages. That was one of the first things we did.

"When we ran some FEA analysis we started to understand that there were no force concentrations in between the bores, it's just more on the back plane of the callipers. So that was another trick that enabled us to remove a lot of material, while still maintaining the calliper's overall stiffness.

"Another thing that we wanted to do was to fit more wheels. The calliper bolts are coming from the inboard side and threaded into the outboard side, meaning that there aren't any bolt heads on the outboard side where they would typically interfere with the wheel. It meant we could put a really aggressive cut on the top of it and so are able to fit many more smaller wheels in tighter spaces."

"With the way it's developed we also plan to move forward into some direct replacement callipers," said Steinkamp. ▶

ABOVE StopTech introduced its C60 lightweight calliper

KIMBERLEY
MEDIA GROUP LTD

Visit our PRI booth 4026 Yellow Hall

BREAKING NEWS | LATEST VIDEO CONTENT | LEADING SUPPLIER DIRECTORY

kimberleymediagroup.com

Driving Technology Into Pole Position INTERNATIONAL RACE TECH Motorsport Engineering
racetechmag.com

HISTORIC RACING Technology
historicracingtechnology.com

Pushing cars to the limit INTERNATIONAL TrackCar performance
trackcarperformance.com

ABOVE 920E is raising awareness in the US as it dips its toe into the market

"Cars like the Camaro and the Mustang come with a factory 4-piston brake system and we want to be able to offer a lighter system – a bolt-on calliper with a pad with a wider range of friction options available that can be taken to the track and driven quite a bit harder than an OE calliper would allow."

920E and **Shiftec** were exhibiting at SEMA for the third consecutive year as part of a brand awareness process. "We don't have distributors in the US at the moment and are dipping our toes into the market to try and understand it and how our products may be adapted or sold into that market," said Nick Stevens, principal engineer at 920E.

"We are bringing out new products all the time and want to be recognised in the very niche market of the motorsport world. What we want to achieve from that is a trickle down into the aftermarket.

"We talk to people here in the US about our involvement with Force India F1 and while they are impressed for a while, they really want to know about NASCAR and drag racing. We've had some really interesting conversations with some of the drag guys about their applications and the things they're missing. For example, I recently spoke to someone about carbon-carbon brakes on a drag racer and it's really different to how we are aware of them being used in endurance races and Formula 1.

"We are generating a range of products that we hope will be quite universally adaptable and bolted onto a wide variety of vehicles. The US market is different in terms of things being bigger and heavier; being a supplier to Land Rover, the truck market is quite interesting for us."

Another brake manufacturer at SEMA was **EBC Brakes**, that typically caters to the performance aftermarket but which is moving into motorsport applications.

"EBC Brakes typically operates in the road and more recently trackday markets. While some people are using EBC's Blue Stuff, our intermediate-grade trackday and race pad, in a lighter and relatively modest-powered vehicle on the track and even racing with it, including six-hour endurance races in BMW M3 E36s, we've never developed a material explicitly for race use," said Adam Freeman, EBC Brakes product development and technical manager.

"Recently, though, EBC has launched a new sub division called EBC Brakes Racing whereby we are looking to get more into the trackday and race market, which is developing very quickly. Cars are going faster and faster and the limits of their potential is ever increasing, which cannot be properly exploited on the road, so owners are increasingly taking them to tracks and we want to cater for that market.

"Underneath the EBC Brakes Racing sub brand we've got a couple of new products, one of which is a floating brake disc that's already been released, and we're adding more applications to the range all the time, such as the Nissan GT-R and the Mitsubishi Evolution X. We've also got a 2-piece floating disc conversion for the Ford Focus RS Mk 3 and the Honda Civic Type R. We are also developing ones for the 991 and 991.2 Porsche GT3 Turbo and Turbo S, both the front and rear, and are also looking to do one for the new shape BMW M2, M3 and M4.

"On the 2-piece floating disc side of things we've got that market pretty well covered. The product is developed and we are selling those now. Every single part of that is built and designed and manufactured in the UK."

Freeman said that EBC Brakes is also looking to develop the RP1 pad material that it will be releasing in the next three to six months. "We've looked at some of the top performers in the race pad market and tried to create a material where we can match or outperform them. The angle we've come at with the brake pad is very different to what a lot of our competitors are doing in this segment. So rather than a very heavily steel fibre-loaded and copper-loaded pad, the classic semi-metallic compound, we've developed and have matched performance with an organic compound, something with much less

ABOVE The new sub division of EBC Brakes is targeting the trackday and race market. This is its two-piece floating brake disc released for the Nissan GT-R

steel fibre content and zero copper content.

"This is going to be very important for people looking to race and use their cars on the road with the copper regulations that are coming in California and in Washington DC, that we expect will spread across the rest of the US. We therefore wanted to develop a material that would still stand after such regulations came into force.

"The feel of the pad is also very different. With a semi-metallic pad you get a very sharp initial response which a lot of guys like. However, we've had a British Touring Car driver test our pads in our company Nissan GT-R and what he has reported back is that being organic, the lead-in is a little bit softer. If you are trail braking or going through the Esses at Silverstone, where you want a very light dab on the brakes, you can do that without unsettling the car because you've got much more control – whereas a semi-metallic is either on or off – and those are exactly the characteristics we wanted."

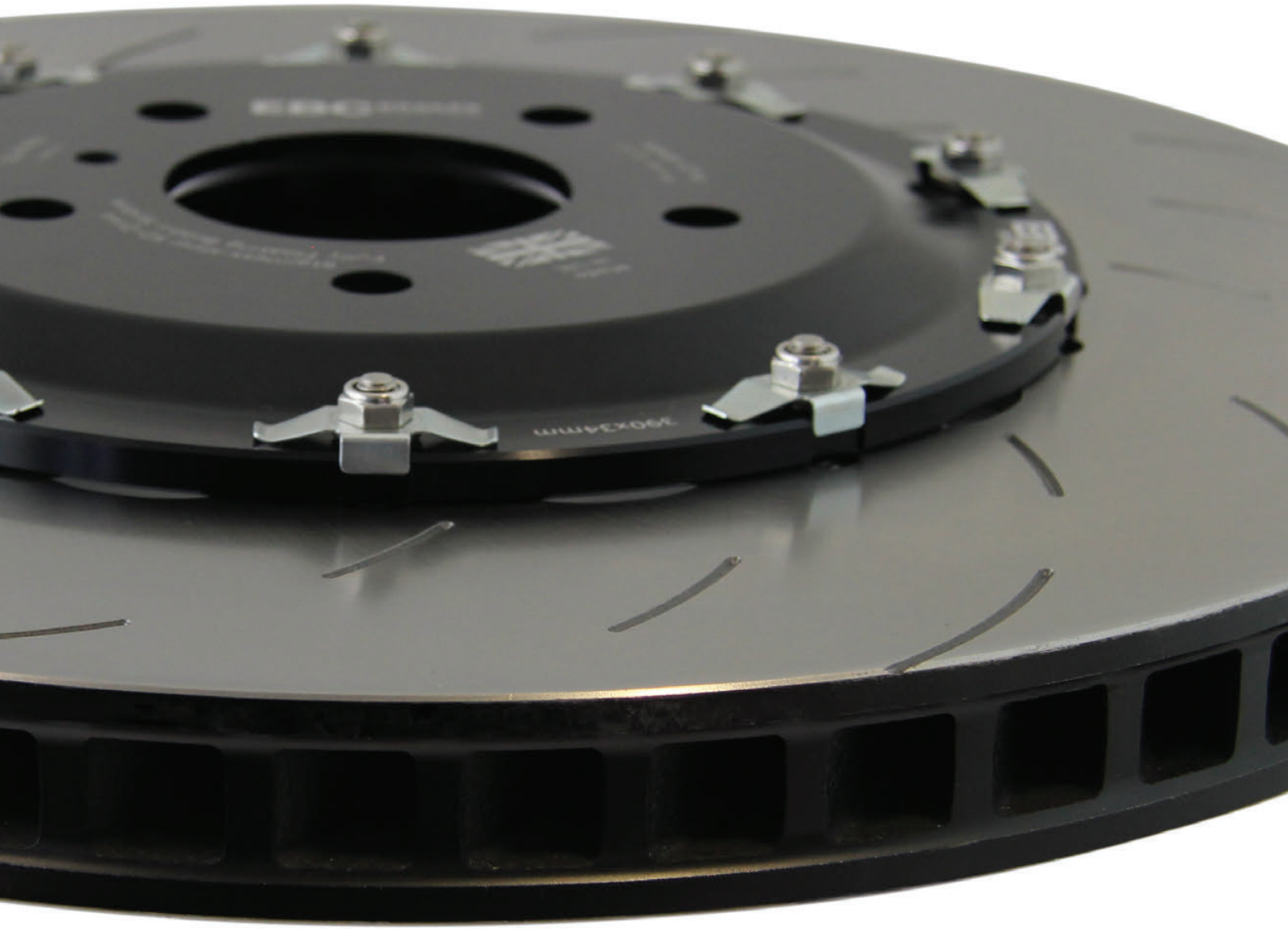
The week after SEMA was the PMW Expo in Cologne where **TMD Performance** was showing its Pagid Racing range of products, including new compounds that have been homologated by the FIA for Formula 3.

"Our Pagid Racing formula compounds RS 34 and RS 36 have been developed for the specific demands in formula racing," said Robert Stelzer, Pagid Racing's marketing and portfolio specialist. "The RS 34 is a compound specifically developed for formula cars and single-seaters with a considerable level of aerodynamic downforce. Its high friction level and optimised shape of friction curve contribute to an excellent controllability with a contained pad wear, which both remain consistent characteristics. The R36's characteristic shape of its friction curve contributes to modulation, while protecting the disc."

"The most important part is the modulation, and how does it feel," said Tim Fischer, TMD's application engineer, motorsport, "as the driver needs to feel confident and secure in the brakes. He needs to know when the brakes bite and the brake point when going into a corner and that it doesn't change.

"We also tailor the pads for specific cars by providing a large variety of different compounds, so we can meet almost every expectation of different companies."

In summing SEMA 2018 up, perhaps the last words should be left to Scooter Brothers, co-owner and chief operating officer of **COMP Performance Group** but also former SEMA chairman: "We talk about the ageing of our industry but, it isn't. When I look around here one of the coolest things I see are young people everywhere, and that excites me as to where we are going to be in 10 years. We've got good hands to leave our industry in and our job is to keep them excited." RT



BELOW Wavetrac is moving into a new sector with its Quick-Change bespoke differential for Harrah Enterprises

NEW CHALLENGES

William Kimberley examines some of the latest developments in transmission technology

WAVETRAC has carved a motorsport niche for itself as the manufacturer of the innovative, patented, Wavetrac device in the centre of the diff that responds during the exact conditions when zero or near-zero axle-load occurs. At or near zero axle-load, the axles, and therefore each side gear in the diff, start to turn at different speeds. It is this speed differential that causes the Wavetrac device to step into action.

Precisely engineered wave profiles are placed on one side gear and its mating preload hub. As the two side gears rotate relative to each other, each wave surface climbs the other, causing them to move apart. Very quickly, this creates enough internal load within the Wavetrac to stop the zero axle-load condition while the drive torque is applied to the wheel on the ground, keeping the power down.

Over the years it has created a unique position for itself, but last year it stepped into a new market. "At the last PRI Show we met Mark Harrah of Harrah Enterprises, for whom we developed a new application for the quick-change rear axles," says Dana Clark, manager, technical operations at Wavetrac. "Harrah Enterprises supplies some unique products that it has developed itself, mostly into NASCAR – most of the high-level guys are using its gearboxes and they've done a very low drag pump for oil in the differentials – but Mark wanted to move into a different segment of racing, more the grassroots side of things such as the Super Late Model and Modified series.

"A quick-change axle is commonly used in this type of racing, but the shortcomings are that the existing differentials aren't very consistent. As a result, the guys find themselves changing the setups throughout the course of the race weekend because they're literally changing from start to finish in a longer event. Mark therefore thought it might be interesting to use something that we do as we have a couple of unique features in our diff that no-one else is doing and so we worked with him to develop the application.

"We were testing it last year right before the PRI show and their car ran the Snowball Derby and finished strong. We had a lot of visitors at the show that stopped by just because the word had spread that there was a new Wavetrac diff run there. This year Harrah Enterprises has been pushing them out to a few customers to make sure it's the right fit and that the guys are receptive to the changes they need to make to their cars as it changes the vehicle's behaviour, but once they're on, it doesn't change and is consistent. Mark says that it's now added the ability to change the line of the racetrack so the guys can drive places that the others can't. It's really changing the way that people are looking at the diff.

> *"It's really changing the way that people are looking at the diff"*

"This is our consistent Wavetrac design that we've tuned a bit to work in a loose traction environment with staggered tyres and things like that, since we have a lot more gear movement inside our diffs than we would in a normal car. It's similar to how we treated it as off-road because there's so much wheel speed. When you are driving straight in these things, the differential thinks you are turning. We have incorporated different friction material internally than we would have with a road car application, but it's fundamentally the same Wavetrac."

Clark explains that one of the things that the Wavetrac differential does, as opposed to a Detroit locker-type diff, is that it is far smoother as it doesn't lock the axles together, so it has the ability for the axle to turn different speeds yet getting two-wheel drive is the benefit of it. The unique features of the Wavetrac over other gear-type diffs give it an advantage in a race environment.

"There are teams running Torsen-style diffs in Super Late Model and Modified series, but they have problems keeping them consistent. They were wearing very quickly as the staggered tyre was creating problems. Our ability to control the friction surfaces

was much better than most other diffs like ours, while the ability to boost the torque bias ratio internally on its own is unique. Its ability to work in loose traction is kind of a shared benefit across most gear-type diffs, but we have the additional benefit of being able to change friction coefficients of the materials inside easily."

As Wavetrac's parent company, Autotech Driveline also represents both Drexler Automotive and Australian company Holinger Engineering in the US. All three brands will be sharing a stand at the PRI. Holinger Engineering has been designing and manufacturing high precision components for motor racing for decades. Specialising in transmissions, it manufactures a range of gearboxes and associated products, from standalone bespoke designs right through to gear sets for existing production cars. Its gearboxes can be found in a wide range of international classes, from GT racing right through to cross-country rallying.

The company is also involved as the homologated supplier to the upcoming S5000 series, the new single-seater series that commences in 2019. Positioned as the premier open-wheel class in the Australasian region, S5000 will boast a brand-new FIA-approved chassis, a powerful and cost-effective 5.0-litre 560 hp V8 Ford Coyote 'Aluminator' engine and a Holinger 6-speed sequential transaxle.

"We'll be showing a new iteration of the S5000 transaxle at the PRI, but which we have upgraded from 700 Nm to 900 Nm for some of the more high-powered sportcars and one mile and half mile drag that are pushing limits a bit in the US," said Leigh Nash, director of Holinger Engineering. "We've done this by adding an intermediate plate in the gearbox with extra bearing support, plus extra room for wider gears. The crown and wheel pinion we had was already more than capable and we have been using that size in the gearbox for off-road racing where the shock loads are a lot higher, so it's more than competent to handle the loads in road racing."

MORE EFFICIENT

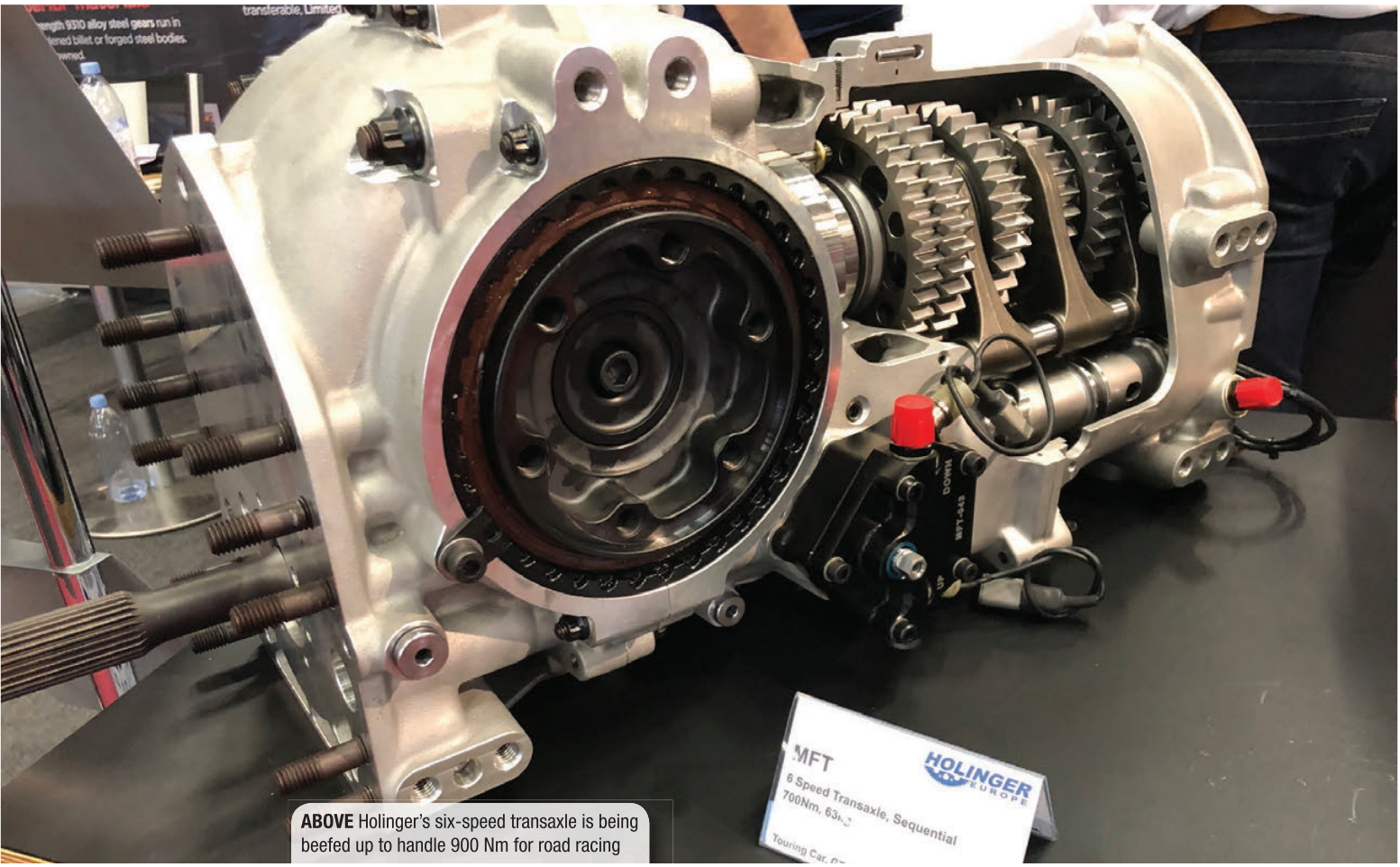
Hewland was displaying two new gearboxes at the PMW show, one being the GTTL that can be used in mid-engined GT cars. By placing the differential slightly higher in the car it allows the gearbox to be placed really low, thereby improving the centre of gravity by allowing the engine to be lower.

Compact and weighing just 34 kg, the GFT is a front-wheel drive gearbox with a high performance-to-price ratio and so is ideal for TCR. It uses the well-tested MLI gearset to offer excellent reliability. It has also been designed to help teams be as efficient as possible, with the easy access it offers to the gear cluster enabling the cartridge to be removed while the gearbox is still attached to the car, avoiding the need to completely strip it down.

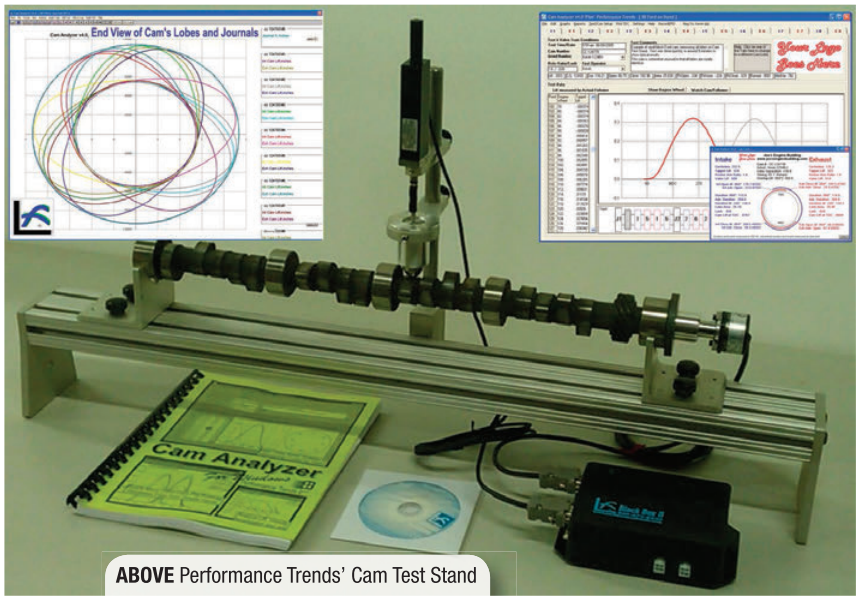
"It just makes it much easier and more time-efficient for teams, while it also reduces the chances of components getting damaged compared to taking the whole thing out and having parts scattered everywhere," explained design engineer Andrew Davidson.

The gearbox also has the option of an externally adjustable differential, which allows the pre-load to be changed using a single tool through an access port. This also brings benefits come race day, adds Davidson.

"You can have one setup for qualifying, and then with just a few turns in one direction, you could have your race setup. It gives you the flexibility to have a variety or potential setups without having to take anything apart or take it off the car." RT



ABOVE Holinger's six-speed transaxle is being beefed up to handle 900 Nm for road racing



ABOVE Performance Trends' Cam Test Stand

Cam Analyzer software

PERFORMANCE TRENDS has updated its popular Cam Analyzer software to version 4.3. It works stand-alone to measure cams by hand with a dial indicator and degree wheel, or with computer generated files such as S96 and Cam Dr. It is also the software that runs its very precise Cam Test Stand. It comes in three versions, Basic, Plus and Cam Grinder.

Some of the new features include the importing of files from Performance Trends' Quick Cam Checker, for quickly checking cams in the engine as it is cranked over with the starter. The lift for rating events can be specified throughout the program, either .050" (1.25 mm), .040" (1.00 mm), or .053" (1.35 mm).

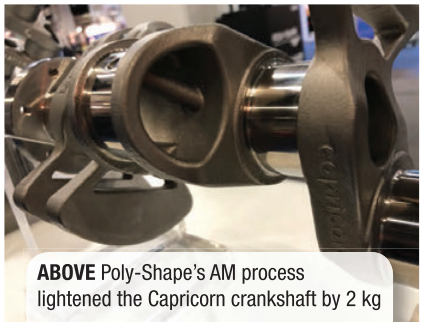
The program can now read several new file formats, including 4stHEAD SVL, .p, ..csv and it has several new features for Save As, to view all the other files in folders when saving files. Deleted files and folders are sent to the Recycle Bin so they can be recovered if necessary.

The graph scale can be specified on the main screen to always be the same (Plus and Cam Grinder versions only) and there is a new "Measure Anything" cam layout to measure non-automotive cams on the Cam Grinder version only. On the Cam Grinder version, a Piece Picture file of the cam, valve train parts, customer's engine or car can also be included in the printouts.

New camshaft layouts include the Hemi 99 (race only Mopar), modern Mopar Hemi 5.7, 6.1, 6.4L, and the GM Gen V LT-4. RT

Additive manufacturing

THE development of a new additive manufacturing process has allowed Poly-Shape to reduce 2 kg from a crankshaft it has produced for Capricorn.



ABOVE Poly-Shape's AM process lightened the Capricorn crankshaft by 2 kg

As Frederic Impellizzeri, responsible for business development, explains: "There are two main advantages thanks to additive manufacturing. The first one is that there's no tooling at all so it's viable to produce just one, two or three components as you do not have to make a mould or tooling for the forge.

"The second advantage is the freedom of design, which is why we were able to lighten the crankshaft. With additive manufacturing you put material where it's needed and simply do not put it where it's not needed, and that makes a big difference." RT

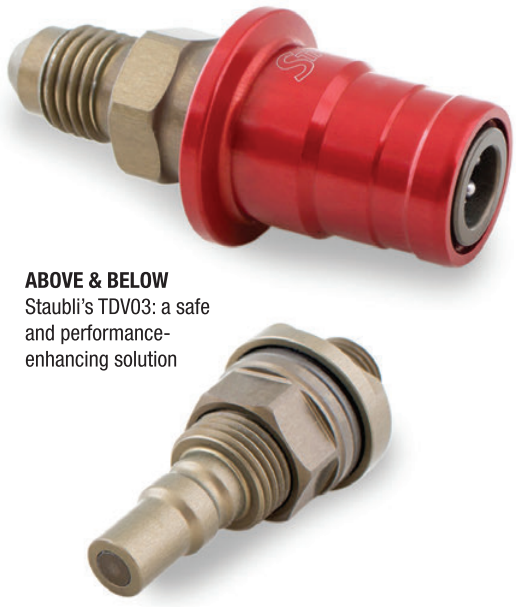
Clean-break

RECOGNISED for innovation, it may be surprising that most motorsport teams still use technology introduced in the 1890s as standard for tyre valves. Identifying the deficiencies inherent in this existing technology, Staubli has introduced a new connector for tyre inflation improving both performance and safety and which is available in a number of rim interfaces, including the widely applied standards of the ETRTO (European Tyre and Rim Technical Organisation).

The clean-break technology introduced by Staubli ensures no loss of pressure on disconnection, providing the required certainty and security. The two-stage valving maintains the correct pressure even if the tyre valve is damaged resulting from racing incidents.

The introduction of the clean-break technology in combination with the two-stage valving also removes the need for a dust cap, eliminating the time lost through removal and replacement during pit stop tyre pressure monitoring.

The Staubli connector can interface with the latest Tyre Pressure Monitoring Systems, while it can also withstand the G-force loads generated by rapid acceleration and deceleration as well as the high centrifugal loads generated during racing. Designed to answer the specific performance and safety requirements of the motorsport industry, the Staubli TDV03 is further available in variants fulfilling the demands of individual race teams and series. RT



ABOVE & BELOW
Staubli's TDV03: a safe and performance-enhancing solution

NATIONAL MOTORSPORT ACADEMY

DE MONTFORT UNIVERSITY LEICESTER

WORLD'S FIRST *ONLINE* Motorsport Engineering Degrees

BSc (Hons) Motorsport Engineering*

NEW - MSc Advanced Motorsport Engineering*

*Degrees awarded by our Academic partner De Montfort University.

Accelerate YOUR Motorsport Career!

The only TRULY FLEXIBLE route to gaining your motorsport engineering degree

- ✓ APPLY ONLINE, choose your own start date & study from anywhere in the world
- ✓ Earn while you learn, study flexibly around your work & family commitments
- ✓ 40% lower fees than other universities
- ✓ Access to student loans for UK students
- ✓ Latest industry CAD & Simulation software FREE

95% OVERALL SATISFACTION
National Student Survey Results 2018

> *"The National Motorsport Academy Online Degree course is a very useful tool for somebody that maybe went straight into work from school & missed university. It gives them a second chance to get that incredible qualification, online, whilst working & develop their career."*
>
> *Rupert Manwaring.*

NMA has students from Formula 1, The World Endurance Championship & The World Rally Championship!

https://motorsport.nda.ac.uk **+44 (0)1159 123456**

Hone/LAT

ABOVE Fans need to see wheel-to-wheel combat, not an easy and inevitable change of position on a long straight

Racing must become more exciting and accessible if it is to compete with the alternatives, says **Sergio Rinland**

THE FIGHT FOR SPACE

AN advertising magazine about computer/video games arrived recently with my Sunday paper. Sixty-eight pages of games!

They catered for every conceivable taste: cowboys, space warriors, Roman wars, football, cars; you name it, they have a game to play in your computer. As I shook my head in disbelief, a thought dawned on me: this is what motorsport – and F1 in particular – are up against!

When I was a teenager, we could go to a scrap yard, buy some old engines, gearboxes, even cars, and with hard work from us and a bunch of friends, we would build a race car for peanuts and go racing. The other alternative, at a similar cost, was to go and play football somewhere.

Today, we have two problems: first, the cost of grassroots racing, as with all motorsport, has gone through the roof and only kids with wealthy parents, willing to part with their spare cash, can start racing somewhere; the second is that these young fellows have an unbelievably wide range of choice of what to do for entertainment. Going to kick a ball somewhere and dreaming of one day becoming a Lionel Messi, is still possible; going racing in karting and dreaming to one day becoming a Lewis Hamilton, which would cost a small fortune, is only for the privileged few.

So, is motor racing becoming just a sport for the wealthy? It always was. It's just that in this day and age getting there by talent alone with a small investment, as was conceivable up to a few years ago, is virtually impossible.

The million dollar question, something I am sure Liberty Media is working hard at, is: 'How do we attract the young generations to our sport?'

On one hand, we have to promote disciplines at the bottom of the motorsport ladder that are affordable to Jo Average, such as karting or small single-seater formulae.

> *"Create the motorsport version of 'The X Factor' and that would get young people interested"*

Formula 1 could very well subsidise the promotional series. Create the motorsport version of '*The X Factor*' and that would get young people interested in participation in the sport. Then we could search for the next Hamiltons, Vettels or Alonsos.

On the other hand, we need to attract the 'computer game generation' to be entertained by motorsport. Is motorsport boring these days? More than it was in bygone years? Perhaps, though we still get very entertaining Formula 1 races. Do we need artificial methods to make it more interesting? Is DRS the answer? Yes, we get overtaking, but we seldom get close racing. And close racing is what we want to see: overtaking should be a consequence of close racing, not the purpose in itself. Is it exciting to see a car pass another in the middle of a straight with a performance advantage? Surely not!

Some people propose ideas like reverse grids, qualifying races started in reverse championship order, Joker laps as used in rallycross, or Fan Boost as in Formula E. All those are artificial; people do not get excited by those moves.

Hamilton, Vettel or Verstappen starting at the back of the grid because of penalties or failures, cutting through the field like a hot knife on butter, that brings some entertainment, but it's hardly super-exciting when differences are so big. What we want to see is wheel to wheel racing, so the regulations should be such that the aerodynamic effect of running close to each other is not of huge detriment to performance – certainly no more than a driver could overcome by taking some risks. That is what we want to see.

If that happens, in Formula 1, 2 or 3 and in touring and sportscar racing, young people on the lookout for excitement and entertainment will be drawn back to watch motorsport. Only then will we be able to compete with all those computer games.

Creating motorsport computer games could be a revenue stream, just like selling tee-shirts and hats, but it is not the way to compete with the other computer games. Don't fight them at their own game; they know it better. Motorsport has to compete with other ways of entertaining by doing what motorsport knows best, and that is delivering exciting car races.

FOM and the FIA are working hard to achieve that in F1, but if they don't tackle the other formulas in parallel, it will be a lot harder to implement. Why? Because if you need to slow down F1 as a consequence, it cannot be too close to F2 in terms of lap time and this to F3 and so on, so changes have to be on the whole at the same time. Too expensive, perhaps, but think about this, it will be a lot more expensive when we are on The Road of No Return.

Let's build anything together.

No, really, it's up to you. By partnering with GE Additive, your factory comes equipped with an increased level of choice, flexibility and design freedom. Now, you can create products that are stronger, lighter and more efficient. Which means, the next thing you make could be anything. Let's build anything together. **Learn how to transform your factory into an Anything Factory at ge.com/additive.**

GE Additive

Some teams
already know the secret...

It's Quicker™

PRI
DECEMBER 6-8, 2018

EXHIBITOR
BOOTH # 4123

verizon indycar series

OFFICIAL BRAKE
SUPPLIER OF
THE VERIZON
INDYCAR SERIES

PFC BRAKES

www.pfcbrakes.com

800.521.8874