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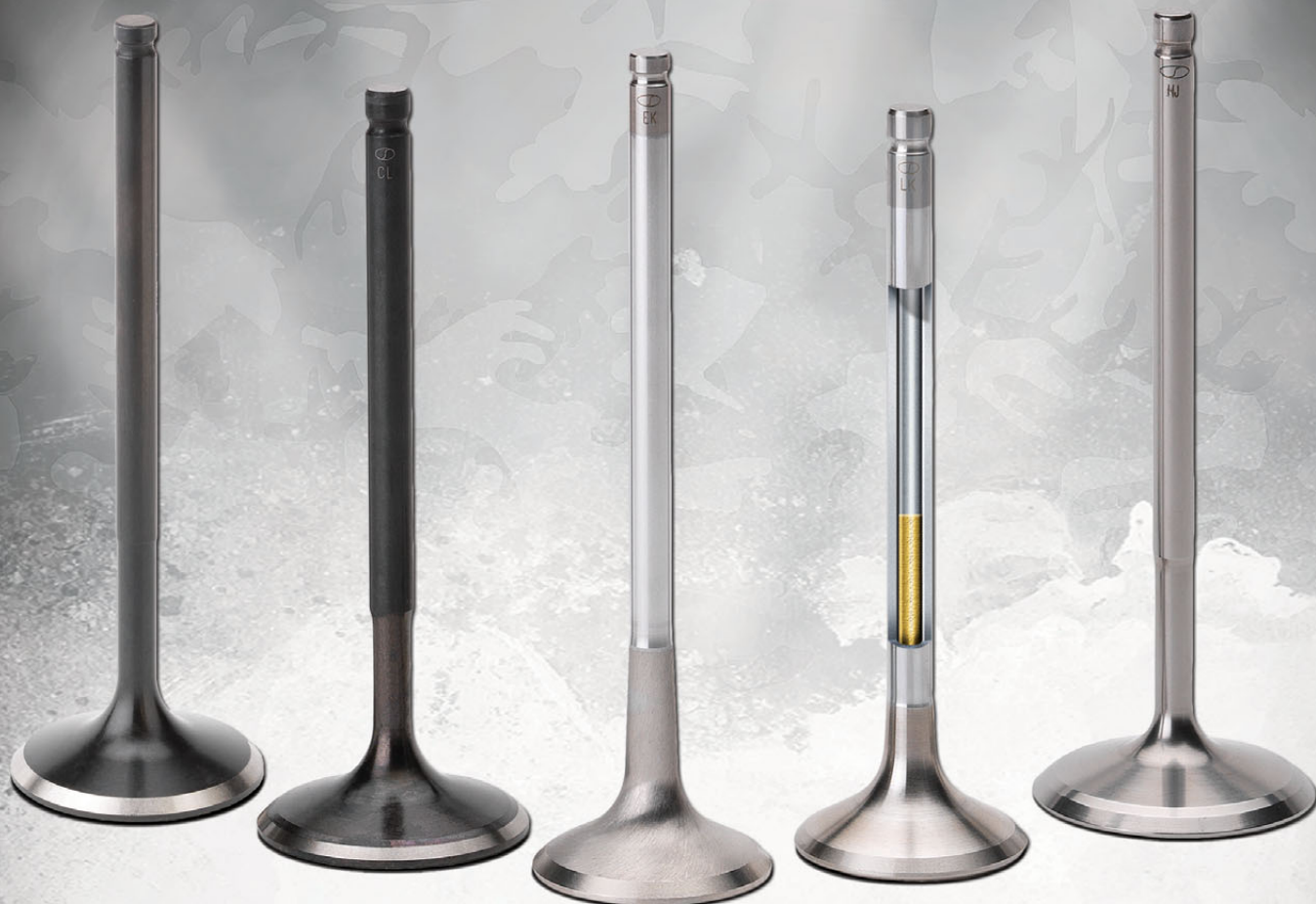
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DON'T BE SCARED OF MONSTERS

If motorsport is to thrive, rather than merely survive, it must have relevance to the rest of the world.

Which is one of the reasons we have focused on truck racing in our lead news pages.

Predictably, perhaps, the discipline was Born in the USA. Equally unsurprisingly, many have often been quick to dismiss it as some kind of 'freak show' since it arrived in Europe in the 1980s.

Nevertheless, these racing beasts have the capacity to fire the imagination like few others and that can be a powerful tool. One of RACE TECH's staff was once fortunate – not the word he used at the time – to be driven around the Goodwood race circuit by one of the truck racing stars. It certainly prompted him to revise his opinion of the discipline.

The racing action can be spectacular, but what about the technology? Aren't we talking 'dirty diesel'? Not any more. The FIA has made sustainable tech a central pillar of its continued support for the discipline, starting with a deal for the TotalEnergies group to supply the series with renewable bio-diesel made from Hydrotreated Vegetable Oil.

This is just the start of a quest to use truck racing to help galvanise the road haulage industry. It's a giant task – in more ways than one – but what a worthy one, for the path of the pandemic has highlighted the importance of the transport industry like never before.

The pandemic also illustrated how, when freed from their obsessive analysis of the details of a racecar, motorsport engineers could be such a mighty force for good. A year ago, that effort was channelled into the scramble to produce Personal Protective Equipment and

breathing devices. In our news section this month, you can read how Project Pitlane's good work is still ongoing.

If ever we needed confirmation of just how talented our design superstars are, it's worth reading this month's Expert Witness feature too. In it, our source reveals just how long – and cunningly – the top teams have been harnessing aero elastic behaviour to create a 'soft' version of the Drag Reduction System long before most of us had ever heard the dreaded term "DRS".

Rather wistfully, perhaps, they also ponder the fact that if these engineers are chasing efficiency, which they are, then perhaps we ought to review the regulatory process to encourage such a trait?

That desire for efficiency brings us full circle to the FIA's ambitions for truck racing. Can it be harnessed as a tech laboratory, and as a showcase?

Maybe. Certainly truck racing's popularity is beyond dispute. More than 500,000 players participated in the European Truck Racing Championship's first ever gaming event. It boasts an impressive social media footprint too.

'So what?' you could argue. After all, my wife has a lot of Facebook friends, but that doesn't mean she's going to save the planet. But if motorsport could be the catalyst for the transformation of the road haulage industry, that just might...



William Kimberley
EDITOR



MISSION TO TRANSFORM ROAD HAULAGE INDUSTRY THROUGH TRUCK RACING

Mark Skewis reports on the FIA's introduction of sustainable tech, starting with renewable bio-diesel made from Hydrotreated Vegetable Oil

A DEAL with French energy giant TotalEnergies spearheads the FIA's attempt to prepare the platform of truck racing for the future.

The FIA European Truck Racing Championship raced into a new era last month at the Hungaroring. The event marked the first time that the trucks were powered by fuel fully originated from renewable sources, part of the new three-year agreement between the FIA and TotalEnergies.

Since 2019 the FIA Truck Racing Commission has been working on a sustainability roadmap to progressively

implement environmentally friendly power sources to truck racing, with the introduction of biofuel set as the short-term objective.

Following the official tender process and the approval of the FIA World Motor Sport Council, for 2021 the FIA ETRC switches to 100% sustainable fuel, the HVO100 biodiesel supplied by TotalEnergies, becoming the first FIA-regulated competition to do so.

The change reflects FIA ETRC's efforts to become the leading platform for sustainable technologies in the road haulage industry, at the same time making truck racing a relevant research and development platform for manufacturers.

HVO EXPLAINED

HVO stands for Hydrotreated Vegetable Oil and is a premium fossil-free diesel product made of 100% renewable raw materials, which does not release any new carbon dioxide into the atmosphere.

It is produced by hydrotreatment of vegetable oils and animal fats. The result is a premium quality fuel, with a chemical structure nearly identical to regular diesel, that can be used in a regular combustion engine without the need for any modifications.

TotalEnergies produces its HVO100 biodiesel from a fully renewable supply.

Owing to its high cetane number, the HVO has a positive impact on performance compared with conventional diesel fuel.



LEFT The ETRA is to showcase new tech that could galvanise the road haulage industry

Furthermore, it also reduces exhaust emissions and combustion noise, also achieving better cold-start performance, thus making the product well suited to the requirements of the truck haulage industry.

HVO meets the Advanced Sustainable (AS) fuel criteria, which state that the fuel must reach greenhouse gas emissions savings of at least 65% over the entire cycle from well to wheel. It also complies with the European Union's Renewable Energy Directive II (RED II).

The introduction of HVO was hailed by Georg Fuchs, European Truck Racing Association Managing Director, as: "a significant step on our way to a more sustainable future".

BELOW

TotalEnergies's La Mède facility is a world-class biorefinery, located near Marseille, France, with a production capacity of 500,000 metric tons of HVO biodiesel per year



TotalEnergies

"We want to use our platform to drive change and adopt a leading approach to accommodate a variety of technical developments to reduce greenhouse gas emissions on track," he added.

"We want to take the championship to the next level and be at the forefront of the industry with our clear objective: we want to become the leading platform for sustainable technologies in the road haulage industry on and off the racetrack."

Pierre-Gautier Caloni, VP TotalEnergies Compétition, said: "We share the ambition of FIA and ETRA on the road to a sustainable future and this is in line with TotalEnergies's road map to get to net-zero emissions for its global business by 2050, together with society. At TotalEnergies we are using the track as a real laboratory to develop the future of sustainable mobility and FIA ETRC is a clear demonstrator."

“We have a great platform and it's our responsibility to utilise it to drive change”

THREE PILLARS

As part of its transformation, the European Truck Racing Association will focus on the three strategic pillars of safety, sustainability and shortage of professional truck drivers. It has also committed to the Paris Agreement – to reach net zero by 2038 at the latest – to take the championship into its next chapter.

Last year ETRA, its shareholder ADAC Mittelrhein as well as the FIA, committed to these three key priorities when extending its promotion contract with the FIA for the European Truck Racing Championship until 2025.

While continuing to highlight the central issues of safety, the ETRC will maintain its efforts in promoting some of the key challenges in the truck and road haulage industry and the shortage of professional truck drivers across Europe through the 999#onetruckfamily initiative. The pandemic has underlined just how important truck drivers are in everyone's lives for the supply of everyday items.

"We have a great platform and it's our responsibility to utilise it to drive change," said Fuchs. "We will adopt a leading approach to accommodate technical developments in the industry while maintaining our unique and beloved character of racing excitement with a strong attachment to our fans. If we can show that new developments work reliably in the extreme conditions of racing, it will help people to understand and accept new technologies." ▶



FIA

LEFT The European Truck Racing Championship is to use HVO100, a 100% renewable fuel from TotalEnergies

NEW TECHNOLOGIES

The introduction of HVO100 in the FIA ETRC is part of the FIA's long-term strategy to implement sustainable power sources across its portfolio of motorsport disciplines. Its aim is to set an example in the reduction of CO2 emissions by leading the development and promotion of new technologies throughout its competitions.

Manuel Vidal, FIA Truck Racing Commission President, said: "Introduction of sustainable energies to motorsport is one of the key strategic objectives of the FIA for the years to come. It's important that we identify which form of them is the most relevant solution for each of our competitions. Therefore, we're delighted to have FIA ETRC paving the way with the switch to HVO100 biodiesel. Through relevance to the truck haulage industry this reflects our race-to-road approach and proves that motorsport can be a laboratory that serves a greater purpose."

Motorsport's positive contribution to the environment is also one of the four pillars of the FIA's #PurposeDriven movement, with the other three being contributions to areas such as health and safety, diversity and inclusion as well as community involvement and development. **RT**

Great past, shaping the future

FROM Formula 1 to the World Rally Championship, and from Le Mans to Moto GP, the TotalEnergies group's DNA is woven into the fabric of motorsport.

It is best known in single-seater racing for its Elf brand, which has scooped titles with the likes of Renault, Lotus, Williams and Red Bull. In the WRC and World Endurance Championship, meanwhile, the company has dominated in its own right with the Total brand's collaboration with both Citroen and Peugeot.

It recorded the first electric lap at Le Mans with the Nissan ZEOD RC in 2014 and it is the 24-hour race which typifies the brand's commitment to developing future technologies. TotalEnergies is a partner in the ground-breaking Mission H24 project, which aims to have a class of hydrogen-powered cars racing in the endurance classic in 2024.

Hydrogen propulsion is one of the pillars of the group's plans to go carbon neutral by 2050. However, it appreciates that different technologies will serve the needs of different industries, and therefore will not attempt to dictate the direction of the technology roadmap. Accordingly, it is investing in electricity, green hydrogen and biofuel. **RT**



ABOVE The group is playing a central role in the introduction of hydrogen propulsion at Le Mans

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Ferrari seals Amazon data deal

SCUDERIA Ferrari has entered into a new technical and commercial partnership with Amazon Web Services. Mattia Binotto, Managing Director and F1 Team Principal, said that the deal would, "transform Ferrari into an organisation driven by data analysis".


For over 15 years, AWS has been the most popular cloud platform. It has continuously expanded its services in high technology fields such as machine learning and artificial intelligence.

The technical partnership will cover the F1 team, but also GT racing, the Challenge series and the road car business. Ferrari and AWS will also jointly develop a new fan engagement platform which, through personalisation tools, exclusive content and interactive applications, is intended to strengthen the relationship with the millions of its fans.

"Ferrari and AWS are both exceptional in their respective spheres of activity and I am pleased to welcome a partner known for the excellence of its innovation and creativity," said Binotto.

"As the Official Cloud Provider, AWS will be able to transform our company into an organisation driven by data analysis, that uses the power of this technology, not just to improve our products, but also to better relate

with the millions of fans we have around the world.

"We have chosen AWS because of its constant drive for innovation, the wide range of solutions for machine learning and its proven experience in supporting partners on a global scale. AWS is without equal in terms of its portfolio of cloud services, including computer vision and machine learning and we intend to exploit that to strengthen and speed up our ability to analyse data." 



RIGHT AWS has been added to the F1 team's livery

Capacity crowd for British GP pilot event

THIS month's British Grand Prix will be run as a pilot event and feature a full capacity crowd – making it the biggest number of people assembled at any UK sporting venue since the start of the COVID pandemic.

The Silverstone race has been included in the latest phase of the UK Government's Event Research Programme (ERP), allowing a full turnout of 140,000 fans.

Ticket holders will be asked for either proof of a negative lateral flow test taken within 48 hours of arrival at Silverstone, or proof of full vaccination, the second dose having been received at least 14 days prior to the first day of attending the British Grand Prix.


The Silverstone team will be working closely with the ERP experts and particularly the Director of Public Health in Northamptonshire on the specific conditions of entry that will enable the event to operate safely.

Stuart Pringle, Managing Director of

Silverstone, said the race offers, "an amazing, safe opportunity to show the world how Britain has dragged itself back on track following the fight against the pandemic."

"This is something we have all been working towards for months," he continued. "Many of our fans rolled their tickets over from 2020 but they are now

well placed to enjoy what is sure to be one of the highlights of the summer."

Stefano Domenicali, President and CEO of Formula 1, said: "It is fantastic news that Silverstone will be a full capacity event and it will be an incredible weekend with hundreds of thousands of fans being there to see our first ever Sprint event on the Saturday and the main event on Sunday." 



LEFT Silverstone has been selected as a trial event by the UK government

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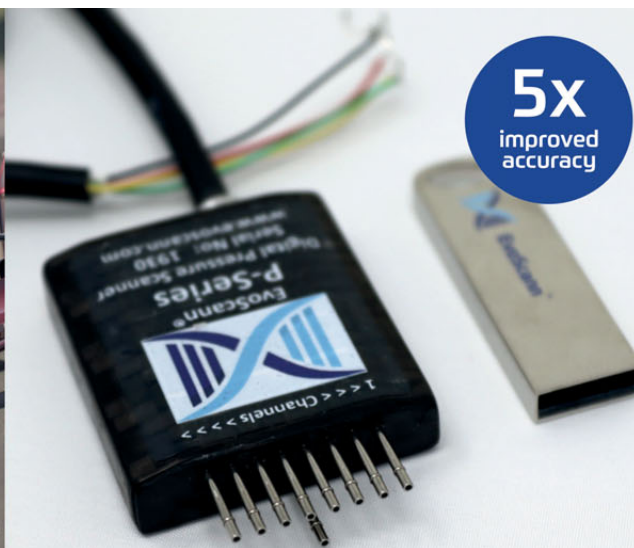
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Sportscar racing bonanza as BMW joins LMDh ranks

BMW is to return to the top flight of endurance racing with a factory team after a 20-year absence.

It has joined Porsche, Audi and Acura by committing to develop an LMDh car for use in the North American IMSA series in 2023. The move sets up the mouth-watering prospect of the IMSA cars taking on the Hypercars of Toyota, Peugeot and Ferrari at the Le Mans 24 Hours.

"BMW is back on the big motorsport stage," said Markus Flasch, CEO of BMW M GmbH. "In entering the LMDh class, BMW M Motorsport is fulfilling the prerequisites to challenge for overall victory at the most iconic endurance races in the world from 2023.

"We will be fully focussed on tackling this challenge. There is a spirit of optimism here. BMW has a successful history in prototype racing – the Le Mans

ABOVE How BMW announced its return to the big-time

victory in 1999 was unforgettable. Reviving this story in a modern prototype with M Power will thrill fans of BMW M Motorsport. The LMDh concept guarantees maximum cost control and offers a wide range of possible applications, including the IMSA series in North America, an extremely important market for BMW M. We are all eager to get stuck into the LMDh category with a compact and highly-efficient team set-up."

Mike Krack, Head of BMW M Motorsport, will be responsible for the development, testing and race outings of the new car. He added: "Everyone in our motorsport team shares the same motivation: we want to test ourselves against our strongest opposition at the racetrack and to celebrate victories for BMW. As such, the LMDh project is a real affair of the heart for us and exactly the new challenge we were hoping for. We have a lot of work ahead of us, but the anticipation is immense."

The regulations for LMDh cars stipulate that they have both a combustion engine and an electric motor. While each manufacturer may develop their own combustion engine, the electric motor, battery and transmission are standard parts supplied by Bosch, Williams Advanced Engineering and Xtrac.

The chassis, based around an LMP2 machine, will also be built by an external partner.

A BMW M Motorsport works involvement, with two cars, is planned from the 2023 IMSA season.

The last big win for a BMW prototype came in 1999, when the BMW V12 LMR won the Le Mans 24 Hours. The car also won the 12 Hours of Sebring in the USA in the same season. **RT**

Marelli and 1NCE partnership to deliver new telemetry solutions

MARELLI Motorsport and 1NCE, the world's first full-fledged operator of IoT network services, are joining forces to develop new real-time tracking solutions in the world of motorsport.

Marelli Motorsport is currently engaged in cellular connectivity use-case trials, developing new telemetry systems to collect real-time car and engine data, such as acceleration, g-force, speed, motor temperature, rpm, alarms, or remaining fuel. Standardized cellular connectivity networks already exist worldwide and can easily be utilized for device communication of sensors in a racing environment.

What's been missing so far, says Marelli, was a globally standardized offering, giving customers the ease to implement cellular

connectivity into their products.

As a technology partner of Deutsche Telekom and with its own cloud native IoT platform, 1NCE represents the link between cellular telecommunication networks and modern cloud applications. 1NCE's offering is available in over 100



ABOVE Marelli Motorsport is delivering new telemetry solutions

countries worldwide at a fixed price over all possible bearer technologies such as 2G, 3G, 4G, NB-IoT and LTE-M. This can be combined with a powerful management platform that helps to automate device onboarding and management with leading cloud applications.

"By offering globally available and easy to implement cellular connectivity, we found 1NCE to be the perfect partner for our needs", said Riccardo De Filippi, Senior Vice President and CEO of Marelli Motorsport. "Combining a worldwide presence and a simple pricing structure, 1NCE delivers the ideal connectivity solution for our upcoming telemetry products. Once set up, we can start using them immediately on any of our motorsports locations around the world."

"Considering myself a big racing fan, I'm all the more pleased about the partnership with Marelli Motorsport," commented Alexander P. Sator, CEO of 1NCE, of the deal. **RT**



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either a Formula E or an LMDh sportscar programme at a later date.

Zak Brown, CEO, McLaren Racing, commented: "From the moment Extreme E was announced we have been following the progress of the series closely. Our attention was immediately drawn by the innovative format of this motorsport platform, in particular the ability it gives us to accelerate and boost our own overarching sustainability agenda, which shares the same priorities of decarbonisation, waste reduction, diversity and equality.

"At the same time, it will enable us to reach a new audience with an innovative race format, connect with a new generation of fans through content served across a variety of channels and provide partners with a purpose-led competition platform to align with and share in a positive, powerful narrative.


"From the outset, McLaren has always been at the forefront and never afraid to push new boundaries. This new venture is true to our roots of participating in a variety of categories, innovation and bravery. Extreme E is paving new ground in motorsport as a force for good in confronting some of the biggest challenges facing our world today and in the future.

"While Formula 1 will always remain at the centre of our world, like IndyCar and esports, our entry into Extreme E is additive to the McLaren Racing franchise and will complement and help support all our programmes. We will be competing against big names we're very familiar with from F1 and IndyCar but, like all series we compete in, the competition objective is clear: we are there to win."

Extreme E highlights the impact of climate change in some of the world's most remote environments, promoting the adoption of electric vehicles to pave the way for a lower carbon future.

The series aims to minimise environmental impact but maximise awareness, racing in places that have already been damaged or affected by climate change, taking fans deep into the heart of the most pressing environmental issues facing the planet. At the same time, the series has built-in equality and diversity, with each team fielding one male and one female driver.

McLaren Racing has been a leader in electric motorsport from the outset, supplying much of the powertrain for the Gen 1 Formula E car and, in collaboration with Atieva from Silicon Valley, the battery for the Gen2 car.

The team will be operated by McLaren Racing using both existing personnel from outside the Formula 1 programme and additional specialist resource. 

ABOVE Brown and Agag seal the deal at the McLaren Technology Centre

McLaren entry a "huge endorsement" for Extreme E

EXTREME E founder Alejandro Agag has welcomed McLaren Racing's entry as "a huge endorsement" of the all-electric off-road series.

The team will compete in the five-race global championship in 2022, helping to accelerate McLaren Racing's own sustainability and diversity agenda.

"Extreme E's mission is to use sport to build awareness and accelerate clean technology innovations that benefit the mobility industry and beyond," said Agag. "To have McLaren on board, which symbolises the highest level of racing and automotive innovation, is a huge endorsement that what we have delivered in just our first two races of Season 1 has already created real impact in motorsport.

"We are absolutely thrilled to welcome the powerhouse McLaren Racing team to Extreme E."

McLaren was in the process of evaluating a number of categories, but felt it needed to act fast before the 12 Extreme E franchises were filled. It hasn't ruled out

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Porsche steps up electric offensive

PORSCHE is investing a high double-digit million amount in a new company, Cellforce Group GmbH, to produce high-performance battery cells – and has pledged to test its new technical developments in motorsport.

“The battery cell is the combustion chamber of the future. As a new Porsche subsidiary, the Cellforce Group will be instrumental in driving forward the research, development, production and sales of high-performance battery cells,” said Oliver Blume, Chairman of the Executive Board at Porsche.

“This joint venture allows us to position ourselves at the forefront of global competition in developing the most powerful battery cell and make it the link between the unmistakable Porsche driving experience and sustainability. This is how we shape the future of the sports car.”

“It is only logical for us to develop and build the key technology of the future – the battery cell – ourselves,” said Michael Steiner, Member of the Executive Board, Research and Development at Porsche. “It is just as logical that we first test this new high tech in the most competitive of environments – motorsport. Our electric sports car Taycan also received key developments and its leading technical features from the racetrack, from the Le Mans-winning Porsche 919 Hybrid.”

Cellforce is the result of a joint venture between Porsche and Customcells, with Porsche holding a majority stake of 83.75 per cent. The number of employees is expected to grow from the initial workforce of 13 provided jointly by both companies

ABOVE Porsche chiefs at the launch of the new joint venture vowed to test new cells in racing

to up to 80 by 2025.

The chemistry of the new high-performance cells relies on silicon as the anode material. With this material, it now seems possible to significantly boost the power density compared to current good series batteries. The battery can offer the same energy content with a smaller size. The new chemistry reduces the battery’s internal resistance. This allows it to absorb more energy during energy recuperation and at the same time it offers improved performance for fast charging.

Another special feature of the Cellforce battery cell is the fact that it is better able to withstand high temperatures. These are all qualities which are highly valued in motorsport. In addition, use on the racetrack does not necessarily require the battery to function in sub-zero temperatures nor remain stable for years over many charging cycles – goals which have yet to be achieved with this new cell technology.

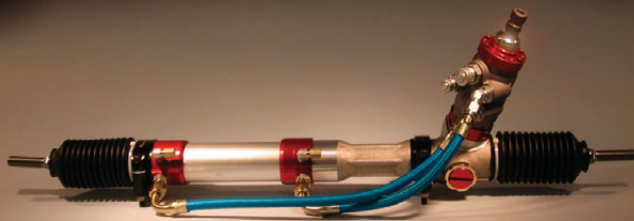
The world-leading chemical company BASF has been chosen as a cell development partner for the next generation of lithium-ion batteries. **TI**

BELOW The 919 Hybrid improved Porsche’s battery expertise



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LEFT Does the pit stop directive target Red Bull?

Red Bull claims it is victim in pit stop controversy

SUSPICIONS that some teams were using fully automated pit stop release systems underpinned an FIA technical directive that sparked fury from Red Bull team principal Christian Horner.

The directive, issued ahead of the Styrian Grand Prix at Austria's Red Bull Ring, will come into force at next month's Hungarian GP. It mandates a minimum 0.15-second delay between the wheel nuts being confirmed as tight and the mechanic operating the jack dropping the car, and 0.2 secs from the jack going down to the driver receiving the signal to leave the pits.

The rules say that both situations should be triggered manually. Insiders see it as a direct response to fears that some systems were fully automated within the pit-stop equipment.

An FIA spokesman said: "The key point is that this is a proactive safety update, building in some required latency into the procedures in order to ensure the decisions are being taken by the equipment operators rather than being automated, and thus to

protect the pit crews from incidents similar to the one seen in Bahrain a few years ago."

This is a reference to an incident in which a Ferrari mechanic suffered a broken leg when Kimi Raikkonen was released too early from a pit stop in Bahrain in 2018.

Red Bull team principal Christian Horner suggested that rivals had deliberately targeted his team, which has a reputation for consistently producing the fastest stops in the pit lane.

"If you can't be beaten, then the most logical thing is for your competitors to try and slow you down," said Horner. "And that's obviously what's happening here."

Mercedes team principal Toto Wolff admitted his team had made an inquiry to the governing body about pit stops.

"We inquired with the FIA on a safety mechanism, which is related to a system that we were using, and whether that could be optimised," Wolff said. "It was a technology question. So did that trigger anything else? Maybe. I don't know."

Horner responded: "To have to hold

the car for two tenths of a second, you could almost argue it's dangerous because you're judging your gaps. The guy that's releasing the car is having to make that judgement, and I think that it's not been well thought through.

"F1 is about innovation and competition. Seeing pit stops sub-two seconds is a remarkable feat and we should be encouraging it, not trying to control it.

"I find it a little disappointing. It's the duty of the competitor to ensure that the car is safe, and the penalty for a wheel not being fixed is you have to stop the car immediately. So it's a brutal punishment, if you haven't got all four wheels securely and safely fastened. So what the technical directive is trying to achieve, I'm not quite sure because I think there's an awful lot of complexity to it."

Horner said he believed Red Bull was being deliberately targeted, following recent rulings aimed at ensuring teams were not using flexible rear wings and mandating stricter tyre-operating protocols. Both followed claims that Red Bull had been finding legal ways to run its car in a manner that was not intended by the rules.

"You can see there's an awful lot of pointed activity in our direction at the moment," commented Horner. "That comes with the territory of being competitive. An awful lot of energy is going into trying to slow the car down which is what obviously happens in a competitive business." **RT**

Essential BOOK for the motorsport engineer's library:

Making Sense of Squiggly Lines: £40

The Basic Analysis of Race Car Data Acquisition by **Christopher Brown**

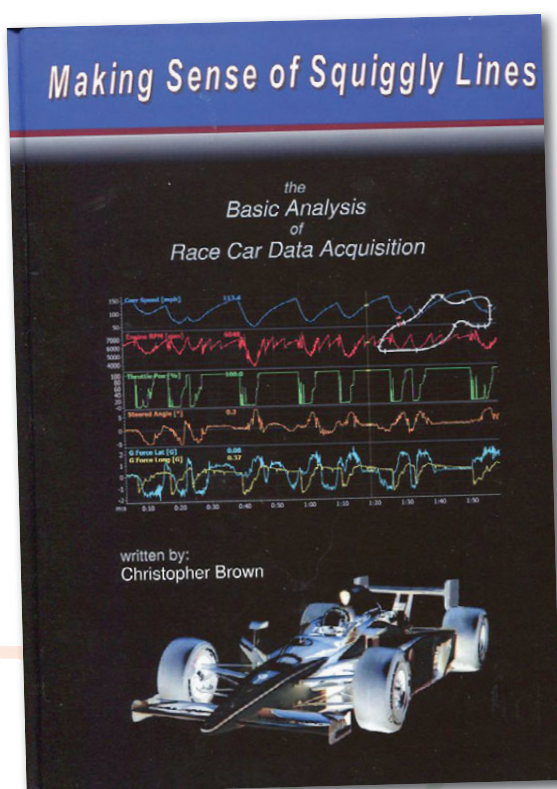


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Prodrive supports global events from Banbury

PRODRIVE has created a remote support hub to provide real time technical support for its hundreds of race and rally customers competing across the world.

The remote support hub is housed in the company's headquarters in Banbury, UK, with live data feeds allowing engineers to monitor the performance of customers' cars while on events. With cars competing everywhere from Australia and Asia to the Middle East, Europe and the Americas every weekend and COVID travel bans and quarantines making it difficult to attend events, the hub was set up to ensure customers could still receive the best technical advice.

Gus Beteli, head of performance at Prodrive, said: "Our primary aim is still to have engineers and technicians on stages and at circuits whenever possible as there is nothing to beat that face-to-face contact. However, some outright travel bans and lengthy quarantine periods mean remote support is often the only practical option."

While COVID restrictions were the catalyst for the remote support hub, Prodrive has found that it is now helping many customers, where previously on-event technical support was not deemed

necessary. From the remote support hub in Banbury, engineers can live stream cars' telemetry from anywhere in the world, analyse the data and provide advice directly to the teams and drivers on the ground.

"The time and cost savings of not having to travel around the world means we can

offer a very cost-effective remote service," said Beteli. "This has led to a significant increase in the number of customers, who previously ran their cars themselves, now seeking our additional technical support, which can help find those fractions of a second which make the difference between winning and losing." **RT**



RIGHT The remote support hub has proved an effective way of functioning

Control opens North American office

CONTROL, a leading cellular telemetry solution provider in motorsport, has opened a North American facility in the heart of Motorsport Valley in Davidson, North Carolina.

Richard Hull, who joined Control as VP of Sales in November 2020, will be heading up the new office to bring local support and services to the company's North American customers.

"The road has been longer than expected to get to this point," said Hull. "Trying to start a new business and organise visas in

the middle of a global pandemic has created some delays. But the team's commitment to bringing Control to North America has been unwavering and we are glad to finally be here and ready to work with our expanding customer base on this side of the pond.

"It is a great achievement by the whole team to be able to grow into this new region."

Initially the office will be a sales and support division. However, the long-term plan is to build its own engineering competency and expertise to better

manage the unique requirements of its customers in North America.

Founded in 2016, Control launched its first purpose-built telemetry modem in early 2017. Built with race engineer input, it was a huge success. The company has since launched its industry-leading TLM-P1 and TLM-P2 solutions to establish itself as a leading provider of race-winning telemetry.

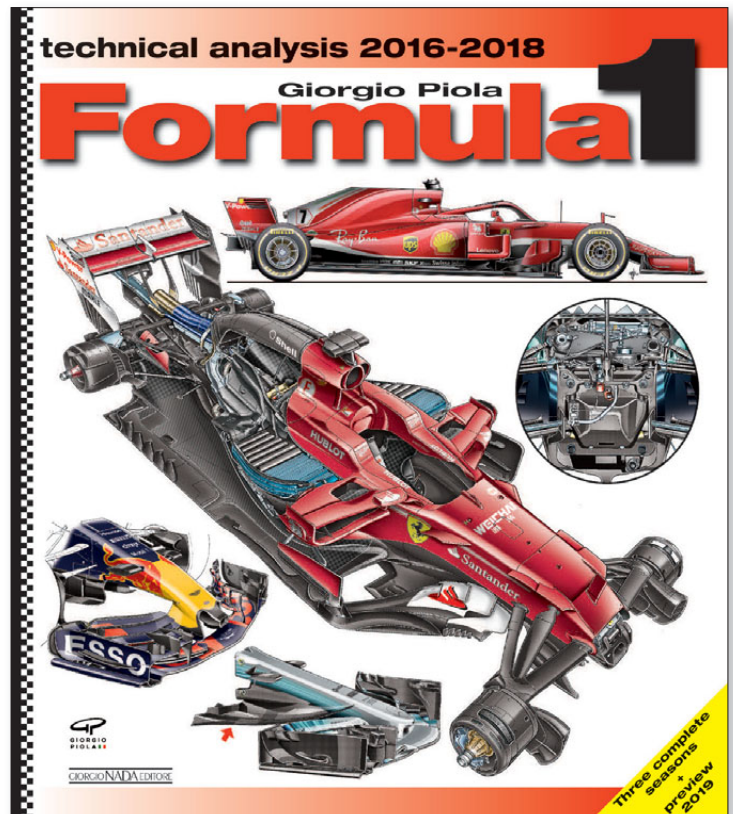
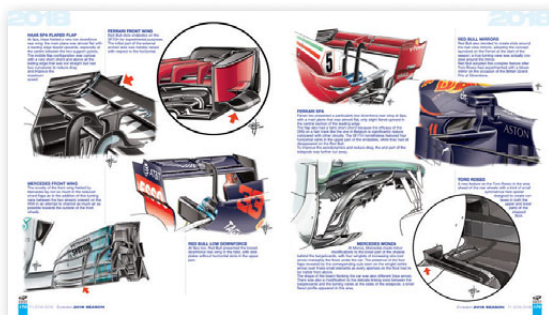
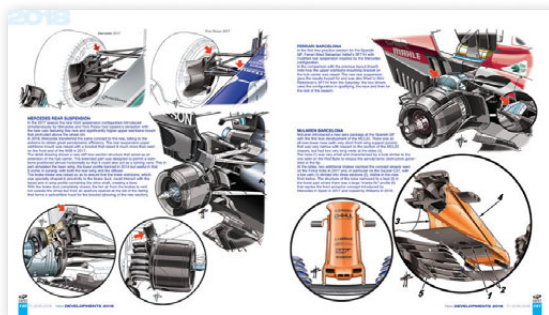
Control currently has customers in the IMSA WeatherTech Series, GT World Challenge America and was involved last month in the 99th edition of the Pikes Peak Hill Climb. **RT**

Giorgio Piola

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THE last edition of an automotive literary classic: the technical analysis of Formula 1 penned by Giorgio Piola. After 25 years of publication, the historic draughtsman brings the curtain down on this experience with a volume that examines the last three seasons, from 2016 to 2018, as always reviewing the principal technical innovations in the spheres of chassis and engine design. This three-year analysis is appropriately completed with a retrospective of some of Piola's most important drawings from a 50-year career that began back in 1969.

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Kreisel Electric batteries set to power the E1 Series RaceBirds

THE E1 Series and Kreisel Electric are joining forces to bring the world's first electric powerboat championship to the water. Kreisel Electric will supply the battery for each electric RaceBird powerboat competing in the E1 Series, set to begin in early 2023.

Kreisel is a pioneer in the electric vehicle battery industry with its customisable state-of-the-art lithium-ion battery module technology. Its immersion cooling technology has applications in both electric motorsport and powerboating.

The company is playing a key role in the World Rally Championship's switch to hybrids in 2022. It is also the exclusive powertrain provider of the FIA World RX1e Racing Kit.

With ocean and sea freight responsible for transporting approximately 90 per cent of global trade, the E1 Series aims to act as a testing ground for electric

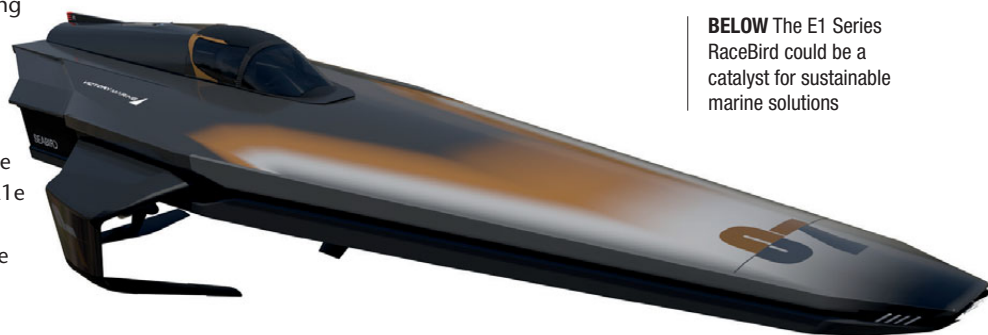
powerboats and speed up the transfer of clean marine technologies.

Using innovative hydrofoil technology, the series' electric RaceBird powerboats will rise above the water's surface, allowing for minimum drag and maximum energy efficiency. With a peak power of 150 kW and 35 kWh battery capacity, Kreisel's bespoke solution for the RaceBirds will enable them to achieve fast acceleration

and longer range between charges.

Rodi Basso, Co-Founder & CEO of E1, said: "E1 and Kreisel's shared vision to electrify future leisure craft made them the obvious choice as official battery partner for the championship. Electrification has a vital role to play in the decarbonisation of the ocean, seas and rivers, and Kreisel's cutting-edge battery technology will allow us to deliver on our mission to revolutionise marine mobility.

"As an engineer, I'm very excited to be working alongside leaders in their field to deliver an electric powerboat and push the boundaries of performance capability." **RT**



BELOW The E1 Series RaceBird could be a catalyst for sustainable marine solutions

Enel X joins Extreme E as smart charging partner

ENEL X has been announced as Extreme E's Official Smart Charging Partner.

The company, the innovative business line of the multinational energy group Enel, will provide charging technology, the JuicePump 40 Race Edition, to power the championship's all-electric SUV.

Francesco Venturini, CEO of Enel X, said: "Our role as Official Smart Charging Partner

of Extreme E is further confirmation of our commitment to pushing the boundaries of technological innovation in electric mobility. By providing our charging infrastructure to such an extreme racing competition, we can demonstrate that electric mobility truly has no limits, representing one of the best ways to combine sustainability and innovation to drive the energy transition."

Enel X was recently announced as one of the World's Most Innovative Companies for 2021 by the prestigious Fast Company. It was recognised for its smart EV charging solutions, including JuiceEco and JuiceNet Green, that charge electric vehicles with clean energy.

The company has a firm commitment in the motorsport sector to develop and test advanced technologies. It has strong roots in the energy industry, working across sustainability, digitalisation and innovation. As the world's complex energy landscape grows, Enel X is developing and executing custom energy strategies by empowering organisations and consumers to take practical steps to reduce carbon emissions.

Alejandro Agag, Founder and CEO of Extreme E, said: "Extreme E and Enel X share a very common goal around the utilisation of electric vehicles in the world. We are demonstrating their capabilities through the excitement of motorsport and Enel X is working on innovative solutions to ensure we can charge these vehicles in the most sustainable way possible." **RT**



ABOVE Enel X will charge the SUVs

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F1 engineers help create innovative device to aid COVID fight

FORMULA 1 engineers have collaborated with academics to produce a pioneering new device to help doctors and nurses communicate clearly whilst wearing personal protective equipment (PPE).

Head-to-toe PPE worn by medical staff treating patients with COVID-19 and other infectious diseases has meant that doctors and nurses regularly have to shout to be heard, which is not only exhausting, but can cause errors of miscommunication which could potentially harm patients.

Tim Coats, a Professor of Emergency Medicine and Associate Dean for Clinical Data Science at the University of Leicester, and consultant in emergency medicine at Leicester's hospitals, created the MedicCom in collaboration with Project Pitlane, a collective of seven UK-based Formula 1 teams.

The prototype MedicCom design uses a throat microphone to pick up and amplify sound, which enables patients to better hear the medical staff caring for them.

The same function also allows doctors and nurses to hear each other much more clearly, whilst a Bluetooth connection links to a mobile phone, enabling the doctor or nurse to hold a clear telephone conversation with the patient's relatives.

The device was positively evaluated

by clinicians in Leicester hospitals and Project Pitlane helped reduce the size of MedicCom with a more compact battery, lightweight circuitboard components and a smaller speaker and sealing mechanism.

Nine prototypes were then produced at Alpine's Enstone headquarters, with Alpine Strategic Advisor Bob Bell, Alpine's former Head of Electronics Jason Rees, and Red Bull Advanced Technologies' Andy Damerum working with Professor Coats on the project.

Professor Coats said: "Even if someone is standing next to you, if you're head-to-toe in PPE, you have to be shouting to be able to hear one another. Not only is that exhausting, but we know that this can cause errors of miscommunication which could potentially harm patients.

"Good communication has a profoundly positive effect on patient care, and that is why we started work on a solution.

"Working with the F1 engineers has been brilliant. We've been able to use their expertise in advanced electrical engineering and their facilities for rapid prototyping to produce in six months a device which would normally take years."

The MedicCom project was supported by KTN, which facilitated conversations between Alpine and the University of Leicester, and funded by UK Research and Innovation (UKRI) and Innovate UK.

Project Pitlane, which was setup in 2020 in response to the pandemic, comprises Red Bull, Aston Martin, Haas, McLaren, Mercedes, Renault/Alpine, and Williams. Mercedes and UCL notably collaborated to design and help mass-produce the CPAP breathing device, while Renault and Red Bull engineers helped produce the 'BlueSky' ventilator among many other crucial collaborations. **RT**



ABOVE & RIGHT Formula 1's engineers helped reduce the size of the device, with prototypes produced at Alpine's Enstone HQ



Bentley's Pikes Peak record bid foiled

ABOVE The truncated nature of the event scuppered Bentley's record attempt

BENTLEY'S Continental GT3 Pikes Peak, the company's first renewably-powered racecar, was thwarted in its attempt to add to the marque's record-breaking feats at the famous hillclimb.

Driven by former King of the Mountain Rhys Millen, it was the fastest racecar running on renewable fuel at last month's event, beating fully electric competitors. It finished fourth overall, second in Time Attack 1, crossing the finish line in 6:36.281.

However, snow and ice near the summit put paid to Bentley's record-breaking ambitions. It meant that the finish line was repositioned to be lower down the mountain at 12,780 ft at Devil's Playground, cutting out the last third of the normal course.

Jointly developed by a collaborative team of Bentley, Fastr, Roger Clark Motorsport, M-Sport and Rhys Millen Racing, the car set a blistering pace over the first two sectors, entering the third and final sector 12 seconds ahead of its nearest rival. A few corners from the finish, a boost pressure problem meant 16 seconds were lost, dropping Millen back to second place in class.

"We know we had the pace today both to win our class, and to break the Time Attack 1 record," commented Bentley's Director of Motorsport, Paul Williams. "The weather sadly wasn't with us though, with the shortened course meaning our assault on the record was never a possibility. While that's a bitter pill to swallow, I'm proud to have entered such


a strong renewably-powered racecar – the fastest at the event – and equally proud of the team that's delivered this project.

"This is the first step on Bentley's renewable fuel journey, and there will be many more opportunities to come. Perhaps we'll even come back to Pikes Peak next year..."

Dubbed the most extreme road car-based Bentley ever built, the machine developed more than 750 bhp in testing and 1000 Nm of torque from its reworked 4.0-litre V8. Its aerodynamics provided 30 per cent more downforce than a standard Continental GT3.

Bentley's entry was the company's third in recent years, following successful record runs in both a specially-prepared Bentayga (Production SUV record) and a Continental GT (outright Production Class record). It also marked the start of a long-term renewable fuels programme that has the ultimate goal of being able to offer genuinely sustainable fuels to Bentley customers.

The project signalled the start of a new focus on sustainability for Bentley's Motorsport department, with every area of Bentley now concentrating on delivering the brand's Beyond100 strategy to transform into the world's leading sustainable luxury mobility company.

The 750+ bhp Continental GT3 Pikes Peak is Bentley's first renewably-powered racecar, but it certainly won't be the last. 

BENDING THE RULES



As Formula 1 introduces new measures to clamp down on teams running flexible wings, we quiz our **Expert Witness** – an F1 insider who must retain anonymity – on a subject that has vexed the sport for decades

We've talked flexi wings to death before, haven't we? So what's new?

"At the Spanish Grand Prix this year it became more obvious that Red Bull were using enhanced aero elastic behaviour of the rear wing to improve its drag reduction with speed, particularly end of straight where it is most highly loaded. This has become much more difficult to conceal in recent times due to improvements in TV coverage, GPS data tracking and competitor analysis."

How did this latest storm come about?

"In this case their car led the race followed in very close proximity by a Mercedes for several laps. I would say a combination of driver comment, GPS analysis and rival competitor analysis pointed to a rear wing movement on the Red Bull at high speed that gave it an improved speed trace compared to expected. This is the most likely mechanism that raised the alarm."

Do drivers really have that sort of spare capacity to notice such things? Or is it more likely, as Red Bull team principal Christian Horner suggested, that this was Merc CEO Toto Wolff talking through Lewis Hamilton?

"The really top drivers definitely do. Those of us fortunate to have worked with those drivers have witnessed it in various situations: interpreting large screen information intended for spectators around the track while racing; the condition of an opponent's tyres compared to theirs; rival car geometries in parc ferme; and, in this case, a very frustrated and ▶

RIGHT The latest dispute arose after Lewis Hamilton spent time behind the Red Bull's rear wing in Barcelona





Red Bull



Mercedes AMG F1

probably confused Lewis directly behind a rear wing for more laps than he would have liked or expected. This would provide the catalyst for the team to then interrogate the GPS data and images much more closely."

Doesn't the use of the Drag Reduction System remove the need for flexi wings?

"No. DRS is only available in the activation zones on the circuit to the car following in close enough proximity and in qualifying. But what if you are trying to defend your position on track from attack from behind, or if you are simply in free air or isolated on track? You still would like that extra drag reduction bonus to improve your straight-line speed everywhere, and therefore guarantee better lap time. Over a race distance, all those increments really add up.

"The 'flexi' rear wing is in itself a 'soft' version of DRS. So when in front of another car, that is either utilising your slipstream or

has DRS and is trying to overtake you, it gives you a drag reduction speed boost allowing you to more successfully defend your track position. Almost certainly this was a contributory factor as to why Lewis was stuck behind Max for so long in Barcelona."

Be honest: have you ever been involved in designing a car to deliberately exploit flexi behaviour?

"Yes absolutely. Aero elasticity or component flexibility is also being deliberately applied to many other areas of the car for performance benefit."

If the amount of performance offered is small – as some of the protagonists insist – why are the teams making such a huge fuss?

"It's Formula 1. Every single piece of performance advantage and benefit is always aggressively sought after and carefully executed. The issue here is much more around the interpretation of the regulations. As

ABOVE Onboard cameras will be trained on new markings on the rear wing (circled) and used to monitor movement

RIGHT Red Bull's rear wing exploited enhanced aero elastic behaviour but passed all the legality tests



Red Bull point out in their defence, their car passed all of the FIA legality tests. However, the governing body, as well as requiring certain maximum deflections with load not to be exceeded, also need to see linear behaviour under load. It is this area that is being respected by some teams and not by others, hence the arguments and changes being sought."

How much of a performance advantage could flexing wings offer, in theory?

"In this case you could argue Red Bull have gone slightly too far as it was obvious enough to be spotted, but depending on how effective the implementation was, a 5 to 10 kph advantage could be achieved over a non-aero elastic solution."

The FIA is said to have a crack team of tech experts looking after the policing of the sport, so how come they can't devise tests to stop flexi wings?

"There are many static tests on several areas of the car to measure and limit deflections already, including both front and rear wing assemblies. What this issue highlights are these results are agreed and published by a definitive regulatory process. A large group of incredibly talented F1 engineers then spend an inordinate amount of time and effort interpreting them and figuring out if there is still scope to circumnavigate what is written to still achieve a performance advantage.

"That's exactly what has happened

"Aero elastic behaviour of the rear wing has become much more difficult to conceal"

here, so the regulation process needs to restart again, as it has done in the past, to come up with a tougher test that removes the opportunity that has been exploited. This is perhaps most obviously seen from the FIA on aspects of safety, ►



Pirelli

“The ‘flexi’ rear wing is in itself a ‘soft’ version of DRS”

continuously improving standards and levels of testing based on new information, accidents and feedback.”

Anecdotally, how long have flexing wings been exploited?

“All racing cars have the challenge of component stiffness versus weight, hence increased use of composites such as carbon fibre. The ability to know how much something deflects on track was notoriously difficult, even for the teams, for a very long time, particularly from aerodynamics. This is because it is a pressure distribution over the whole component in multiple directions, not a single point load at a given car position.

“The big breakthrough in understanding came when F1 cars started testing in full scale wind tunnels and did straight line aerodynamic tests with increased sensors in the late nineties and early two thousands. Initially what was perhaps a shock to see how much



Ferrari

ABOVE Ferrari was one of the teams to acknowledge that its aerodynamics would be impacted by the FIA's rules clarification

components were moving at speed compared to expectation through a wind tunnel window, quickly turned into improved correlation, FEA tools and then very quickly exploitation of this capability.”

BELOW The FIA's more stringent tests were introduced at the French Grand Prix, with a 20 per cent tolerance margin initially permitted

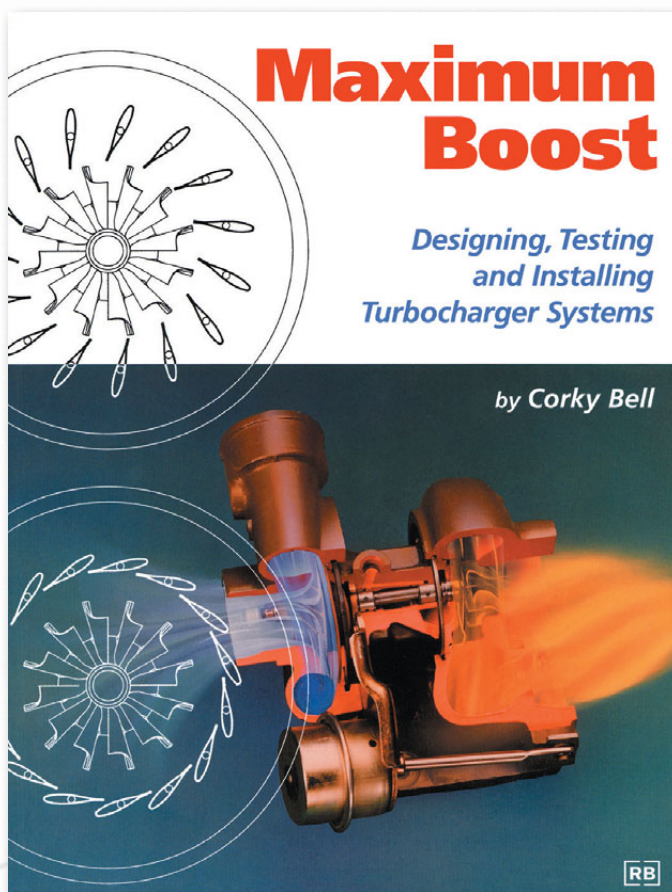
So while technical advances have helped the FIA police the situation, they have, at the same time, enabled teams to better exploit aero elastic behaviour? ►



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LEFT Ross Brawn has seen both sides of the fence. Pictured here observing the FIA check the legality of the rear wing during his time at Ferrari, he now finds himself F1's MD and a gamekeeper, rather than poacher

"Clearly yes. The understanding of ever advancing materials, how loads on the car are distributed to interact with those structures, exactly where mountings or stiffness elements are positioned, etc."

What do you think about the FIA's reaction to the latest episode: giving the teams a month's warning and a percentage margin of error?

"While there was instantly a vociferous objection from

their rivals, the rear wing is also a safety critical and complex structure on a racecar. At any level, following due process to come up with a new more stringent test on rear wing deflection that all the teams must be tested and comply with in future takes time. For example, if any team logistically had to design, modify or then remake race quantities of rear wing assemblies to comply for a future race weekend, this could not be reasonably or safely imposed immediately."





Courtesy of F1

ABOVE & LEFT The FIA has assembled a top team of aero talents. Primarily, their aim was to devise the 2022 regulations, but their expertise will also help the governing body police aerodynamic infringements

How much is the use of cameras to check flexing a game-changer?

"It moves the many traditional static load and measurement tests from the FIA pit lane rig out onto the track, so yes this is strategically a significant change. However, this is also a measurement process that will best capture if a car structure is behaving as required and expected on track, rather than more artificially when static in the pit lane."

Ross Brawn once suggested that flexible wings, like traction control, should be opened up to end the culture of innuendo. What was his reasoning?

"As this incident proves, when you get deep into the technology of the sport, like software or aero elastic structures, it becomes incredibly difficult to police. If something is too long or too high, it's easy.

"There is also the future technologies aspect to consider. The game is changing and not having the current latest and best thinking on the pinnacle of the sport potentially puts it out of alignment. Aero elastic wing behaviour is only sought by F1 engineers because they want efficiency: lower drag down the straights and still downforce in the corners. It's the same with traction control: I want to most effectively use the power, while saving my tyre life. However, active aerodynamics, traction control and many other beneficial systems are increasingly available on many road cars."


“Aero elastic wing behaviour is only sought by F1 engineers because they want efficiency”

Now he is in power, do you get the feeling he might have changed his mind?

"I think they will continually review the application of any of these new systems against cost, especially safety, team and FIA control and management, but particularly does it improve and benefit the whole sport? Is the show and the racing benefited? Is it still the ultimate driver category?"

Looking ahead, the next F1 cars, in 2022, will have had their wake studied in an effort to solve traditional problems. So, do you still think we will be talking about flexi wings in 2022 and beyond?

"I think the battle of teams versus governance on component flexibility will continue as it has done for at least the last 20 years, probably with increasingly diminishing returns on all the expected aerodynamic performance areas of the F1 car.

"What will be far more interesting is if philosophically how, where and why F1 allows active aerodynamics to be opened up in the future to enable the engineers to achieve the characteristics they currently have to chase with aero elasticity." 

A NEW SPARK OF LIFE FOR GT RACING

With Discovery, the global media giant, now on board as official promoter, the ground-breaking FIA Electric GT Championship is poised to shake-up the GT ranks. **Anthony Peacock** reports

LIKE it or not, electric mobility is where the automotive industry – and motorsport as a consequence – is at right now. If it's not silent and doesn't have the ability to shock you, then manufacturers on the whole aren't too interested.

The move is driven of course by legislation rather than sentiment, with governments all over the world planning to outlaw sales of conventionally-fuelled cars: in many cases within the next 20 years. So that puts motorsport at a crossroads. Does it become a technological test bed that moves with the times? Or should it instead become a gloriously anachronistic piece of escapism, a bit like the Grand National?

Predictably, manufacturers have voted to move with the times. The same trends we see on the road are starting to appear more frequently on the track, with the creation of new electric racing (and rally) championships all over the world.

Formula E, Extreme E, electric

rallycross and PURE ETCR have already made their debuts: now the FIA has recently added Electric GT to its roster, for launch in 2023. There will be at least six events during the first season, with races in Europe and Asia (including the Middle East). During season two, in 2024, it will expand to the USA.

As a result, Electric GT won't be a world championship from scratch, but the idea is for it to become so. As the FIA's director of sport and touring cars Marek Nawarecki points out: "This is clearly the aim of the project: to elevate it to the level of world championship, but that's something that has to be earned."

The transition isn't being rushed: electric GT is designed to slot neatly in alongside the existing GT3 formula, which Stephane Ratel's SRO organisation has a virtual monopoly on, thanks to various highly-successful championships all over the world. But Electric GT will instead be promoted by the Discovery group, which owns and runs ▶





BELOW One of the aims of the new series is to be a catalyst for, and showcase of, fast-charging technology

FIA

Eurosport Events – the promoters of the European Rally Championship, as well as TCR (in both its electric and fossil-fuelled guises). Discovery has also been a shareholder in Formula E since 2014, which makes it a solid fit, but the American TV giant is going to be much more directly involved when it comes to marketing Electric GT.

“For the first time, we’re putting the full power of Discovery behind Eurosport Events, allowing us to meet the expectations of premium car manufacturers and develop a new flagship asset,” says Francois Ribeiro, the head of Eurosport Events. “We share a common vision with the FIA for a next-generation championship that features advanced technologies and outstanding electric mobility performance, all delivered through exciting and sustainable racing.”

According to the FIA’s technical delegate, Xavier Mestelan Pinon, Electric GT is long overdue: “The role of electric propulsion in the automotive



Porsche AG

RIGHT With battery development and integration such a key part of the equation, the FIA has turned to space and defence expert Saft for its technology



FIA



LEFT The new category has been designed to slot in alongside GT3, one of motorsport's success stories

industry is ever-increasing, as we want motorsport to be relevant to our industry, so more and more competitions are going in this direction. This is crucial to the manufacturers who want to develop road-relevant technology rather than relying on standard components."

Manufacturers also want to develop cheaper technology. Ostensibly, the new cars will be production-based with the option to upgrade them to GT3 specification. While the new electric GT cars will be designed to deliver performance close to the current GT3 class, they will significantly outperform them on pure acceleration and outright pace in qualifying trim.

Powerful message

Anyone who has driven an electric car on the road probably won't find that a massive surprise, but exactly how a battery-powered car can be made compatible with endurance racing is a much more intriguing question.

Get it right, and Electric GT has the potential to send out the most powerful message of any electrically-powered championship anywhere in the world: that electric cars can deliver both performance *and* duration. Because what stops most people ►



“Does motorsport become a technological test bed that moves with the times? Or a gloriously anachronistic piece of escapism?”

“There are electric series that never really reached the fans. We have learned from that: we are not just running after ideas like lemmings”

buying electric cars is ‘range anxiety’. If you can show people that an electric car can nonetheless win an endurance race, that goes a long way towards overcoming those reservations.

Unfortunately, we’re not quite there yet. The plan will initially be to hold a qualifying sprint race on Saturday, followed by a 45-minute main race on Sunday, which will contain 700 kW fast-charging pit stops. That might not sound like much, but it’s the first step on the way towards an electric car one day winning a 24-hour race. Which will probably happen sooner than we think.

Race-to-road

As Jean Todt, FIA President, believes: “This concept is sustainable, innovative, and embodies our race-to-road approach in terms of technology transfer, making it relevant to manufacturers and road users.”

No surprise then that just like the winning GT3 formula, Electric GT will be manufacturer-focused, meaning that brands will be encouraged to join the new championship, implementing their own



ABOVE The goal is that a kit of EV hardware can be retro-fitted to existing GT3 cars

BELOW BMW, which has just launched its new GT3 model, is among the manufacturers known to be evaluating the series

technology and innovation within a common technical rulebook.

The full details are yet to be made clear, but if the FIA reaches its objectives, the cars will become incredible feats of engineering: they are set to feature a 430 kW lithium-ion battery (and should reach 300 kph in just 2.4 seconds).

As well as range, the other key to a successful electric racing car is lightness, in line with Colin Chapman’s famous dictum. Electric GT cars should weigh between 1490 and 1530 kilograms. This is vital to ensure an ►



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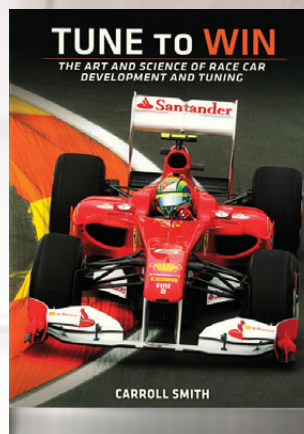
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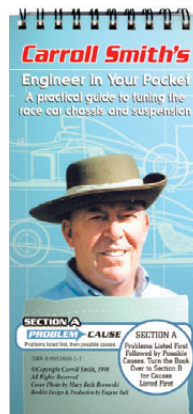
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optimal power to weight ratio from the cars, combined with almost immediate torque. That's where the eye-popping performance should ultimately come from.

The batteries are also fast charging and have the potential to last far longer than Formula E powertrains. Additionally, Electric GT will race on full-length circuits and not temporary street tracks like its Formula E counterparts. The championship organisers are determined to learn from some of the criticisms levelled at other forms of electric competition: namely that it's not 'real racing' and instead an artificial show with cars that lack passion.

So the accent is going to be firmly on both aesthetics and pure performance, ensuring that the end result is cars that go as fast as they look. Figures are going to be in the region of 778 horsepower, combined with 995 Nm of torque, from up to four electric motors through either rear or four-wheel-drive transmission.

That will be the case when it comes to going round

corners as well as in a straight line, thanks to front splitters and a rear wing that give improved grip and increased downforce.

Other technical features include double steel wishbone pushrod operated suspension and dual circuit, single pedal hydraulic race brakes.

Given the phenomenal torque combined with the extra weight of battery-powered cars, it's clear that it's not enough to use normal racing tyres. As a result, Pirelli – the championship's designated supplier – is devising a special electric racing tyre to fit the needs of these very specialist vehicles.

It's obviously early days, so not entirely clear yet who exactly is going to sign up. But one name that has been linked to the project is BMW which, as its LMDh announcement revealed, is keen to explore options beyond Formula E.

"We have been in discussions with the FIA," confirmed BMW M-Sport boss Markus Flasch, who

RIGHT Discovery will be much more directly involved than it is with Formula E, of which it is a shareholder



FIA



LEFT & BELOW
The FIA is intent on creating a revolutionary category that has a net-zero carbon footprint instilled within its DNA

also takes responsibility for motorsport. "If this series is going to be fast enough, spectacular, then we are going to be in it. But we are not pushing just because it is electric. It has to make sense for the fan. There are series in the world that are electric and everyone runs in them, but they never really reached the fans. We have learned from that: we are not just running after ideas like lemmings."

Time for Tesla?

And there have even been some more outlandish whispers that this is a championship that could finally entice Tesla into the world of motorsport: an arena that the American firm has resisted strongly right up until now.

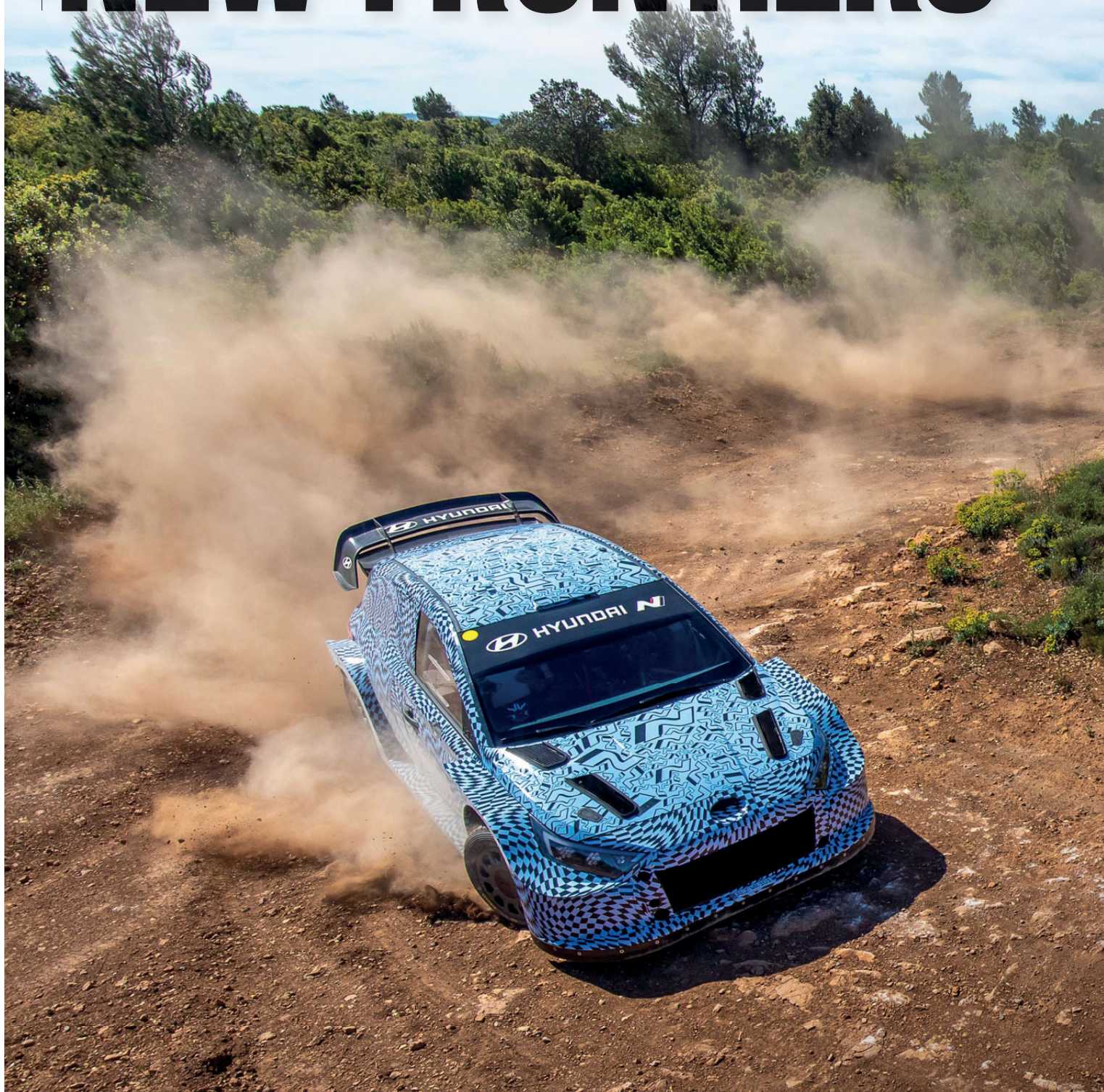
It's clear that there's going to be a

somewhat different approach: the FIA has even promised a "theme park" around electric mobility at each of the races – whatever that entails. And there's going to be an e-sports component built into the championship from the very beginning, allowing people to feel part of the action from the outset. From year one there will be net zero-carbon races, with the emphasis on renewable energy sources. Thanks to Discovery's involvement, expect a solid TV package too.

So all the ingredients are in place to create something that's potentially revolutionary. But will the hype live up to the reality? Or is BMW – a manufacturer that was clearly left disappointed by Formula E – right to sound a note of caution? Over the next few months, we get to find out. **RT**



WRC EXPLORES NEW FRONTIERS



With transmission technology a key battleground in the World Rally Championship, Hyundai Motorsport has selected Ricardo Performance Products to develop the all-new four-wheel drive transmission for its next generation hybrid WRC challenger. By **Chris Pickering**

OVER the years, rallying has seen more innovation in transmission technology than any other branch of motorsport. Famously, it was the arrival of four-wheel drive in the early 1980s that paved the way for the 500 bhp monsters of the Group B days. Later, active differentials pushed the boundaries of technology during the World Rally Car era, and soon found their way onto road cars too.



Hyundai GmbH

ABOVE & LEFT The hybrid four-wheel drive transmission for Hyundai's 2022 challenger, seen here in testing, takes the WRC into an exciting new era

Now, the World Rally Championship is facing its biggest technical shake up since the arrival of Group A in 1987, with the new Rally 1 regulations that will replace the current WRC format in 2022. And it's the driveline that's once again at the centre of this innovation, with a plug-in hybrid system that drives directly onto the rear axle.

The 100 kW (134 bhp) 650-volt motor-generator unit will be a spec item provided by German company Compact Dynamics, which is already involved with hybrid development in Formula 1, Formula E and the World Endurance Championship (WEC). Meanwhile, the 3.9 kWh lithium ion battery pack comes from Austrian specialist Kreisel Electric.

There are other changes to the driveline too. In an attempt to simplify the core transmission, the number of ratios drops from six to five, while active centre ►



differentials will be banned. The gear shift system will become a manually-operated sequential.

Working with a trusted transmission supplier is now more important than ever. For reigning World Rally Champions, Hyundai, this means a new contract with Ricardo. The British firm already has an existing partnership with Hyundai, having supplied transmissions for the company's R5 cars for the last five years.

"There's no doubt in my mind that our relationship with Hyundai in the R5 category strengthened our bid for the Rally 1 contract," comments James Oakenfull, head of motorsport at Ricardo Performance Products. "Our team have designed a very competitive gearbox that performs really well."

The news also marks a welcome return to the top step of international rallying for Ricardo. The company's Performance Products division is deeply rooted in the sport. Prior to joining the Ricardo empire, it began as Ferguson Formula Developments – the company that designed and manufactured the transmission for the Ford RS200 (in fact, the viscous coupling used by a number of Group B cars was another Ricardo invention).

Ricardo's rally involvement continued through the 1990s with the Ford Escort Cosworth. And when M-Sport scooped both the Drivers' and Manufacturers' crowns in 2017 it was once again with one of the company's transmissions. Sébastien Ogier successfully defended the Drivers' title the





ABOVE & ABOVE
RIGHT The new collaboration builds upon a successful five-year partnership on the Hyundai i20 R5, which features a 5-speed sequential gearbox and differential unit designed and manufactured by Ricardo

LEFT Ricardo will draw upon its extensive experience of electric motorsports, which includes multiple Formula E championships, when developing the new WRC transmission

following season with the same unit.

"Ricardo is involved in a lot of different areas of motorsport these days, but it's fair to say that rallying has played a pivotal role in that story," comments Oakenfull.

"We very much see the World Rally Championship as the pinnacle of its genre. So securing this long-term partnership with Hyundai was absolutely huge for us."

Ricardo is also no stranger to electrified motorsport. The company has worked on hybrid projects in Formula 1 and the WEC, as well as all-electric drivetrains in Formula E.

R5 inspiration

The forthcoming World Rally Championship transmission – currently testing in Hyundai's new Rally 1 prototype, based on the i20 N road car – is a clean sheet design. Nonetheless, it shares a number of similarities with the existing R5 setup – not least its transverse, five-speed layout and the lack of a centre differential.

That system can trace its roots back to the early days of the R5 category, when Ricardo designed a gearbox for an aborted project with another carmaker. At the time, transmission suppliers had to offer a universal design that could be used by any manufacturer. The rules have since changed to allow exclusive partnerships, but it meant that the Ricardo engineers already had the basics of a design that they could adapt.

"As with any customer motorsport programme, the R5 project came down to designing the best gearbox that we could

“Even greater performance and more road-relevant technology”

offer for a sensible price. You can always take things further – for instance, with the detail design, the level of technology in the production processes and the various surface treatments that you use – but sometimes these come with a high cost levy. So it's about understanding how far it's appropriate to go before you run into diminishing returns," comments Tim Gee, engineering director of Ricardo Performance Products.

Alongside these financial considerations came the fundamental constraints laid down by the technical regulations and the design of the car.

With those key constraints set out, it's possible to start visualising the internals of the gearbox. What follows is mostly a packaging exercise, Gee explains: "The art of packaging a rally gearbox comes down to the fact that you're generally working with a car that's based on a front-wheel drive production model that hasn't necessarily been designed with that usage in mind.

"The people we're working with at Hyundai are seasoned rally engineers, and so they give us a packaging target that's largely achievable, but it's still a challenge. ►

You start off looking at the fundamental stuff, like the crank, chassis legs, differential and the steering rack positions. By the end you're down to looking at clearance to ancillaries and access to the fixings. We also have to be mindful of weight targets, but those are generally quite achievable – especially in R5 where there are quite generous minimum weights.”

A clean sheet

To the untrained eye, the new Rally 1 transmission looks very similar to the existing R5 design. They even share a number of components. However, the detail differences in the packaging and the requirements are sufficiently significant that Gee and his team effectively had to start the whole process over again.

“It’s all about detail – bearing arrangements, shaft supports, selector mechanisms,” he comments. “These components all look very similar, and conceptually they are, but in most cases they’ve been engineered from scratch.”

Budget is still a factor in the WRC – certainly more so than it is in a championship like Formula 1, he points out: “We try to design a gearbox that maxes out on quality without blowing the budget. There are always options that you could pursue, but there’s a minimum weight limit that caps a lot of the

“A comprehensive suite of in-house software tools for design and analysis”

extravagance. You can focus a lot of effort into taking weight out of the gearbox if money is no object.”

There is a direct correlation between the complexity of a gearbox and its cost. For instance, additional finishing processes or detail refinements to the geometry can be added almost ad infinitum, but there comes a point where these become difficult to justify.

Generally, these decisions are left to the transmission supplier, although the engineers from the manufacturer have a say and it’s their prerogative to step in and request specific features or enhancements.

Hybrid system

The standardised hybrid system takes the form of a self-contained unit that sits just ahead of the rear axle, with the drive fed in at the front, close to where the propshaft enters. The technical regulations are quite prescriptive in this area too, with the gear widths for the gear train between the motor and the rear ▶

BELOW The World Rally Championship faces a mammoth technical shake up for the 2022 season, with the driveline once again taking the spotlight

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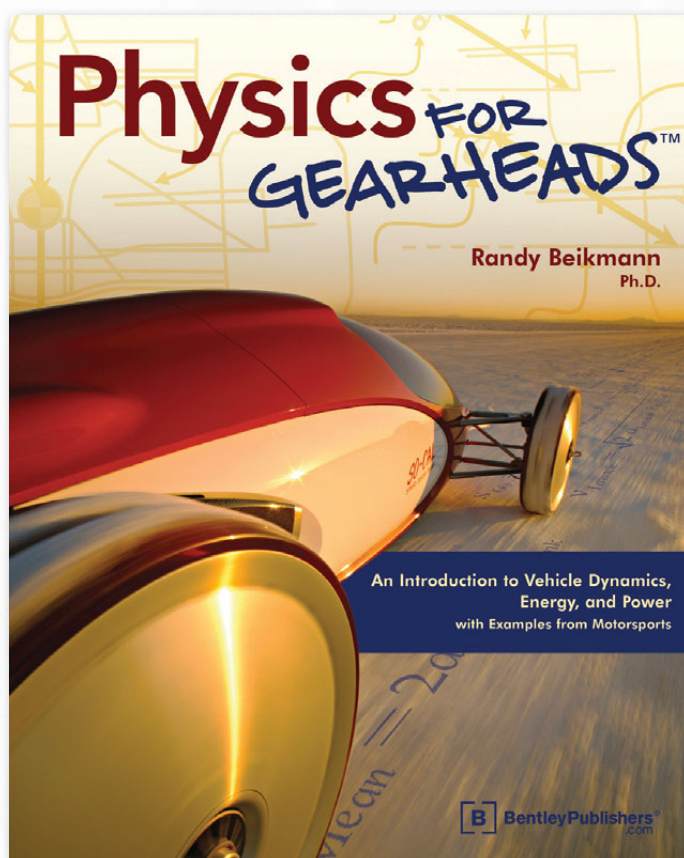
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differential laid down in the rules. "They're quite wide – I think we could have gone for something quite a lot smaller and lighter if we were allowed to," notes Gee.

However, there are still plenty of variables in the detail design, he points out, so there's more to it than simply joining the dots set out in the rules. For instance, four-wheel drive rally cars typically use a device that disconnects the rear driveshafts when the handbrake is applied. Integrating this with the hybrid system brings its own challenges.

"There's a lot more content now on the rear axle. In terms of design, I'd say there's at least another 100 per cent [more parts] involved," comments Gee. "We now have to package an axle that's more akin to a gearbox. It's got a gear train to the hybrid system, a limited slip diff with a preload adjuster, its own oil pump and circulation system, and a handbrake disconnect device, which is quite a significant multi-plate hydraulically-operated disc

“We try to design a gearbox that maxes out on quality without blowing the budget”

and spring arrangement.”

Not only does all this hardware have to be packaged in a confined space, it potentially has to be accessed quickly for maintenance or repairs. The whole system also has to be fitted within the subframe and in with the fuel tank. It all adds up to a significant exercise.

There are knock-on effects elsewhere in the drivetrain too. The same differential internals have to be used front and rear, which means that the engineers can't focus solely on the requirements of the electrified axle.

RIGHT Head of Motorsport James Oakenfull sees the long-term partnership with Hyundai as a real coup for Ricardo

BELOW Ricardo's transmission expertise underpinned Sébastien Ogier's back-to-back WRC crowns in 2017 and 2018





Manufacturing

The vast majority of the manufacturing for the transmission is carried out in-house by Ricardo. One exception is the casting. The 3D printed sand cores for the prototype builds were outsourced to a German supplier. This saved time on the prototypes, but production tooling will be implemented to control costs on the final parts.

Although the fundamentals of transmission design and manufacturing are well established, Gee and his team are constantly on the lookout for potential improvements. Ricardo recently acquired a Klingelnberg bevel grinder, for instance, which is used for the company's crown wheel and pinion sets. This uses a different approach to the palloid method previously employed for bevel gear cutting.

"That doesn't just change the way that you manufacture the parts, but its impact extends right into how you design the gears. It's a continuous learning process," he notes. "We produce the gears using a finish ground full-form duplex grinding method, but designing the gear is the majority of the exercise. Coming up with the prescription to transfer to the grinding machine – the actual micro geometry

created by the process – is a whole area of study in itself."

Other recent advances include greater use of CFD for lubrication flow analysis, he explains: "We've been using CFD in transmission design for quite a while, but we find that every time we use it for a project we tend to use it more widely and in greater depth."

Ricardo has its own comprehensive suite of in-house software tools for design and analysis. The simulation work that has been carried out using these capabilities, along with decades of race and rally experience, have given the engineers sufficient confidence to eschew rig testing and go straight to vehicle testing with a set of prototype parts. These are on the car as we speak, undergoing Hyundai's durability testing on a variety of surfaces.

All being well, the car should debut at the first round of the revamped World Rally Championship at the beginning of next year. In doing so, it will usher in a new era for Hyundai and Ricardo. More to the point, it will mark the start of a new chapter in the sport. One that promises even greater performance and more road-relevant technology. **RT**



BELOW The company's driveline pedigree in the WRC dates back to the iconic Group B era



WORKS OF SCIENCE FRICTION

Ferodo's R&D work has paid dividends with an impressive start to the season. Sergio Bonfanti, its general manager, tells **Sara Goodsell** that there's more to come



ABOVE The DS3.12 compound was created for GT racing

If the last few weeks are anything to go by, then Ferodo Racing is literally winning.

Not only has it gained podium finishes in GT3 and GT4 with the Corvette C7 GT3-R of Callaway Competition at the ADAC GT Masters and the Mercedes AMG cars at Zandvoort circuit respectively, but now it is onto a winner with TCR: Halder Motorsport's Hondas set the pace at Navarra Circuit in the opening events of TCR Spain's inaugural season.

So, it's no surprise that Sergio Bonfanti, Ferodo Racing's general manager, encouragingly muses that: "things are starting to happen at great speed."

This is partly to do with its big project of the last three years in the brake pad formulation of the DS3.12, a heavy duty circuit compound created for top-level GT racing, but now also the introduction of its new DS4.12 formulation, also for GT racing.

The basic difference between the DS4.12 and the DS3.12 starts at the friction level. "With the DS4.12, the friction starts at a higher level and has a flatter torque curve which means the ABS is not upsetting the car from the very beginning," explains Bonfanti.

The drivers using the DS4.12 on the GT cars enjoy the fact they have to spend less time on the brakes and gain something out of that. The DS3.12, which had a lot of success last year, starts at a lower level but it spikes quicker so that the friction level rises much faster than the DS4.12.

Bonfanti continues: "The flatter torque is on the

“Higher initial bite to take away 70-80 km per hour in the first second of braking”

DS4.12 – as soon as the driver is starting the brake application, the brakes are at a certain level of temperature which we believe should be between 350°C and 400°C. While you are keeping your foot on the brake pedal the car decelerates, so the speed is going down, but at the same time the brakes are aiming to transform the energy into heat and therefore the temperature is rising.”

Balancing the friction level, depending on the type of car and the settings of the ABS systems, presents another set of variables.

Bonfanti explains: "The trick is to play with as high a friction level as possible, ►





without having the ABS interfering too much. If the ABS is upsetting the car at the rear, the result is that the car oversteers. If it interferes too much on the front, then the effect is that it understeers and the driver can't take the car out of the braking area with the level of speed he needs in order to be competitive."

Higher friction

Due to the ABS system, the GT cars typically have to go with higher friction at the front of the car and a lower, flatter friction level at the rear. But Bonfanti says Ferodo is working with some manufacturers to achieve the same friction level across the four wheels, using its popular DS3.12 compound to give the car

more of an advantage.

"We have achieved with some manufacturers that we can use the same friction levels on the rear," he says, "which is quite unusual from the history of GT cars. But with some work on the balance of the brakes we managed to give something extra to some cars by having a higher friction level on the four wheels."

The development of new formulations for brake pads isn't confined to GT racing. Ferodo has also been developing new material compounds for the TCR series.

When it comes to TCR cars, the braking requirements are very different. The majority of them race only for half an hour at a time and have a sequential



TOP Three years of painstaking research underpin the success of the DS3.12 product line

RIGHT It's been a successful start to the season for Ferodo-supplied teams





ABOVE Ferodo's prototype TCR formulation helped the Halder Hondas to a hat-trick of wins in Spain's inaugural TCR event

gearbox but no ABS. The prototype being tested by Ferodo "has a higher initial bite to take away 70/80 km per hour in the first second of braking," says Bonfanti.

The TCR pads will be launched soon. Judging by the success of the prototype compounds, they are likely to prove a popular addition to Ferodo's range.

Sintered metal

R&D doesn't stop with TCR and GT racing. Ferodo is also currently working on a sintered metal formulation – where the metals are fused together at extremely high temperatures during manufacture, rather than using a resin – for rallying and use in 24-hour races.

Bonfanti says: "We've already had the next results for this formulation, so are fine-tuning it. The good wear characteristics and shear strength offered are good points in favour of this technology, but at the moment

“Our target is to make sure you don't do any change on the brakes in the full 24 hours”

they have to be weighed against higher production costs.

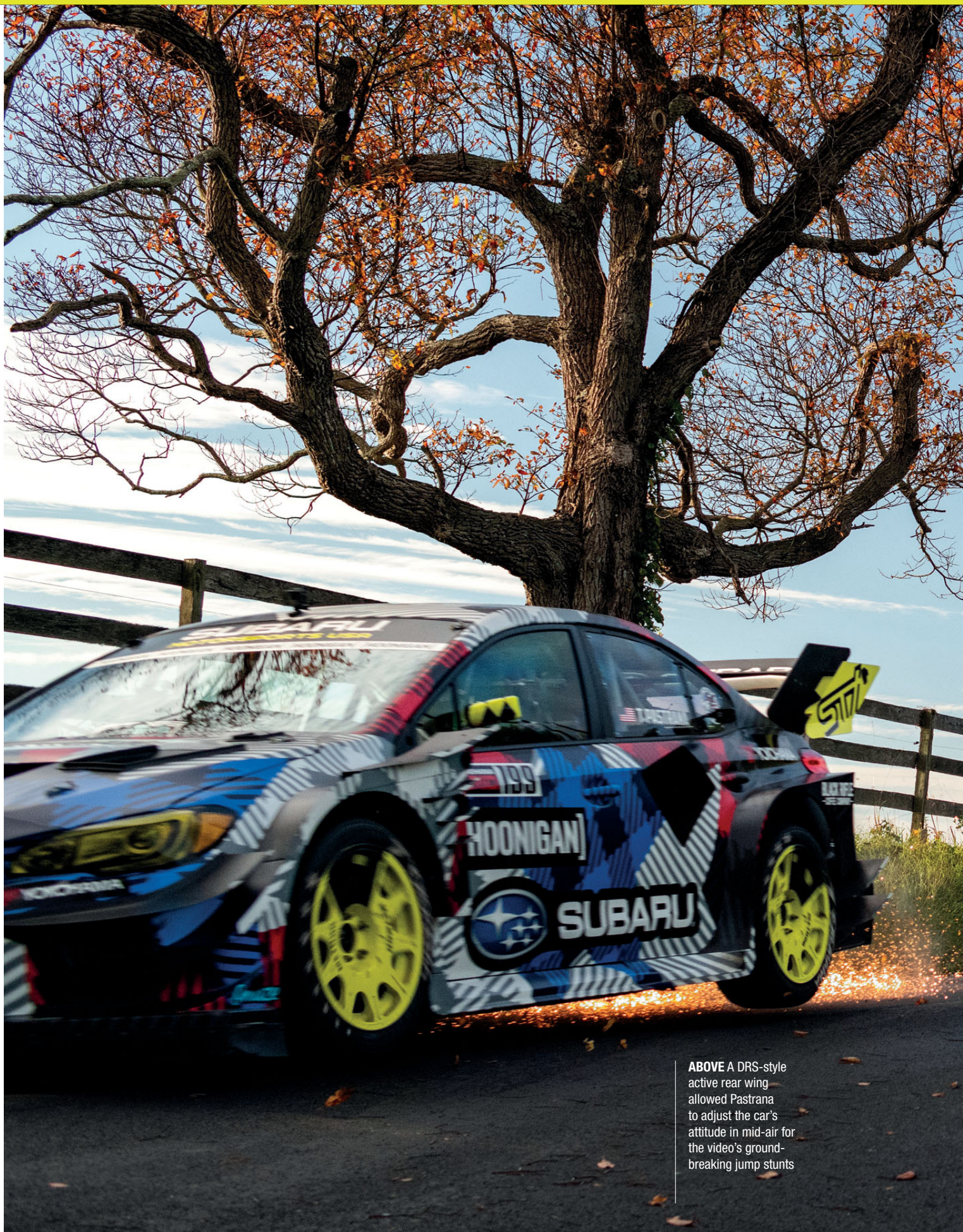
"The intention is to use the technology not only for rallying but also for 24-hour races, which we are currently involved in. It's just a case of improving it and improving it again. Our target is to make sure you don't do any change on the brakes in the full 24 hours."

Endurance racing and rallying aren't the only other series Ferodo has its sights set on. The Ferrari Challenge – which uses a carbon ceramic disc – is an area of interest Bonfanti describes as, "intriguing", admitting that the company is watching very closely at the moment.

However, as Ferodo delves into the

brake technologies of tomorrow, there is one commitment it is adamant on making today, around sustainability. It is something Bonfanti says the company thinks about every day and why it is about to implement a reduction on plastic waste by 98% in its after-market motorcycle range.

It is also the reason Bonfanti says Ferodo's staff will continue working from home following the Pandemic. He concludes: "It is the smart working way which is much more effective and more sustainable because if people are working from home, it means less pollution, less waste. I think that is the way to go." It looks like there's another winning formula from Ferodo. **RT**



ABOVE A DRS-style active rear wing allowed Pastrana to adjust the car's attitude in mid-air for the video's ground-breaking jump stunts

“THE WILDEST WRX STI EVER BUILT”

Hal Ridge discovers how a design team drew on the Subaru brand's experience in rallying and rallycross to deliver a car that has become an Internet sensation

SUBARU'S greatest successes in world motorsport propelled the brand to iconic status in the World Rally Championship. The spectacular feats of Colin McRae, Richard Burns and Petter Solberg, winning world titles on the biggest stage in the blue and yellow Japanese machines, became the stuff of dreams.

Back then, the cars were conceived and developed by British firm Prodrive. More recently though, Subaru has achieved success in America, in stage rallying and rallycross, with machines created by the Vermont SportsCar outfit.

Having claimed a string of rally titles, notably with British driver David Higgins and extreme sports star Travis Pastrana, the Vermont squad – operating as Subaru Motorsports USA – has also created one of the world's fastest rallycross Supercars.

Last year though, VSC received a very different brief – one that freed it from the restrictions of conforming to the technical regulations required in specific series. It was tasked to deliver a car for Pastrana to drive in the latest instalment of Ken Block's Gymkhana video sensation series, Block having handed over the reins to Pastrana for a Gymkhana takeover. ►





The requirement was to create a Subaru WRX STI that could corner, slide and fly better than any car before for the 11th instalment of Gymkhana videos. The result has since been dubbed 'the wildest WRX STI ever built'.

Pastrana's take on the Gymkhana concept was shot around his home town of Annapolis, Maryland, and as ever, the video was made up of multiple scenes and locations, including normal roads, airfields, town centres and huge jumps. That meant the WRX STI couldn't just be a high-power hardly-controllable monster: driveability was key.

Show-stopper

"We got word of the idea in late 2019 but did not really start on design of the car until late January 2020. Then COVID hit in early March and we had to shut down our shop for a while. That really impacted the progress of things," says VSC CMO Chris Yandell. "The car was on the ground testing in early September.

"The objectives for the car were directly linked to video concept and the stunts being dreamed up by the production crew and by Travis. This was one of the more challenging aspects of the project because there were many ideas for stunts on the table, and things were always evolving as the concepts for stunts and the locations for filming were being defined. We had to design the car around the idea that most of these stunts' final details would be locked in place well after the car's design phase had been frozen."

The easiest solution for the project would have been to tailor it around Subaru's title-winning American rallycross WRX STI. But, in a bid to make the car unique, and with a desire to exploit the lack of a rule book, VSC crafted a new machine. That was, however, heavily based on the rallycross

car in certain areas.

"Critical things that we carried over were drivetrain items we would not have time to develop fresh for this project," says Yandell. "From a timing and budget standpoint, we wanted to take as much as what we had in our parts bin and utilise it.

"Testing time and overall timeline was very, very condensed for this car. Our newly-developed engine for the rallycross programme was a key carry-over, although we did 'massage' it for more power."

The power increase Yandell references was a step up from around 600 to 862 horsepower and 664 lb-ft torque. That was largely thanks to increasing the capacity from the regulation 2.0-litre engine in rallycross trim by 15%, to 2.3-litre for the Gymkhana car. While the crankshaft was carried over from the ►

“Travis damaged the car most when he backed into his garage at five miles per hour!”



ABOVE The flat floor culminates in an aggressive rear diffuser

RIGHT The WRX STI has become an Internet star for its high-performance stunts



rallycross application, the bores were opened up to 99.5 mm, combined with a stroke of 75 mm.

Boxer engine development has been key to VSC's progression up the rallycross timesheets in recent seasons. By increasing the capacity of the Gymkhana car's longitudinally-mounted four-cylinder motor further, it was able to exploit that homework in a bid to provide more 'natural' torque to Pastrana, and aid precision driving.

As ever in rallycross and rally circles, specific details of the engine – which uses a billet block and cylinder heads together with DLC-coated camshafts, sodium-cooled valves and a twin timing belt system – have been kept well under wraps. Both inlet and exhaust manifolds, the timing system, turbo wastegate, fresh air valve and dry sump system were all developed in-house.

"We felt it was a tough but interesting challenge from Travis and Subaru of America to produce the power required

without additional known and well used modifiers like fuel or additional turbochargers," notes VSC powertrain manager Dan Farley. "Due to the aggressive timeline, many rallycross chassis components were carried over like the fuel cell and cooling packages. This limited the amount of fuel the car could carry, which prevented use of fuels like methanol.

"The rallycross engine bay is designed for one turbocharger, so we were constrained to produce the required power with



one unit. We worked with Garrett Motorsports to produce one of the highest flowing turbos in this configuration. We also had to keep a balance between the highest flow possible and surge margin to maintain performance in the car.

"In rallycross we have been required to use mandatory code in the ECU for the past three years. For Gymkhana, we were free to explore the potential of the system and developed unique logic to complete some of the challenges required and to aid quick changes during filming."

As Farley references, the rear cooling package, with



ABOVE The aero detail was validated in wind tunnel testing

air intakes in the rear doors, was carried over from the rallycross concept. It is generally considered to aid with weight distribution, but in this instance also to aid cooling during the lower-speed stunts and high yaw angles. The rear-mounted radiator and front-mounted intercooler are made by PWR.

Thanks to being mounted over 200 mm back from its standard location, the engine sits directly above the VSC-developed front differential. The six-speed sequential Sadev gearbox is in the centre of the car, spaced back from the engine by a torque tube, housing the triple-plate Alcon carbon clutch.

Increased power

While the transmission is similar to that used in the rallycross machines in terms of packaging and design, in order to deal with the increased power and torque, the gear sets have been increased from 20 mm used in rallycross to 24 mm wide gears. A Sadev-made rear differential is used in the rear of the car.

The rally version of the WRX STI uses 15" Method race wheels, while the rallycross machine used 17", both by regulation. Freed from such constraints, the Gymkhana car uses 18x8.5" Method wheels, fitted with Yokohama's A052 and Apex rubber.

Just as in drifting, tyres might seem elementary in this type of application, but they in fact play as pivotal a role as in any competition-derived machine. Just as in a drift car, the key for a good tyre balance is to have high tyre grip that is then overcome with the engine power, where coming out of the throttle and decreasing the output of power and torque to the wheels means the tyres grip up quickly. This is crucial for precision proximity driving – doing tight donuts around street architecture for example – when combined with a high-flow customer power steering pump and rack, with a ratio on 11:1.

The wheels are joined at each corner by in-house designed suspension arms and hubs, and Reiger multi-way adjustable MacPherson strut dampers. Inside the rims, Alcon four-pot calipers are used all round, with 350 mm front and 320 mm rear discs. Brake pads are courtesy of Endless. ►



LEFT The timeline was one of the biggest challenges the team faced as they worked around the path of a pandemic

A team like VSC is used to working in a field of compromise. After all, that's what rallycross is all about: creating a car that is efficient on both sealed and unsealed surfaces, while also taking on jumps and big kerbs. That's useful here too, because the Gymkhana WRX STI was created with various compromises in mind. None more so than the ability to deal with the huge jumps that are high on adrenalin-junkie Pastrana's requirements for such projects, and for making the car work as well as possible while going forwards, sideways and upwards.

"The challenges were based around the need for this car to do wild stunts, survive them, and then do more wild stunts, over the course of a week," says Yandell. "The car also had to be spectacular to watch and easy to drive for Travis. So much of our time was spent designing around those parameters. For sure there were conflicting parameters that were a challenge: a car that must do controlled drifts and precision driving is typically not also a car that can fly and land huge jumps. The setup of the car for those two objectives is wildly different. We needed to design around that challenge and be careful to

ensure all objectives could still be met."

Experience of US rallycross circuits, comprising both steel and dirt jumps, aided both the design of the jumps for the filming and the design and then setup of the car's suspension characteristics. Little change was made between different filming locations however, apart from adjustments to the ride height.

Born to fly

Aside from the engine, where this car differs most from its rallycross counterpart is in the aerodynamics, with its numerous winglets and two diveplanes on the front bumper corners. Similar features are carried through to the rear arches.

While the front splitter is increased in size, the biggest details are arguably at the rear, with the carbon fibre rear diffuser the final element of the fully-flat floor. Above that is an enlarged multi-element rear wing, with the upper element active.

"The aerodynamics for the body were developed as part of an intensive study incorporating CFD and the development of a 40% scaled model. The scaled model was used at a controlled wind tunnel test centre ►

BELOW & RIGHT The aim was to create a Subaru WRX STI that could corner, slide and fly better than any car before

“A car that must do controlled drifts and precision driving is typically not also a car that can fly and land huge jumps”





where measurements were taken at a number of simulated driving conditions," says chief designer Jonathan Carey. "For example, at high yaw, high pitch angles and also with the car jumping. The information obtained was used to establish a new body shape as well as the key locations for applying additional devices for maximum efficiency."

Active rear wing

The active element of the rear wing was at the request of X Games and Nitro Circus legend Pastrana. He is a driver who has 'previous' in jumping cars, not only in his most recent brainchild – the Nitro Rallycross circuit in Utah – but, among several other occasions, from when he jumped a Subaru Impreza over the Long Beach Harbour on New Year's Eve in 2009.

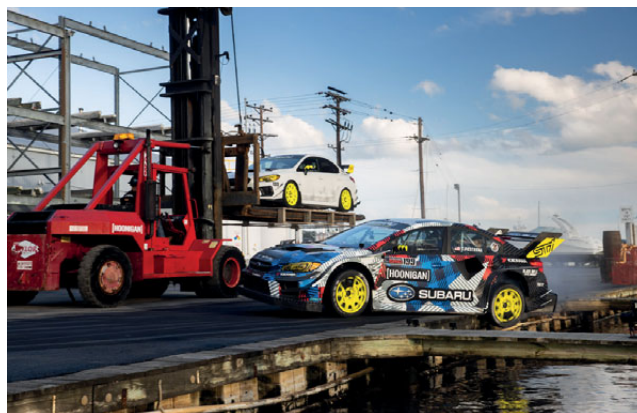
With the aero increased on the front, there were concerns that the front might dive in mid-air over the huge jump used in the Gymkhana video. As such, by having

an element of the rear aero that Pastrana could adjust, it would act in stabilising the 1,190 kg car (less driver) mid-flight.

"It was known from the original project brief that the vehicle would require the ability to manoeuvre at high yaw angles across a broad speed range. In addition, it was known that the vehicle would be required to jump long distances at high speeds," says Carey. "It was chosen to incorporate an active rear wing primarily for body pitch control mid-flight as a rearward aerodynamic balance shift could be made to prevent the vehicle from landing too aggressively on the nose. Adding the increased

RIGHT One of the more heart-in-mouth moments of the action as one wheel slides over the edge of the dock

BELOW ECU mapping can increase the flames from the bonnet-mounted exhaust





flight control opened the window for increasing the speed and size of the jumps used during the video. The wind tunnel information had given clear results showing the influence of each aerodynamic element on the vehicle. The effect of increasing rear downforce mid-flight was clearly present in the results giving good confidence that the rearward balance shift would provide the required effect without actually turning a wheel."

Fire-breathing

The rear wing is operated by a button on the car's steering wheel, where it is joined by controls that select different ECU maps to increase flames from the exhaust (which incidentally exits through the bonnet) and the speed limiter for the jumps, to ensure the car is doing the correct speed for take-off.


Those parameters are set within Cosworth's MQ12DI ECU, while the British firm supplied the power control module and switch units, data logger and driver digital display. The latter is located directly behind the steering wheel, in front of Pastrana's Recaro seat and Schroth six-point harness. Below the carbon sequential gear lever and vertical handbrake, to the right of the steering wheel, is a MoTeC vehicle-status display.

While the exterior of this car, clad with its composite bodywork, is impressive, the attention to detail inside

the steel front doors is exceptional: from items like the bespoke custom roll cage, to the more formless function facets, like Pastrana's familiar 199 number being stamped into the floor in front of the pedal box.

Asked how the car stood up to the intensive period of filming, after only a small amount of testing, Yandell says: "Exceptionally well. I think Travis damaged the car most by backing it into his garage at five miles per hour and hitting his garage lift with the rear! Other than that, the car ran flawlessly and was able to move from one stunt to the next easily and quickly."

The team was also pleased that the engine, at the type of power level they hadn't previously worked with, ran without issue. The whole project has provided a great platform to both evolve this Gymkhana concept, should that be commissioned, and to carry over those learnings into its rally and rallycross programmes.

Most importantly, it's a case of mission accomplished. From relatively humble beginnings, with Ken Block making his very first Gymkhana video with a Subaru in 2008, now over 34 million have watched the *Gymkhana 2020: Travis Pastrana Takeover; Ultimate Hometown Shred* video on YouTube. Nor will the car only star on screen: starting from the Goodwood Festival of Speed this month, the Subaru is set to make various appearances around the world. 

ABOVE If the outward appearance is impressive, the detail within is spectacular

LIFTING EXPECTATIONS



The unique requirements of Formula E were the catalyst for a new range of air jacks from Breda Racing. **Mark Skewis** explains

FOR spectators, pit stops often provide some of the most dramatic moments in a motor race.

For the teams, however, drama is the last thing they desire. Which is why many of them collaborate with Breda Racing to ensure that the pit equipment they use is strong, light and, above all, reliable.

With every split-second crucial in the pit lane, as it is on track, the technology involved is vitally important. But so is the human factor, the relationships – not to mention the confidentiality – that underpin the development of each piece of equipment.

“Before we were a motorsport company, we were all motorsport people,” explains

one of the company founders, Giorgio Breda. “Our senior technical people all have extensive experience at the racetrack. They understand the problems of working in the pitlane, know the requirements of specific cars and specific championships. They appreciate that theoretical data is one thing, but all equipment has to be tested and validated in real life conditions, with feedback from the people who will have to use it.

“Our people understand the technical points but, beyond that, they have the passion and motivation needed to overcome obstacles. The strong relationships we have developed with many manufacturers, teams and

individuals ensures that they can bring us their technical requirements and problems, then have the confidence to leave it to us to find the solutions they need.”

Breda Racing has been supplying high quality equipment for more than three decades. When the company was founded, the term ‘electric racing’ applied only to Scalextric model cars. Today, with electric racing such a vital part of many manufacturers’ quest for carbon neutrality, this new form of racing throws up many of the obstacles that Breda encounters due to the different needs of these cars.

One such challenge concerned the air jacks it has developed for the Gen2 Formula E car.



LEFT The advent of all-electric racing threw up a number of challenges for suppliers due to the different nature of the cars

Breda Racing has a wealth of experience to draw from, having been many teams' go-to partner for air jacks for more than 30 years. Indeed, it was one of the very first pieces of equipment that it was ever commissioned to produce. It manufactured them initially for the old Formula 3, F3000 and sports prototype categories.

As demand grew, so did the complexity: where the attachment point of the first

“Our senior technical people all have extensive experience at the racetrack. They understand the problems of working in the pitlane”

'standard' model fitted a large range of cars, teams increasingly demanded bespoke solutions as manufacturers began to alter the cars' lifting points compared to their original positions. This move was accelerated by mandatory safety regulations, as the attachment that allows the air jack to lift the car correctly needs to have particular conditions and to be perfectly adapted for that specific car.

BELOW The Gen2 Formula E cars required the development of bespoke equipment due to the need to lift them higher than normal single-seaters

“The structural calculations of this equipment must always be carried out considering the airjack and its attachment as a single entirety. The attachment arm is a part that has a big influence in the global lifter behaviour, the weight it

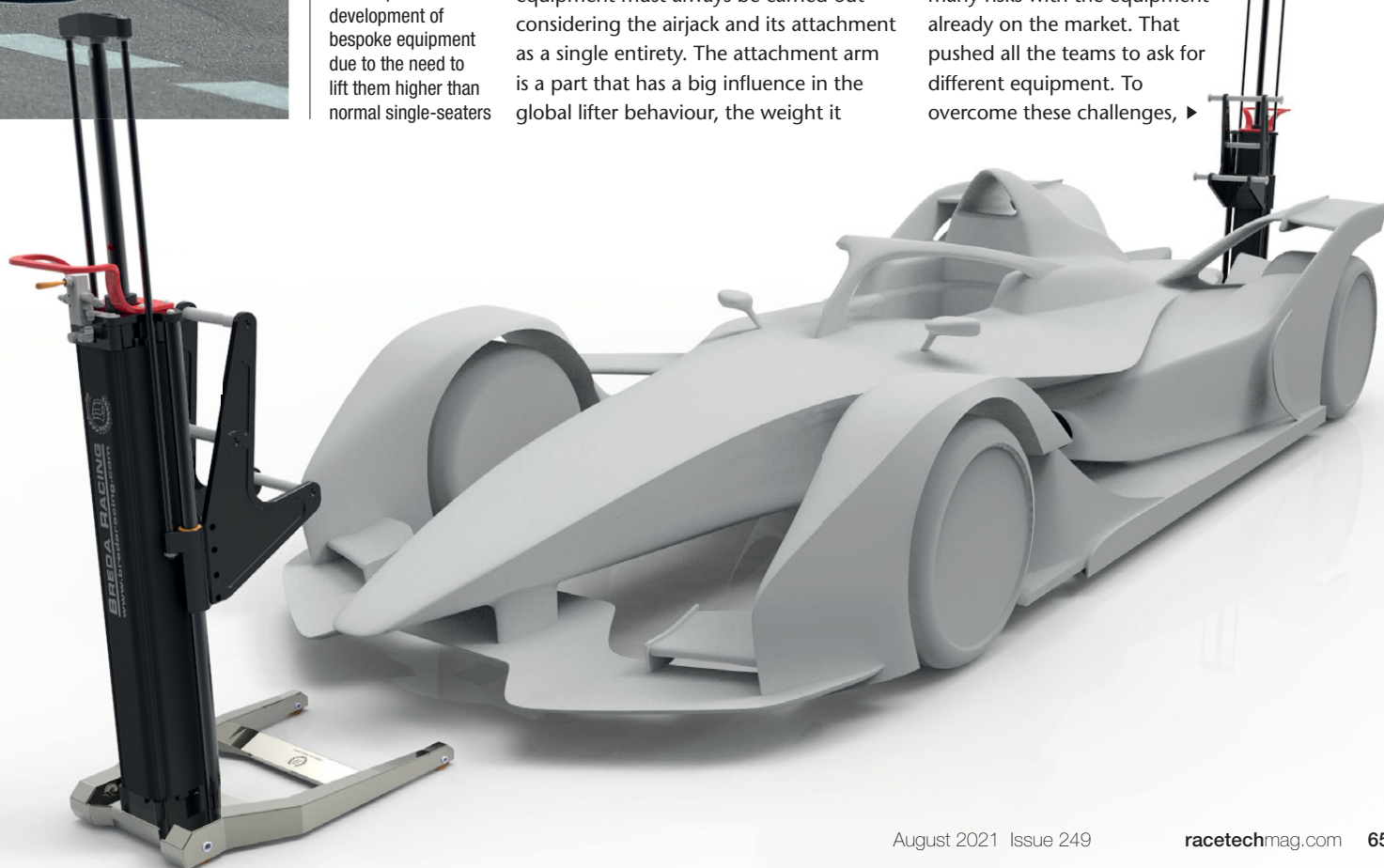
can effectively lift and the safety of the equipment,” explains Breda.

The advent of Formula E was a game-changer for everyone. Just as the racecars were like none that had come before, so the issues they created for suppliers were also unique.

The battery installed in the Gen2 Formula E car – developed by Atieva and McLaren Applied Technologies – required sufficient volume for the competitors to complete a full race distance without the midway car swaps of its predecessor. This necessitated a battery that, while state of the art, is nevertheless relatively large and heavy in racecar terms.

New heights

“The pneumatic lifters for a typical single-seater formula car require a stroke of 620 mm or 700 mm – enough to position the car over the high stands (usually around 500-600 mm) to do the necessary work,” explains Breda. “The first-generation Formula E car didn't present a problem in this sense. It was lifted with normal stroke air jacks, with its specific lifting attachment developed according to the car lifting points. But with the Gen2 car, the need to lift the car very high to replace the batteries presented too many risks with the equipment already on the market. That pushed all the teams to ask for different equipment. To overcome these challenges, ▶



we were forced to create a dedicated project for the specific way of working needed in this championship: higher and with an attachment quite different from usual formula car arms."

The solution is a new air jack series that can lift these cars 800 mm from the ground. It features projecting attachment arms that support the car's weight and enable the mechanics to conduct their work in total safety.

Wide range

The Breda Racing range of air jacks has now been revised to offer even more options.

The UltraLight, that can lift 500 kg, depending on the specific attachment arm, was developed for formula cars in response to teams' requests. Usually these came from series which involved a lot of air transport, where weight is a paramount consideration.

"The focus on weight is very important for a lot of championships," reveals Breda. "They want the lightest weight possible, but at the same time need

“Delivery to short timescales is one of our strong points”

the ability to lift the max weight where necessary, in total safety. For this reason, during the development there is a particular attention to the quality of raw materials chosen. Throughout the whole life of the equipment, there is also a continuous effort made to improve things further."

In such cases, Breda often supplies the equipment with dedicated flight cases or soft bags. They have been specifically manufactured for this purpose by renowned companies which specialise in such accessories.

"Our idea was to think of all such details, related to our equipment, in order that the teams didn't have to," says Breda. "This leaves them free to concentrate on more important matters."

Next up in the Breda range is the 'New Classic', which usually lifts 600 kg. Designed to replace Breda's initial jack, which was called the standard model,

this version is used in LMP cars, both in European championships but also series like IMSA, where cars are often heavier.

This model is also used for formula cars where air transport is not such an issue. It has proved popular with teams who want the option to maybe use it in the future with heavier cars too. In such instances, all that is needed is to check the attachment point and, if necessary, replace it for the new car.

Both the UltraLight and New Classic jacks

can be manufactured with a standard 620 mm stroke or with 700 mm and attachment kits specific for each car model.

In single-make championships – such as F2, F3, regional F3, SuperFormula, F4 or IndyCar – the attachment works for each car model. In the higher echelons, such as Formula 1, unique attachments are developed for each team, in a close technical exchange. At this level it is also often requested that the jack's piston be hidden from view by a carbon fibre cover. ▶

BELOW & RIGHT
Breda Racing collaborates with some of the top teams in Formula E, as it does in high-profile series like Formula 1 and IndyCar



**SET UP WHEELS
SET UP PADS
WITH LOAD CELLS**



**PROJECT SPECS
BASED ON THE CAR MODEL**



**NEW GENERATION
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Another option still, the GT Wheel, has been developed for the GT ranks. Whilst not yet as well known as the rest of the range, it is becoming increasingly popular.

Where single-seaters and sports prototypes are usually lifted by the deployment of one jack at the front and one at the rear, GT cars don't always feature lifting points safe enough to be used in this manner. Instead, Breda has developed a series of air jacks with fork-like attachment points at each wheel. In this case four units are required, but they enable these heavy cars to be lifted in complete safety.

The GT Wheel uses the same higher piston stroke, 800 mm, as the Gen2 Formula E air jack or it can also be manufactured at 700 mm.

These cases provide just a snapshot of the challenges faced by the company in a fiercely competitive arena. Accordingly, Breda Racing constantly reviews and evolves its range of equipment.

As ever in racing, the teams' drive to be better in every single area can raise conflicting demands. "They always want lighter equipment that can still lift the most weight possible in complete safety!" observes Breda. "Another challenge is to always be open to the teams' requests, particularly where something needs customising, and at the same time to have a quick reaction time.

"The bespoke nature of the requests doesn't allow us to simply manufacture equipment and keep it in stock, as each one is different. However, the company is structured to allow delivery to short timescales and this is one of our strong points that differentiates us

"And, at the top of the challenges, is the need to produce products in this way but still keep prices down."

Breda Racing's success in this respect is demonstrated by the fact that it has become trusted at every level of the racing pyramid. Its equipment is used in all single-seater championships, from the entry-level series through to IndyCar and Formula 1. Its pneumatic lifters are also popular for the heavier sports cars used around the world, from WEC to IMSA, and from ELMS


to the Porsche Carrera Cup. The company also caters for the needs of the burgeoning historic market.

Evolution

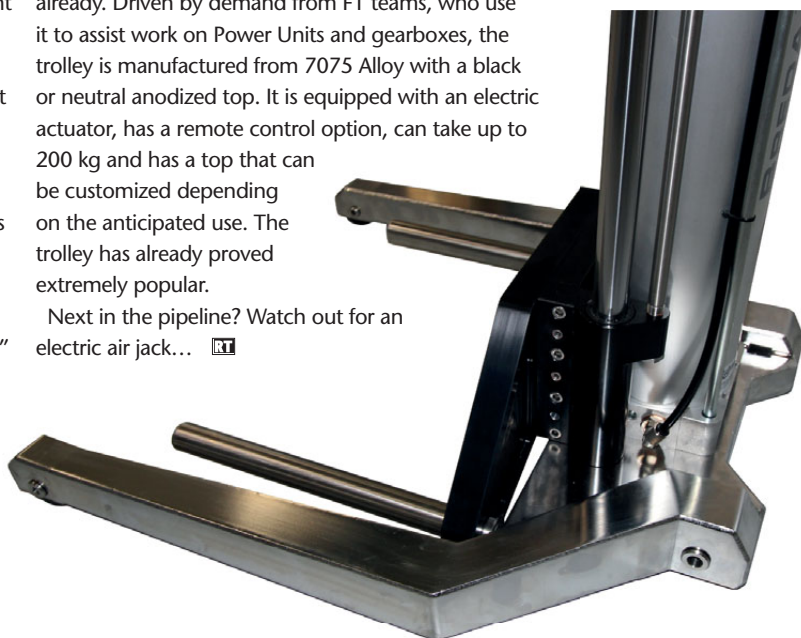
Of course, it's not only the cars that move quickly in motorsport: the technology involved in the pit equipment must evolve too. With Formula E's Gen3 car on the horizon, Breda is already in discussions to understand any modifications needed to existing equipment, or the requirements for any new equipment that must be developed.

"There is a lot of disruptive technology entering motorsport at the moment," notes Breda, "but there are still a lot of championships with traditional-engined cars too. Breda Racing, as supplier of equipment, needs to follow the demands of the teams and the championships."

Electric is the new buzzword, though, be it on the racetrack or in the pit lane. Breda Racing's electric pit trolley, the 'EAE', has been in use for several seasons already. Driven by demand from F1 teams, who use it to assist work on Power Units and gearboxes, the trolley is manufactured from 7075 Alloy with a black or neutral anodized top. It is equipped with an electric actuator, has a remote control option, can take up to 200 kg and has a top that can be customized depending on the anticipated use. The trolley has already proved extremely popular.

Next in the pipeline? Watch out for an electric air jack... 

ABOVE & BELOW The GT Wheel, featuring four air jacks with fork-like attachment arms, is becoming increasingly popular



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CHELL REVEALS PIT 100

New portable automated leak and flow test system created for tubing looms

GAS measurement and control expert, Chell Instruments, has revealed its newest development: the PIT 100, a self-contained automated leak and flow test system.

Pipe-work integrity (the PIT 100) is the first instrument of its kind and performs a number of tests to determine the integrity of pressurised pipe-work, looms or harnesses.

Nick Broadley, Managing Director of Chell Instruments, says: "Leaks threaten the integrity, accuracy and safety of many critical pressurised systems. This automated system can quickly and consistently calculate leaks in tubing looms and was developed by our engineers to test a whole range of applications."

Pressure decay

Chell's PIT 100 has been created to test both a single port or up to 16 ports simultaneously, so it can be used for both small and large operations. Its three main functions are leak testing, continuity testing and flow testing.

The PIT 100 can perform leak tests by applying pressure to all the ports in use, isolating the pipe-work or harness from the supply and then measuring any pressure decay.

For continuity testing, the PIT 100 can also test multi-way looms. Each channel is pressurised and the operator can then confirm that the gas is being passed through the appropriate port.

Lastly, the PIT 100 can be used as a flow tester. The test is used to detect abnormalities in the system, such as restrictions or breaks which give a different flow of gas and therefore a different measured pressure.

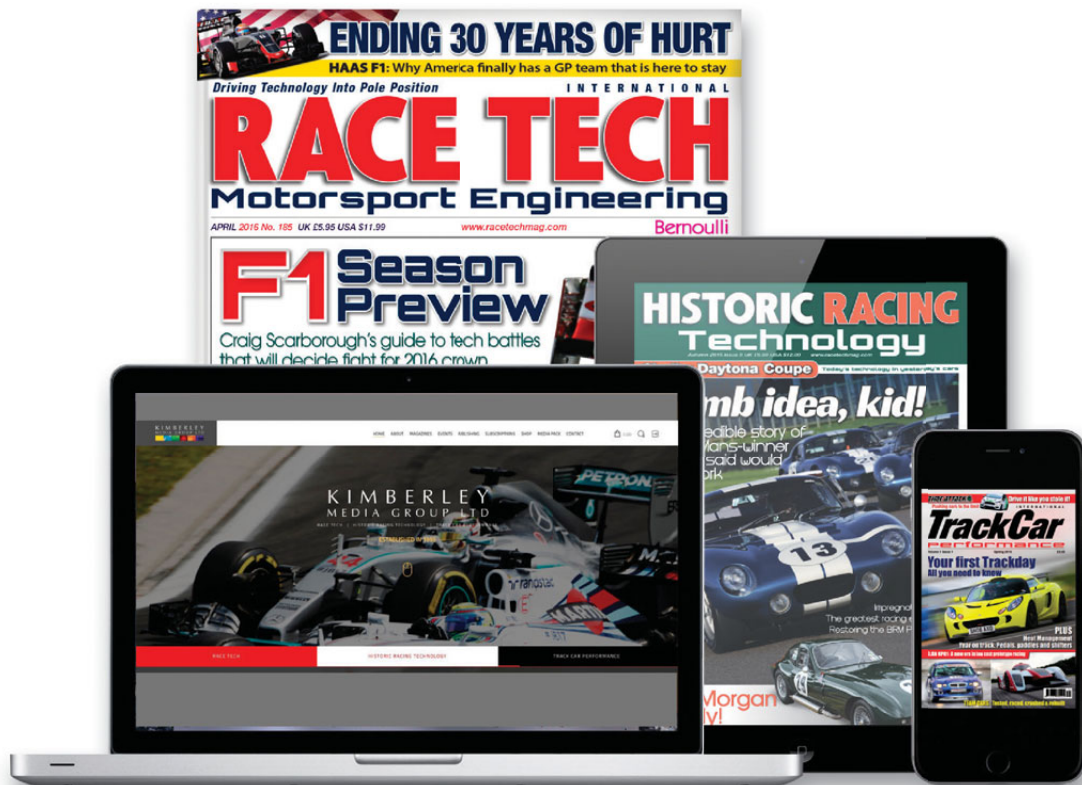
BELOW The PIT 100 can quantify the integrity of tubing looms

Broadley concludes, "Our PIT 100 is designed with our clients' needs in mind, which is why we made it portable and able to perform varying tests to determine and quantify the integrity of tubing looms. We've also made reading the configurations easy through our colour LCD display or via the embedded web server."

Chell Instruments has supplied and manufactured pressure and gas flow measurement and control instrumentation since it was established in the 1970s. Its products are used for high accuracy pressure, temperature and flow testing within sectors including motorsport, aerospace – in which it recently created a mobile jet engine test facility – pharmaceuticals and energy. In early 2020 it became part of the SDI Group of companies. **RT**

“Leaks threaten the integrity, accuracy and safety of many critical pressurised systems”





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NASCAR'S REVOLUTION

Sergio Rinland admires the manner in which NASCAR bravely ripped up all that it had clung to, creating the Next Gen machine

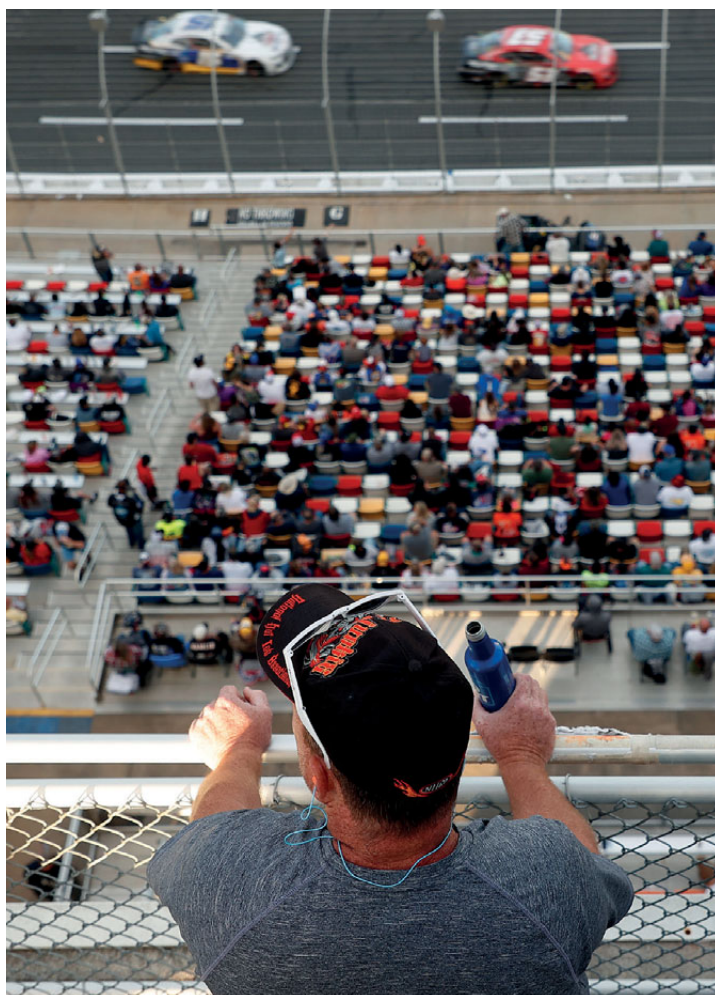


SOME years ago, I was invited to the Daytona NASCAR 500-mile race: a great experience and my first taste of a 'different' discipline of motorsport.

'Different' is an understatement! At one point during the race, I could see a 'yellow': the pace car was out. I looked at the giant screens, peered all around me, but could not see any accident. So I asked my host, Dr Andy Randolph, engine manager at Hendrick Motorsports at the time and now tech chief at ECR Engines, "Where is the wreck?" (using their language). Andy



Photos: Getty Images for NASCAR



ABOVE The Next Gen NASCAR represents a huge shift in thinking, bringing cars more in line with the technology now seen on the street

responded matter-of-factly: "There is no wreck. The race was getting monotonous, so they deploy the pace car to pack the cars together and start again."

A family show

For me, that summed up the philosophy of NASCAR and where their priorities lie: entertainment. In a marked contrast to Formula 1, the public is allowed in the paddock, where they interact with

“Great stuff from NASCAR. Courageous work”

drivers and mechanics. Every team has the 'autograph' area where the fans queue up for a memento. Fans are whole families: dad, mum, and kids. This is the heart of NASCAR, a spectacle for the families, and the grandstands are always packed.

Another big difference I observed, in stark contrast to what I was used to, was "scrutineering": a big open area where every car has its space. There, scrutineers could ask the competitor to even strip the engine, in daylight and for everybody else to see, including spectators! They had nowhere to hide. This was a breath of fresh air. ►

LEFT NASCAR has traditionally put spectacle for the fans first

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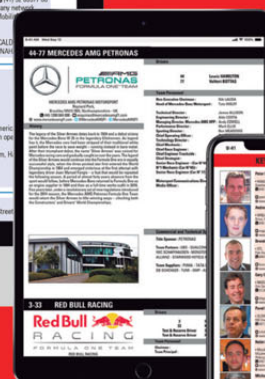
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ABOVE The micro-development of the current cars shocks even Formula 1 engineers

When it came to the technology, it was a different story. A few years after that experience, in 2007, I did some consultancy work with Hendrick Motorsports and had the opportunity to get a first-hand view of all the car's technical details and the manufacturing processes. Not much has changed since then, save for some details related to safety: you have an army of engineers and mechanics to micro-develop a car keeping technologies that were in use in the 1950s and 1960s – a mammoth effort in engineering and money to develop something that has no use to the automotive or motorsport industry.

Clinging to a lost world

In 2007, for example, the budget on carburettor development was over one million dollars, yet no other cars on the planet were running on carburettors!

Only recently did NASCAR adopt fuel injection – a great cost-saving for the teams. Like the carburettors, the same goes for suspension, steering, engine and gearboxes: huge amounts of money to make antiquated systems with modern technologies and processes. The examples abound: Xtrac making H-pattern

gearboxes, or Toyota's pushrod engine.

The paradigm of motorsport is changing all over the world and NASCAR cannot be oblivious to this. The old ways of trying to save costs, keeping 'tradition', are no longer viable. The changes have to be substantial, like we are seeing in other disciplines. Hence, NASCAR responded in a more vigorous manner than any other discipline in motorsport, with a technical and manufacturing process shake-up, the like of which it had never seen before.

The result of that labour is the 'Next Generation' NASCAR. It is, by NASCAR's standards, a revolutionary car. The seismic scale of the change, both in terms of technology and way of thinking, is perhaps best illustrated by

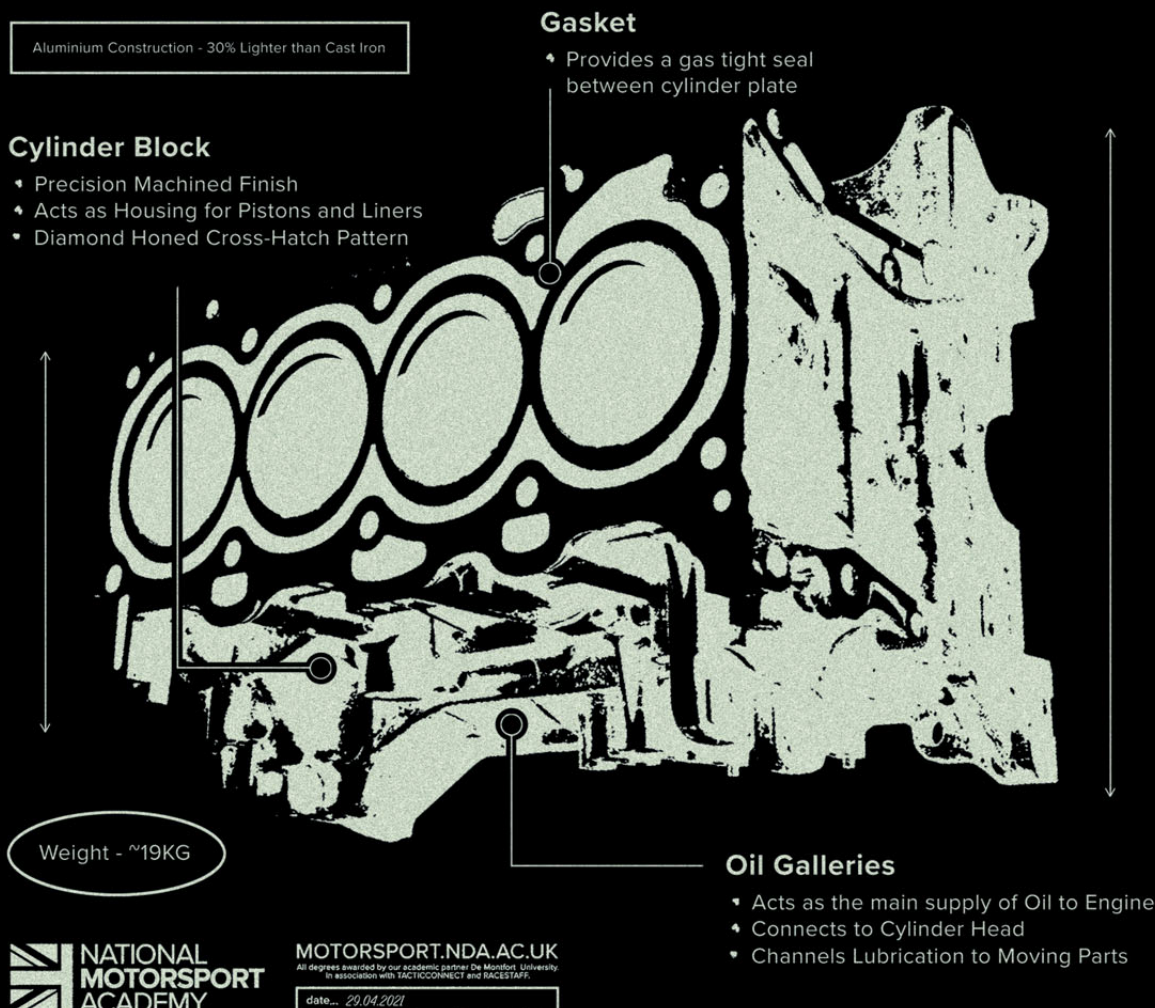
the aerodynamic regulations: NASCAR has opted for the same philosophy as the ACO has for the new Hypercar category. You've read that ethos many times in these pages: freedom of design, but limits on downforce and drag to equalize the different-looking bodyworks.

No aspect of the new car has escaped the knife: chassis, suspension, steering. The only remaining item, which I expect will change soon, is the engine. For now, it is still the great-sounding pushrod V8, but again, as in Le Mans Hypercar (LMH), with a cap on power.

Great stuff from NASCAR. Courageous work. Surely the teams will spend less, and the spectacle will be the same, or even better. **RT**

RIGHT The Gen 7 car might have been delayed by the pandemic, but there was no holding back the tide of change





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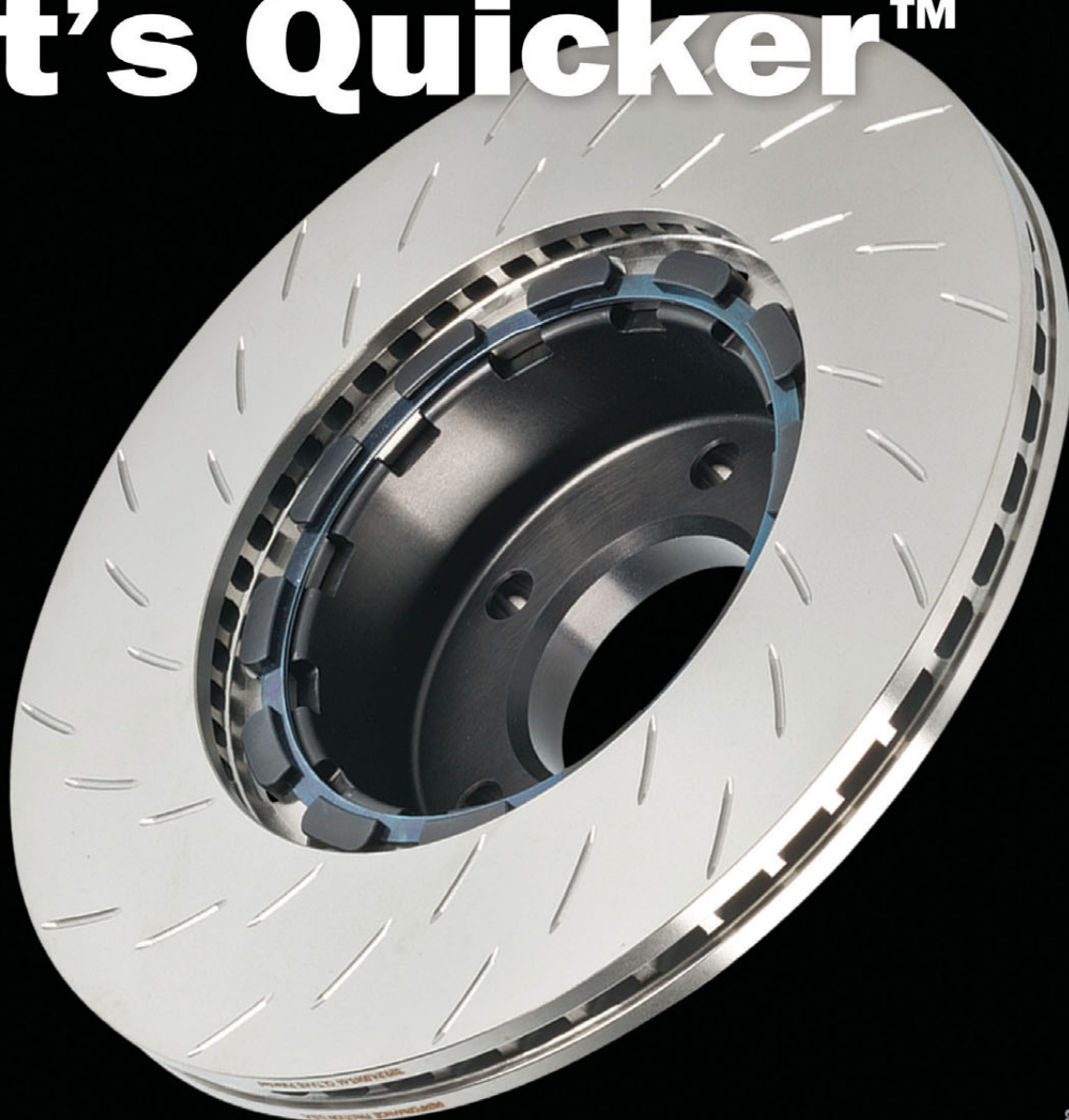
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