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71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,
90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,
106,107,108,109,110,111,112,113,114,115,116,117,118,
119,120,121,122,123,124,125,126,127,128,129,130,131,
132,133,134,135,136,137,138,139,140,141,142,143,144,
145,146,148,149,150,151,152,153,154,155,156,157,158,
159,160,161,162,163,164,165,166,167,168,169,170,171,
172,173,174,175,176,177,178,179,180,181,182,183,184,185,
186,187,188,189,190,191,192,193,194,195,196,197,198,
199,200,201,202,203,204,205,206,207,208,209,210,211,
212,213,214,215,216,217,218,219,220,221,222,223,224,
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WRC's NEW ERA

Rallying's quest for a greener future



COVER STORY PAGE 28

ON THE COVER

28 WRC'S QUEST FOR A GREENER FUTURE

Anticipation and apprehension accompanied the build-up to the start of the World Rally Championship's new sustainable era. So how did it go? Anthony Peacock reports from Monte Carlo

56 WIN FOR SUSTAINABILITY

Chris Pickering discovers how a stroke of luck shaped Prodrive's impressive Dakar campaign with the Bahrain Raid Xtreme team – and reveals their plans to respond to the ASO's tech revolution

46 GEARING UP FOR NEXT GEN NASCAR

The switch to a spec transmission for the Next Gen Cup car involved overcoming many challenges. Chris Pickering speaks to the team behind NASCAR's most advanced transmission to date

6 INDUSTRY NEWS

Audi's stunning pace ignites Dakar controversy; Formula E's Maserati coup; hydrogen on Formula E's radar; Evernham warns NASCAR fans to be patient with Next Gen; ERA-ETCR partnership to help young talent climb electric racing ladder; Porsche chooses V8 twin-turbo for LMDh; Toyota unveils GR GT3 concept; Las Vegas hosts "real birth of autonomous racing"; US motorsport pays tribute to "visionary" Kalkhoven; Schubert Helmets added to United Autosports portfolio; M-Sport WRC squad signs Bell deal; BPS appointed ROKiT F4 British Championship Simulator Partner

74 COMMENT

Does the rules reset for 2022 offer a chance for giant-killing feats? Sergio Rinland looks ahead to judgment day

38 SUPERSTAR RACING EXPERIENCE

NASCAR legend Ray Evernham tells Chris Pickering about the formation of the Superstar Racing Experience and offers his thoughts on the introduction of the Next Gen NASCAR

66 GREEN TECH

One of the most significant events of this year's Dakar Rally occurred on a day when no cars even left the bivouac. Hal Ridge reports on the launch of GCK Motorsport's e-Blast H2, the first-ever cross-country car designed with an integrated hydrogen fuel cell



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RALLY REVOLUTION BUILDS MOMENTUM

THE motorsport ground is shifting beneath us.

Later this month, the results of Formula 1's much-vaunted transformation become evident when the new cars, designed to a completely fresh philosophy, break cover. So too, NASCAR's Next Gen stock cars race for the first time.

The switch to the Next Gen car, which features more innovation than any other machine in stock car history, already represents a seismic shift, but there's more to come. Our feature on Xtrac's new gearbox for the US series reveals the extent of the preparations for something that was once unthinkable: the first NASCAR hybrid powertrain.

An exciting month lies ahead. First, though, the Dakar Rally and World Rally Championship acted as the torch-bearers for motorsport's new sustainable era.

In both disciplines, as in NASCAR and Formula 1, the engineers have been scrambling to get to grips with the sheer scale of the technical upheaval they faced across an uncomfortably short timeframe. For all the upbeat talk of hybrids, alternative powertrains and sustainable fuels, there have been many holding their breath as the moment of truth approached.

It speaks volumes for the prowess of those technical trailblazers that we have been left discussing the positives, planning for the future, rather than contemplating an embarrassing string of retirements.

On the Dakar, all three of Audi's RS Q e-tron cars passed their baptism of sand

with flying colours. A hybrid 4x4 with three motor-generator units combined with an internal combustion engine, this is the most complex car the German manufacturer has ever built. Yet in total they covered around 24,000 desert kilometres – almost three times the 8,700 test kilometres that Audi had previously completed – without experiencing powertrain issues. How impressive was that?

On the Monte Carlo Rally, meanwhile, the transition to hybrid technology also went without a hitch. The new cars are certainly the safest in rally history. In due course, as the hybrid technology is fully unleashed, they might even turn out to be the fastest too.

But perhaps I was wrong. Not *everything* is changing. 'Fresh' from finishing second on the Dakar Rally, 47-year-old Sébastien Loeb went one better in Monte Carlo. His victory means he has topped the WRC podium in three different decades.

Co-driver Isabelle Galmiche, a 50-year-old schoolteacher, was making her first top-tier start. She became the first female winner of a WRC fixture since 1997.

Yes, the technology played a starring role this month. But I think the humans deserve a mention too. **RT**



Mark Skewis
CONSULTANT EDITOR

Audi's stunning pace ignites Dakar controversy

Innovative tech grabs the headlines as "Dakar Future" project takes shape. **By Mark Skewis**



WHEN winning your event becomes so important to the teams that they start squabbling, you know you must be on to a good thing.

Such is the case with the Dakar Rally.

The hugely impressive pace of the factory Audi RS Q e-tron, a hybrid 4x4 with three motor-generator units (MGUs) combined with an internal combustion engine, was the headline act on this year's event. The three-car team's performance vindicated the organisers' ambitious "Dakar Future" project – an energy transition plan to foster the development of alternative engines and slash emissions – but underlined the challenges ahead in terms of balancing the new technologies it is inspiring.

For the time being, more conventional machines still hold sway at the top of the leader board – but for how long? Toyota Gazoo Racing's Nasser Al-Attiyah produced

a strategy master class to dominate the 44th Dakar Rally, in Saudi Arabia, from start-to-finish in the new Hilux T1+. The Qatari benefited from co-driver Mathieu Baumel's meticulous navigational skills to see off a fierce challenge from the BRX Hunter of nine-time WRC champion Sébastien Loeb and reach the finish in Jeddah with a winning margin of 27min 46 sec.

For the Prodrive Hunter in its all-new T1+ specification, it was an impressive result, hailed as second place overall but a 'victory for sustainability'. Throughout the event, the team proved that sustainable fuels, like Prodrive EcoPower made from agricultural waste, can offer the same performance and range as petrol, while reducing CO2 emissions by 80%. The three Prodrive Hunter V6 turbo engines ran faultlessly over a total of more than 25,000 km on the new fuel made by Coryton Advanced Fuels.

But it was Audi that truly made the

biggest splash on its Dakar debut this year. The RS Q e-tron is the most complex car the German manufacturer has ever built, yet while the drivers encountered a number of problems, its electric powertrain performed faultlessly. All three cars mastered the world's toughest off-road rally on their debut in Saudi Arabia. In total, they covered around 24,000 desert kilometres – almost three times the 8,700 test kilometres that Audi had previously completed. The car won four of the 12 stages – including three in the second half of the rally.

It could have realistically contended for overall honours against the Toyota and Bahrain Raid Xtreme teams, with only a crash for Stephane Peterhansel on Stage 1 and navigational dramas for Carlos Sainz and Mattias Ekström on the same day leaving it out of the fight.

Ekström was the highest-placed of the three Audi drivers in ninth at the ►



ABOVE Audi's RS Q e-tron is still overweight but its pace was sufficient to startle rivals

Future Vision

THE grand vision is of a Dakar fully powered by alternative energy by 2030.

The number of new projects taking shape certainly points to an exciting future. Already this year's event had attracted five low-emission vehicles in the T1-U class. In addition to the innovative Audis, the Riwald team, which fielded diesel-electric trucks, has been part of the rally raid since 2020. Team owner Gert Huzink is adamant that "the hybrid truck is sustainable and ready for a top 10 finish". Japanese constructor Hino, another Dakar regular, has achieved an overall power rating of 1,070 horsepower!

currently yields valuable data that will contribute to the development of a model that could be in the race as soon as next year. "We expected to have a range of 250 km on rugged terrain, but we have got to 400 km, which fills us with optimism," said Christophe Gaussin.

Gaussin is also a stakeholder in the event's energy transition: for example, with the Smart Bivouac, a temporary facility that burns hydrogen for electricity.

Many more constructors are joining the trail from next year on. The Spanish EcoPower Automotive outfit, which in 2015 was the first squad to field a fully electric buggy, is coming



Julien Delfosse/DPPI

LEFT Philippe Jacquot, driver of the Gaussin H2 Racing Truck, in action during Stage 3

Guerlain Chicherit was also back this year with a medium-term project. The Frenchman teamed up with Alex Winocq to drive an environmentally-friendly bio-ethanol-powered GCK Thunder Buggy. He suffered a roll and several mechanical setbacks before retiring on the final day.

In addition to those competing, two demonstrator vehicles were unveiled on this year's event. GCK (Green Corp Konnection) showed the very first hydrogen-powered rally raid race car, equipped with a fuel cell. Éric Boudot, Managing Director, said: "Green Corp Konnection sees motorsports as an excellent test bed for technological solutions that we will later be able to market to users through our industrial activities."

Gaussin, meanwhile, a trailblazer in the clean, smart transportation of goods and passengers, unveiled its H2 Racing Truck. It is a zero-emission truck powered by hydrogen that entered the rally as a demonstration vehicle. Each outing

back for more in 2023 with a 4x4 rated at 250 kW (340 horsepower). "The future is now," said Edu Blanco. "We have been working to develop electric cars since 2015 without forgetting that the present influences our future."

Gen Z hopes to enter the Dakar as soon as next year with its H2 Racing, a fully hydrogen-powered vehicle entrusted to five-time Dakar champion Cyril Despres.

Koolen Industries CEO and PROJECT2030 truck driver Kees Koolen is targeting a 2023 debut for his fully electric Nicias truck. He has no doubt that "the Dakar is the ultimate test bed for future technologies".

Dakar legend Gerard de Rooy, the winner of the truck race in 2012 and 2016, has teamed up with UMS (Urban Mobility Systems) and Allison Transmissions to develop a fully electric truck. He intends to bring it to the rally in 2024. "That's quite a challenge but it's the good direction for the whole category and the Dakar," he said. **RTI**

finish, after punctures, a navigational mistake and a broken damper had cost Sainz a lot of time and he came home in 12th. Peterhansel suffered broken suspension and radiator issues and had to call upon his assistance truck on two occasions.

Dakar veteran Peterhansel said: "We're making good progress. I'm not necessarily a stage hunter but each Audi driver won at least one stage. This is good for morale. We need to win in 2023. Failure is not an option."

However, Audi's pace grabbed not only the headlines, but the attention of its rivals. David Richards, whose Prodrive operation powered the BRX team to second with Loeb at the wheel, warned that Audi could "kill" the sport when it returned in 2023 with a more reliable car.

"It's the fastest car by a long way," Richards said. "Everyone seems to think we are very equal between Toyota and ourselves. But clearly the performance of the Audi is at a different level. They are 200 kg overweight and they are still a lot faster than our car. So if they had been reliable they would have won by an hour, easy."

Ironically, Audi's Sainz had complained before the event that the rules didn't give the German manufacturer's car parity with its petrol-powered rivals. The three-time Dakar winner argued that Audi had to contend with a car that is significantly heavier than its competitors, while not having any more power or the inflation-deflation system to compensate for the extra weight.

The president of the FIA's cross-country commission, Jutta Kleinschmidt, refuted the suggestions that Audi's electric car was at a disadvantage, pointing out that the extra weight was of Audi's own making.

"I see them everywhere because I'm in the helicopter," she said. "I can see them flying over the piste. So for me there is definitely no disadvantage in power or even



ABOVE & BELOW
Winner Nasser Al-Attiyah celebrates a masterful drive

with the extra weight they have, they are very fast.

"I'm very happy about our regulations and I think we did a great job. We have in each car now data loggers, in the new T1+ and also in the T1 Ultimate. So after the Dakar everything will be analysed."

The very fact that so much sabre-rattling already dominates discussion over the future regulations is surely a good sign that the Dakar vision is being universally embraced.

David Castera, Director of the Dakar, is certainly delighted with the buzz around "Dakar Future": "Our extremely ambitious project has become a reality," he said. "This new era is in line with the zeitgeist and will enable us to move our sport forward in a greener way." **LT**

GCK'S HYDROGEN FIRST

See page 66



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A victory for sustainability

Polymakers urged to support race for more sustainable solutions

RALLY cars powered by agricultural waste claimed second and fourth place in Dakar 2022 and saved 28 tonnes of CO2 emissions in the process.

Bahrain Raid Xtreme (BRX) was the first major motorsport team to compete with a new generation of advanced sustainable fuels. The squad claimed second place with the Prodrive Hunter driven by nine-time World Rally Champion Sébastien Loeb and Fabian Lurquin. The sister cars also survived to finish in fourth and 54th position.

Using a bespoke fuel, created by global specialists Coryton, the project ideally captured the spirit of the organisers' 'Dakar Future' energy transition strategy, reducing CO2 emissions from the three vehicles by up to 80% during the race.

The cars ran on a second-generation biofuel, produced by the catalytic transformation of bioethanol derived from agricultural waste, combined with efuels created using CO2 captured directly from the atmosphere. This bespoke blend could be used as a direct replacement for unleaded petrol in almost any vehicle. It's one of 4,000 unique blends that Coryton produces each year in the company's quest for a greener future.

Fresh from this success, experts at Coryton are now urging policy makers and the general public to fight for more advanced renewable fuels to be

ABOVE Fuelled using farm waste, the Hunters' use of sustainable fuel helps open up the wider debate

used in everyday settings as part of the war on climate change.

Andrew Willson, CEO at Coryton, said: "This phenomenal result is proof of what can be achieved with sustainable fuels when the conditions don't yet support electrification.

"Of course, the move towards electric transport is one we fully support but the world needs time to get a robust infrastructure in place. And, in the meantime, millions of internal combustion engines in cars, heavy goods and aviation vehicles are still hard at work using emission-heavy fuels.

"There are more sustainable solutions we could be scaling up the production of right now, such as biofuels, that could seamlessly integrate with our current forecourts and vehicles while making a massive difference to the climate issues we face.

"As it stands, this option isn't being discussed enough. But, through global stages such as Dakar, we hope to raise awareness of just how effective and efficient renewable fuels can be. The results at the Dakar for Loeb and the Prodrive team are phenomenal, and we've taken a massive step forward for sustainable motoring too. We hope it creates more conversations around the opportunities available for a greener way forward."

Arthur Shaw, Prodrive's Chief Engineer for Engines, added: "When we designed the fuel the brief was it had to use genuinely sustainable feedstocks, but just as important was that its performance was comparable to our old racing fossil fuel, which it's proven to be.

"As part of a blend of technologies, sustainable fuel genuinely is part of the future and can give us a very practical solution to the problem of CO2. This has been a real-life demonstration of how motorsport can be more sustainable but it also allows motorsport to demonstrate that there are solutions for the wider community using this technology too." **RT**



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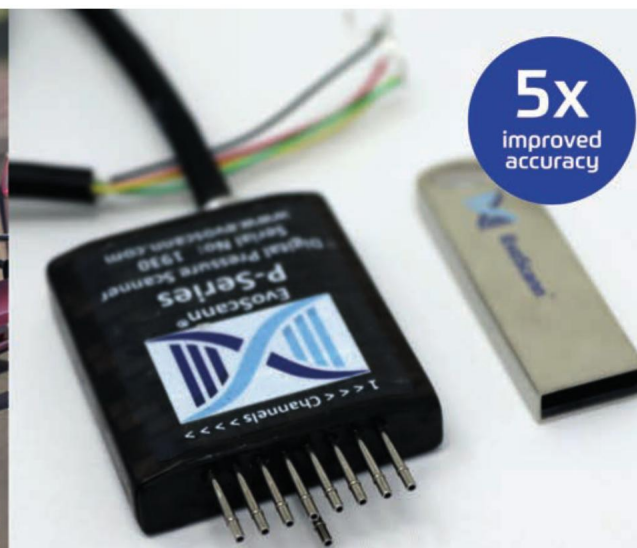
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Maserati coup proves Formula E bubble hasn't burst

Iconic racing brand enticed
to join the Gen3 revolution

FORMULA E founder and chairman Alejandro Agag admitted the coup of luring Maserati into the series is: "probably one of the greatest days in the history of the championship".

Rocked by the withdrawal, in quick succession, of the Audi, BMW and Mercedes factory efforts, the all-electric series endured criticism for escalating costs as detractors lined up to suggest its 'bubble had burst'. But it has struck back in decisive fashion.

First, it plotted the introduction of its Gen3, billed as the most efficient racecar in history. Then it finalised a framework of financial regulations to carry the series into that new era. Now, in Maserati, it has enticed a famous brand that has been courted by Formula 1, as well as the US endurance racing ranks.

Agag said it was an "incredible moment" for the series, adding: "The ABB FIA Formula E World Championship provides the perfect environment for the most dynamic and innovative high-performance car brands to showcase their technological capabilities alongside their sporting ambitions."

The first Italian brand to compete in the series, Maserati is the first manufacturer to join the series since Porsche's arrival in 2017. It will enter in 2023 with the Gen3 package, the fastest, lightest, most powerful Formula E racing car ever. Maserati's high-performance heritage, allied to its approach towards electrification, aligns perfectly with the ABB FIA Formula E World

Championship.

The first step in the company's motorsport strategy, the Formula E campaign will be the trailblazer for 'Folgore', its full electric range.

All new Maserati models will also be available in 100% electric solutions including Maserati Grecale, Maserati GranTurismo and GranCabrio and the Maserati MC20 super sports car.

Davide Grasso, Maserati CEO, commented: "The Maserati brand is going back to the future, going back to its roots of racing. We are powered by passion and innovative by nature. We have a long history of world-class excellence in competition and we are ready to drive performance in the future."

"Purest expression of Maserati"

Grasso continued: "In the race for more performance, luxury, and innovation, Folgore is irresistible and it is the purest expression of Maserati. That's why we decided to go back to racing in the FIA Formula E World Championship, meeting our customers in the city centres of the world, taking the Trident forward into the future."

Maserati is now part of the STELLANTIS automotive group, which is to invest €30bn through to the end of 2025 to develop its interests in electrification.

"It is a great pleasure for STELLANTIS Motorsport



ABOVE Maserati CEO Davide Grasso and FIA Formula E founder and chairman Alejandro Agag are bringing the Trident brand back to motorsport

to play a part in getting Maserati back in the Race," commented Jean-Marc Finot, Senior VP, STELLANTIS Motorsport. "Beyond this piece of history, Maserati Formula E will be our technological laboratory to accelerate the development of high-efficiency electrified powertrains and intelligent software for our road sports cars. Formula E is the perfect championship for this purpose."

Jamie Reigle, CEO, Formula E, said: "We are delighted Maserati will join the Gen3 era of the ABB FIA Formula E World Championship and play a defining role reimagining the future of motorsport."

Mohammed Ben Sulayem, the new FIA President, said: "For such an iconic manufacturer with a tremendously proud and successful heritage in motorsport to pledge its commitment to the series is testament to the overwhelming faith in the ABB FIA Formula E World Championship's future as we prepare to usher in the next era. The new Gen3 single-seater will represent the pinnacle of sustainability, technology and performance."

The first racing car to bear the Trident logo on the bonnet was the Tipo 26, which debuted at the Targa Florio in 1926, winning first place in the class up to 1.5 litres, with Alfieri Maserati at the wheel.

Maserati ended its tenure as a manufacturer team



in single-seater racing back in 1957 after Juan Manuel Fangio won his fifth Formula 1 title at the wheel of the 250F.

The 250F retained popularity among privateers afterwards, remaining in use until the end of 1960 at the climax of the 2.5-litre powertrain regulations.

Maserati's last appearance in racing was with the MC12, developed for GT1 regulations. The model won 22 races and a total of 14 titles from 2004 to 2010. **RT**

ABOVE Maserati's last foray in racing was with the MC12, which scooped 14 drivers', teams' and constructors' titles



ABOVE The brand was last seen as a manufacturer team in single-seater racing when Juan Manuel Fangio won his fifth F1 title at the wheel of the 250F in 1957

Photos: Maserati



FIA/Formula E

Formula E contemplates hydrogen to lure OEMs

FORMULA E is considering the introduction of hydrogen fuel cells in a bid to attract more manufacturers.

The championship's Gen3 model, dubbed the most efficient racecar ever built, will come on stream for the 2022-23 season, with teams taking delivery of the first chassis this spring. But already the Gen4 regulations are under consideration, with potential new manufacturers invited to brainstorm their ideas for the future direction of the series.

Speaking to Motorsport.tv, championship co-founder Alejandro Agag said: "Gen3 is already amazing. But we're just going to start now thinking on Gen4, which is coming in five years. We have to start the discussion now.

"We will, of course, invite the OEMs and the manufacturers that are with us now. But we will also expand the group to invite all the manufacturers to brainstorm with a very open mind about how Gen4 should look. There, everything is open. Anything could happen."

As part of this open approach, Formula E will consider adopting hydrogen fuel cell technology to power the electric motors. Agag noted that: "Hydrogen is within the licence of Formula E with the FIA [referring to an exclusive 25-year rights deal to electric-only single-seater racing].

"There are two ways to use hydrogen: one way is to burn the hydrogen, which is very inefficient, but some

people are working on maybe making it more efficient.


"The other way, which is the one we would use, is a hydrogen fuel cell that basically produces electricity that then powers an electric motor. So as soon as those technologies start being widely available and operating in a racing level, we will definitely look into those."

A hydrogen fuel cell is already used by sister series Extreme E to charge the ODYSSEY 21 E-SUVs on site at each race event.

The drawback to the introduction of such technology is, of course, the potentially spiralling costs that helped usher the BMW, Audi and Mercedes factory teams through the exit door. A €25 million manufacturer cost cap over two consecutive seasons comes into effect in October 2022, but the balancing act involving new tech but controlled costs is a difficult one.

The problem was further underlined recently when Porsche revealed that one of its ambitions was for a partial opening up of battery technology, thus far a locked down spec component.

Agag acknowledged that conflict. "You need to give that amount of freedom so manufacturers can develop technologies and have a reason why to compete in the championship," he said. "The balance is the key.

"[But] the more freedom you give, the more money the teams have to spend and then after a little bit they run out of money, and they leave the championship." 

ABOVE Hydrogen fuel cells are on Formula E's radar



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Evernham urges NASCAR fans to be patient

NASCAR legend Ray Evernham has warned NASCAR fans that they will have to be patient as the stock car giant undergoes the biggest technical upheaval in its history.

The Next Gen car, which represents a seismic shift in philosophy, races for the first time this month. But NASCAR's tech team, like the suppliers and race squads, have been scrambling to be ready in time.

Evernham, who won three NASCAR Sprint Cup championships as a crew chief for Jeff Gordon, and was inducted into the NASCAR Hall of Fame in 2018, is relishing the introduction of the new car.

"I think it's not only a positive step, but the *only* step

BELOW NASCAR's Next Gen cars race in anger for the first time this month

to continue the evolution of the sport," he told RACE TECH. "They need to keep the racing safe and they need to keep it cost-effective enough to bring in new manufacturers and new team owners, so I applaud what they've done. I think it was a similar philosophy that saved IndyCar. They had to bite the bullet and effectively introduce a homologated car, which brought back the competition."

But Evernham is mindful of the problems that will inevitably arise as the series grapples with understanding and operating the new technology.

"There are always some bumps in the road when you introduce something new," he said. "So I think people will need to be patient if this car isn't perfect everywhere when it first comes out of the box. I hope people will appreciate that NASCAR is going out on a limb and making these changes."

Evernham, who has more than four decades of experience in the automotive and racing industries, is currently working on preparations for the second season of the Superstar Racing Experience, the spiritual successor to the International Race of Champions (IROC).

Meanwhile, the latest star to be enshrined in the NASCAR Hall of Fame, two-time Daytona 500 winner Dale Earnhardt Jr, participated in the recent Next Gen test at Daytona. He remains very optimistic about the potential of the new car and offered interesting details and comparisons about the new and previous cars – the feel and the competitive expectations.

"At Daytona, I never drove one of the cars with those big spoilers on the back," Earnhardt said, noting the seven-inch spoiler on the 2022 cars. "So, I was pretty taken aback when we were drafting just how much drag is on the car."

As for the steering, he said, "It's very 'surgical', very delicate, very small movements of the steering wheel are going to give you the same reaction in the car that a big movement or a lot of movement in the wheel would have in the old car.

"All these guys that drove with manual steering box, you get muscle memory. And when your car gets loose you got an idea, it's instinctual how much you have to turn the wheel to correct that slide or catch the car. You know what to do, but you have to relearn all that with the rack and pinion [on the new car]. You can't rely on that muscle memory or instinct, but some guys will to a fault and make those adjustments they did all those years and that could get interesting and maybe a little messy in the race." **RT**



**SUPERSTAR
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See page 38



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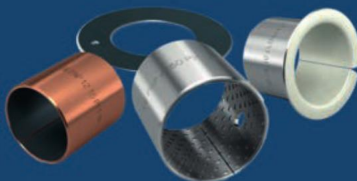


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LEFT The 9X8's wingless configuration is a triumph for the new WEC rules philosophy

Peugeot steps up 9X8 preparations

PEUGEOT TotalEnergies has ramped up its preparations, both on the racetrack and in the simulator, for the entry of its revolutionary 9X8 to the 2022 FIA World Endurance Championship.

But will that be with or without a rear wing?

The car's early track tests were conducted in close to its original launch configuration, without a rear wing, relying on the generation of underbody downforce. "This configuration is permitted by the ACO/FIA hypercar regulations," said Olivier Janssonie, the Technical Director of the WEC


programme. "Our calculations and wind tunnel work have confirmed the pertinence of our decision to run without a rear wing. Along with the developments and settings this option calls for, we expect it to be validated as we test at different circuits with differing characteristics."

With the clock ticking down to the 9X8's race debut, the team has successfully kept to its original roadmap and several key phases have already been completed: the first dyno test of the bi-turbo V6 engine took place last April; the 9X8's 200 kW motor-generator

unit was bench-tested in November; the complete powertrain in four-wheel drive mode was bench-tested in December; the maiden track run was also conducted before Christmas.

The team will not race in Sebring's season-opener. Nor has it yet committed to when its first race will be. Given that the homologation submitted to the sport's governing body will apply until 2025, it is imperative that the car's specification is frozen only when the engineers are satisfied.

"The 9X8 will make its race debut based on its level of readiness, reliability and competitiveness as agreed with the championship's organisers, who we will keep regularly updated as our development programme progresses," said Stellantis Motorsport Director Jean-Marc Finot.

The 9X8 combines a rear-mounted 2.6-litre bi-turbo petrol V6 that delivers more than 500 kW (680 hp), a front-mounted 200 kW motor-generator unit, all-wheel drive transmission and a high-density battery developed jointly by Peugeot Sport, TotalEnergies and its subsidiary Saft. 

Zurlinden joins Multimatic

THE former head of factory motorsport for Porsche, Pascal Zurlinden, is to join Multimatic Special Vehicle Operations (MSVO) as Director of Performance Engineering.

As the Special Vehicle Operations group, which specialises in high performance vehicle development and runs Multimatic's motorsport programmes, continues to grow, Zurlinden's knowledge, expertise and experience will be an important asset to the organisation. He will report directly to MSVO Executive Vice-President, Larry Holt.

Holt said: "We have worked with, and competed against, Pascal over the years and he has proven to be an outstanding technical partner as well as a tough adversary when we ran the Ford GT head to head against the Porsche 911 RSR. He is a highly skilled motorsport

engineer with an extremely strong intuitive feel for race craft and a great approach to leading a team when subjected to the high pressure of competition.

"As partners with Porsche on a number of motorsports programmes, it can only enhance both companies to keep Pascal in the fold."

Zurlinden was instrumental in the birth of Porsche's and Audi's development process of their LMDh race cars, for which Multimatic is the chosen "spine" (chassis) constructor partner.

The 39-year-old Frenchman first joined Porsche in 2014, working as an engineer on its world-beating LMP1 programme, then went on to take the reins of the factory GT programme where his leadership took Porsche to success in all of the blue riband GT races across the world. He assumed responsibility for all factory racing of the brand

from 2019 onwards.


Elsewhere, the recruitment merry-go-round has been busy in the last few weeks:

- Former BMW motorsport head Mike Krack will become Aston Martin F1 Team Principal, taking over from the recently-departed Otmar Szafnauer. Although not a familiar name in the world of F1, Krack has headed up BMW's global motorsport operation since 2014, leading the German manufacturer's Formula E, GT and IMSA programmes, as well as overseeing its expansion into the new LMDh category. He has previous F1 experience with Sauber and BMW Sauber, working with current Aston Martin driver Sebastian Vettel when the latter was a test driver.
- Andreas Roos succeeds Krack as Head of BMW M Motorsport. Roos brings two

decades of experience in motor racing and has headed up a variety of projects over the course of his career, latterly overseeing Audi's innovative electric-hybrid Dakar project.

- Long-standing Head of Rally Engineering, Chris Williams, was appointed M-Sport's new Technical Director ahead of the 2022 WRC season. In nearly 25 years of service at M-Sport, he has been responsible for many of the winning rally projects to come out of Dovenby Hall.

- Alain Prost has left his advisory role at Alpine, accusing the outfit of having "no respect" after it leaked his departure. Prost's exit follows that of Marcin Budkowski. The French outfit has been linked with Otmar Szafnauer...

- Supercars has appointed long-serving Chief Operating Officer Shane Howard to replace Sean Seamer as the head of the Australian organisation. 



Photos: Porsche AG

Porsche opts for twin-turbo V8 for LMDh project

PORSCHE and Audi will use a 'large capacity' twin-turbo V8 engine for their LMDh cars in the FIA World Endurance Championship and IMSA WeatherTech SportsCar Championship.

Both companies will use the same platform for their endurance challengers: Multimatic's next-generation LMP2 design. The engine has been designed to run on renewable fuels, with TotalEnergies supplying a new biofuel for the 2022 WEC season.


"We were spoiled for choice with the engine for our LMDh prototype, because the product range offers several promising baseline units," explained Thomas Laudenbach, Vice President Porsche Motorsport. "We decided on the V8-biturbo, which we feel offers the best combination of performance characteristics, weight and costs. The kick-off to the active test programme was an important step for the project."

Urs Kuratle, Overall Project Manager LMDh at Porsche Motorsport, said: "The rollout of the LMDh racing car was also the first track outing for Porsche Penske Motorsport. The squad worked well together right from the start. This shows a high level of professionalism in all areas. After all, the operational requirements for the safe running of a hybrid vehicle are very high. In the next outings we will focus on going deeper into the required processes and procedures. During these first test days at Weissach, the V8-biturbo impressed us in every respect. We're convinced that we've chosen precisely the right unit."

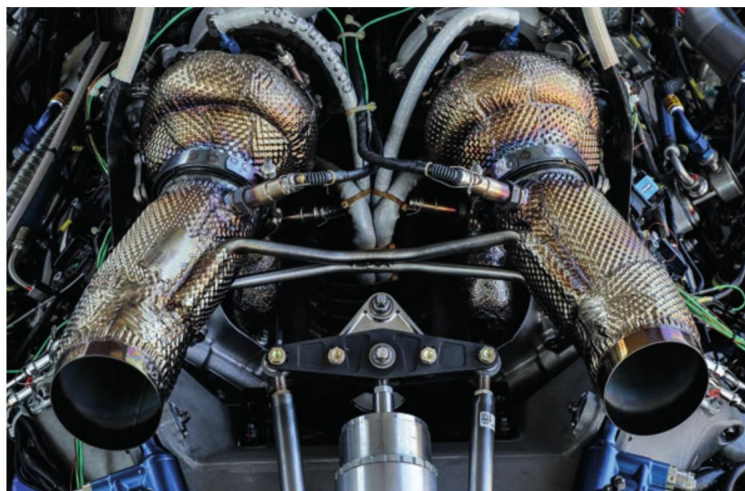
The engine regulations for the LMDh vehicle class allow a great deal of freedom in terms of displacement, design and number of cylinders. Maximum revs are 10,000 rpm, with the pass-by noise measurement capped at 110 decibels. The engine must weigh a

minimum of 180 kilograms, including the air supply and exhaust system as well as the peripheral cooling components. If used, this weight also incorporates the turbocharger/s including the charge air cooling.

In line with the regulations, the maximum output lies between 480 and 520 kW (653 to 707 PS). This range also allows adjustments to be made within the Balance of Performance (BoP) parameters, which are intended to ensure parity between all competing LMDh racing cars.

The torque curve is also clearly defined. Under racing conditions, the combined power output of the combustion engine and hybrid drive totals 500 kW (680 PS) at the halfshafts. The standard components for the recuperation, storage and delivery of electrical energy are supplied by Williams Advanced Engineering (battery), Bosch (motor-generator unit and control electronics) and Xtrac (transmission). 

ABOVE & BELOW
Porsche's LMDh
rollout at Weissach





ERA-ETCR partnership to help young talent climb electric racing ladder

ORGANISERS of the ERA Championship, the world's first all-electric junior formula race series, have announced a 10-race calendar and global broadcast package for the inaugural season of the championship, as part of a new partnership with the FIA ETCR - eTouring Car World Cup.

The launch of the series, like so much of motorsport, was originally delayed by the global pandemic. Now, however, a new generation of young drivers will take to the track in all-electric single-seaters as part of the FIA ETCR racing package, with the ERA Championship making its debut at Istanbul's Street Circuit of Beyoglu on May 20-22, followed by races at the Hungaroring and Jarama in June and Zolder and Vallelunga in July.

The ERA Championship is created to be an accessible entry-level electric formula racing series, launching a career pathway for promising young driving and engineering talent and demonstrating the power of an electric future through exciting and sustainable wheel-to-wheel racing.

The field of 10 ERA drivers will race identical Mitsu-Bachi F110e single-seaters. The cars are based on the Japanese Dome F110 chassis and fitted with a 24 kWh battery. Each driver will have 130 kW (175 bhp) at their disposal, making for top speeds of around 210 kph, while performance modes will be adaptable at the flick of a switch.

The Mitsu-Bachi F110e has completed a thorough development and testing programme throughout the last year at the championship HQ in Zolder. It will take part in a demo event during the opening round of the FIA ETCR championship at Pau, before racing officially begins in Turkey.


Each race event will feature free practice, two

qualifying sessions and two sprint races, offering the field of young racers every opportunity to impress in front of FIA ETCR team principals and fans.

Highlights of every race will be broadcast on Eurosport channels on the Tuesday after each event in more than 70 countries in Europe and the Asia-Pacific region. Details of a live broadcast package – to be available on several platforms in 2022 – will be revealed at a later date.

Beth Georgiou, ERA Sporting Director, said "We have seen the phenomenal success of electric racing in recent years and if you look at the opportunities now for drivers to develop a professional career, it is clear that electric racing is an increasingly attractive option and we only see that going in one direction. Drivers in the ERA championship will be the first in the world to take a step onto an all-electric career ladder and it's important for us to ensure the environment is there to support and inspire them as they build their career."

Xavier Gavory, FIA ETCR - eTouring Car World Cup Series Director, said: "Creating an electric-racing festival was – and remains – part of our plan at Discovery Sports Events and the addition of the world's first all-electric junior single-seater championship is a fantastic next step. Not only will the Team Principals of some of the world's most prominent electric motorsport manufacturers have the chance to see the next generation of stars competing right under their noses, but the fans will be introduced to the names that could dominate this area of the sport for the next generation.

"The team at ERA Championship share our vision of creating a more sustainable form of motorsport that can showcase the mind-blowing potential of electric racing and we can't wait to see it unfold on-track." 

ABOVE ERA's young racers will benefit from a slot on the ETCR package

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Toyota unveils GR GT3 concept

TOYOTA Gazoo Racing's commitment to developing attractive, "driver-first" cars for customer motorsport was illustrated by the debut of its new GR GT3 concept at the 2022 Tokyo Auto Salon.

As was the case with the GR Yaris, by commercializing motorsports cars rather than simply adapting production vehicles for use in motorsports, TGR intends to use feedback and technologies refined through participation in various motorsports activities to develop both GT3 and mass-production cars and further promote making ever-better motorsports-bred cars.

As well as targeting the popular GT3 market, the pinnacle of customer motorsport, TGR also showcased its GRMN Yaris. The development of the GRMN Yaris is faithful to the wish of Toyota President Akio Toyoda (aka racing driver and motorsports fan "Morizo") to "deliver cars

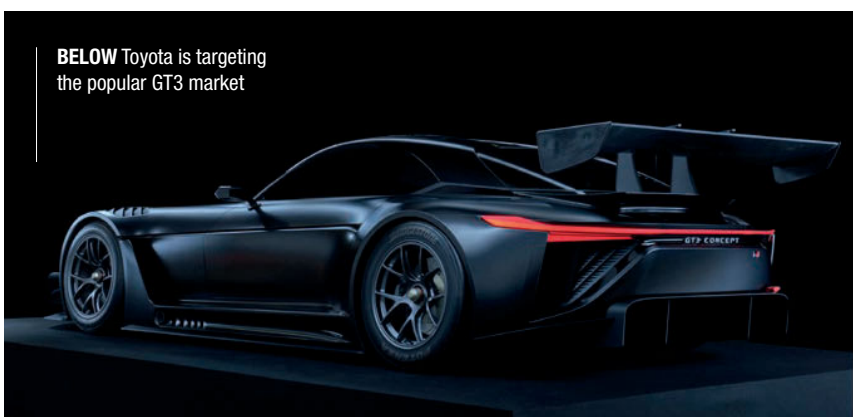
to customers that evolve quickly and can be tailored to individuals, such as in the field of motorsports."

Only 500 examples of the new GRMN Yaris will be built and these will be available exclusively in Japan. The car's weight has been reduced by around 20

kg; its width has been increased by 10 mm to improve aerodynamic performance; and its height has been reduced by 10 mm to lower the centre of gravity. The cars will only be available via a reservation lottery for Japanese customers.

Toyota also showed the bZ4X GR Sport Concept, based on the soon-to-be-launched bZ4X, Toyota's new purpose-designed battery electric SUV. The car is designed to offer a higher level of both environmental performance and driving pleasure. Features include large-diameter tyres, sports seats and matt black exterior body panels. **RT**

BELOW Toyota is targeting the popular GT3 market



Kumho seals TCR Europe deal

KUMHO has been appointed official tyre supplier for the TCR Europe race series from 2022.

The products provided will be its proven dry weather ECSTA S700 and wet weather ECSTA W701 competition tyres. The supply arrangement will also include TCR Spain, TCR Denmark and TCR Eastern Europe.

Launched in 2015, the various TCR series are hosted by World Sporting Consulting (WSC). They feature mass-produced 4/5-door touring cars powered by 2.0-litre turbocharged engines of up to 350 bhp driving through sequential transmissions.

Marcello Lotti, President of WSC Group, said: "Motorsport competitions offer a great opportunity to showcase and test advanced vehicle technologies. Kumho has made a great effort to embrace TCR, and that dedication is shown first and foremost in the quality of the product, which we have now evaluated and approved."

Paulo Ferreira, the TCR Europe Promoter, commented: "Having a single tyre across a range of TCR series makes total sense for both organisers and competitors, and I think it shows great foresight by Kumho to work with WSC and series promoters in the production of a bespoke TCR tyre."

"We will use this partnership to enhance

our motorsport technology image and brand recognition in the global marketplace," said Tony Gangseung Lee, Senior Vice President of Global Marketing at Kumho Tire.

No stranger to touring car racing, Kumho was the official tyre partner for TCR Korea at its launch in 2018. The company's success in the world of motorsport has embraced everything from European F3 to WCR rallying, while in 2007 it developed prototype tyres for F1. **RT**

BELOW Kumho has produced a bespoke TCR tyre





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LEFT PoliMOVE became the first head-to-head autonomous racecar champion

Las Vegas hosts “real birth of autonomous racing”

THE Indy Autonomous Challenge (IAC) team PoliMOVE, from Politecnico di Milano (Italy) and the University of Alabama, won the Autonomous Challenge @ CES, making history as the first head-to-head autonomous racecar competition champion.

PoliMOVE competed at the Las Vegas Motor Speedway in a field of five teams from five countries representing seven universities to win the \$150,000 grand prize. TUM Autonomous Motorsport from the Technische Universität München (Germany) took home second place with \$50,000.

The rules of the IAC competition required each team to qualify in a high-speed autonomous racecar time trial competition, determining their seed in the head-to-head passing competition. The IAC teams raced

the Dallara AV-21, the most advanced autonomous racecar, which features three Luminar Hydra LiDAR sensors to provide 360-degree long-range sensing.

PoliMOVE competed against TUM Autonomous Motorsport in the final round of the competition. In addition, PoliMOVE set the fastest speed record on an oval with a top speed of 173 mph.


Last October's IAC, held at Indianapolis Motor Speedway, eventually morphed from the concept of head-to-head racing into a single car time trial format as competitors hit trouble. But Sergio Savaresi, team lead of Politecnico di Milano, referred to the Las Vegas event as the “real birth of autonomous racing”.

“The real high-speed multi-agent racing was pushed to its very limits,” he added. “The research on autonomous cars will

certainly benefit from this historic milestone.”

Organized by Energy Systems Network, the primary goal of the IAC is to solve real world problems by advancing technology that will speed the commercialization of fully autonomous vehicles and deployments of advanced driver-assistance systems (ADAS). Pushing limits for the entire autonomous community and helping to increase safety and performance is of critical importance, not only in motorsports, but across all modes of commercial transportation.

“We came to CES, the world's most influential technology innovation event, to showcase to the world how this competition is catapulting autonomous technologies forward,” said Paul Mitchell, president and CEO, Energy Systems Network. “We're harnessing the power of prize competitions to attract the best and the brightest minds from around the globe to further the state-of-the art technology in safety and performance of automated vehicles and the teams did just that with another historic competition.”

Halo, a remote-piloted driverless car service operating on T-Mobile's 5G network, served as the official pace car, leading each set of IAC teams off of pit lane and completing a warm-up lap at speeds of 65-80 mph before the start of each round. 

IndyCar extends Dallara contract

INDYCAR has signed a multi-year extension with chassis manufacturer Dallara, continuing a relationship with one of the longest-running partners in the series. The contract runs parallel to the current agreements with engine manufacturers Chevrolet and Honda.

“An important part of the success and growth of the NTT IndyCar Series can be directly traced to Dallara's collaboration with our entire paddock,” said IndyCar President Jay Frye.

“This extension provides IndyCar and its teams continuity and a stable platform as we look well into the future.”

Dallara first supplied driver safety cells

for the series in 1997 and has been the sole chassis supplier since 2008. In 2012, the manufacturer expanded its US operations by opening a factory in Speedway, Indiana, where the company



ABOVE Dallara has been part of the IndyCar journey for 26 years

produces and assembles chassis for a variety of racing series.

Since 2015, production has included the chassis for IndyCar's Indy Lights Presented by Cooper Tires. In 2018, Dallara began manufacturing the current universal body kit (AK-18) for the NTT IndyCar Series. 2022 marks the company's 26th consecutive season with IndyCar.

“This partnership will continue to fall in line with Dallara's core values and what we want to see our technology and innovation developed for – adding emphasis to safety and sustainability for the future,” said Andrea Pontremoli, Dallara Group CEO. 

US motorsport pays tribute to "visionary" Kalkhoven

LEADING members of the US motorsport industry have paid tribute to Kevin Kalkhoven, the man who played a crucial role in reunifying the country's leading two open-wheeled racing series.

"Motorsports has lost one of its true leaders," said legendary IndyCar team boss and current series owner Roger Penske. "Kevin Kalkhoven had a great passion for open-wheel racing, and his vision and support helped guide the sport through some turbulent times."

"As a leader of the Champ Car World Series, Cosworth Engineering and the KV Racing Technology team, Kevin had an incredible impact on IndyCar."


"Kevin was a colourful, forceful personality who constantly brought new ideas to the table in an effort to grow the sport. I will miss him," added Mark Miles, President and CEO, Penske Entertainment Corp.

Kalkhoven's deep involvement in motorsports started after a very successful career as a business executive in fibre-optic telecommunications networks and as a venture capitalist. A native of Adelaide, Australia, he joined Gerald Forsythe and Paul Gentilozzi to purchase the assets of CART in late 2003, when the series was on its knees. Together, they formed the Champ Car World Series.

In February 2008, Kalkhoven and then-IndyCar Series and Indianapolis Motor Speedway CEO Tony George completed extensive negotiations that reunified North American open-wheel racing after 12 years of two competing series.

Kalkhoven was co-owner, with CART champion Jimmy Vasser, of the No. 11 Hydroxycut KV Racing Technology-SH Racing Chevrolet that Tony Kanaan drove to an emotional victory in the 2013 Indianapolis 500 presented by Gainbridge.

Kanaan's first Indy 500 win was the highlight of more than a decade of team ownership for Kalkhoven, who fielded teams in the Champ Car World Series and the NTT INDYCAR SERIES for many champions and stars of the sport, including Kanaan, Vasser, Will Power, Cristiano da Matta, Paul Tracy and Sebastien Bourdais. Kalkhoven's teams – known as PK Racing, PKV Racing and KV Racing Technology – earned seven victories between 2003-16 in major North American open-wheel competition.

Ownership of various racing teams was only part of the story, though, for Kalkhoven was a noted philanthropist. He served on the board of directors of the Association of Hole in the Wall Camps, which benefits children with serious illness. He also was an avid aviator, with a commercial pilot's licence and experience in a variety of aircraft, including Gulfstream intercontinental jets. 



RIGHT Kalkhoven was a colourful personality

Cosworth saviour


ONE of Kalkhoven's legacies is his role in the rebuilding of the Cosworth brand in motorsport and beyond.

Together with Gerald Forsythe, he bought the iconic racing powertrain company Cosworth Engineering from the Ford Motor Company in November 2004.

Kalkhoven proved an influential figure in repositioning Cosworth from a motorsport powerhouse into a growing and profitable, transportation technology business up to his resignation as Director and Chairman of the Board last October, at which time Hal Reisiger was elected Chairman.

Through his passion for the Cosworth brand, Kalkhoven worked tirelessly to ensure that the business not only retained its relevancy in the motorsport and automotive sectors, but also expanded into adjacent markets, such as marine, defence and aerospace.

He was also instrumental in Cosworth expanding its global footprint with an eye on international market trends. He possessed a visionary outlook that Cosworth's shareholders have pledged to continue for the future continued growth of the business.

Hal Reisiger, CEO and Chairman of Cosworth, said: "Since his involvement with Cosworth in 2004, he had been a key source of inspiration for the business. His passion for motorsport is well documented, but he was also a visionary and pioneer of future technology. He was a leading force behind Cosworth's evolution into a transportation technology business – and we honour his contribution, which will undoubtedly have a long-lasting beneficial legacy." 

Schuberth Helmets added to United Autosports portfolio

UNITED Autosports has been named as official distributor for Schuberth Helmets in the UK, adding another premium brand to the Yorkshire-based motorsport specialist's portfolio.

Schuberth has almost 100 years of experience dedicated to the development of head protection solutions and 20 years of providing elite drivers in the world's top championships with the safest and most technologically advanced helmets.

Schuberth helmets have been most notably worn by newly-crowned Formula

1 World Champion Max Verstappen and seven-time Formula 1 World Champion Michael Schumacher.

United Autosports will be distributing the latest Schuberth helmets to drivers and teams across the UK, including the recently-released FIA 8860-2018 SF4, the SF3 ABP and also SP1 CARBON.

Schuberth joins HRX and AERO Sustainable Paint Technology as another premium motorsport brand in United Autosports' portfolio of UK agencies. HRX is the world's fastest-growing

racewear manufacturer and specialises in the production of FIA-approved race equipment and clothing. AERO Sustainable Paint Technology is a ground-breaking replacement for conventional paint, which it is claimed will soon revolutionise the way vehicles are presented.

Schuberth UK will be housed in United Autosports' 62,000 square foot headquarters near Wakefield, West Yorkshire with easy access to the A1, M1 and M62, making it a perfect distribution hub to reach customers across the country. **TI**



RIGHT Reigning F1 champ Max Verstappen wears a Schuberth helmet

M-Sport WRC squad signs Bell deal

THE M-Sport Ford World Rally Team has announced a three-year deal with Bell Racing Helmets, the manufacturer of state-of-the-art head protection.

Having made its return to the World Rally Championship in 2021, Bell has used two years of research and development with drivers and teams to set new standards of comfort, performance, and acoustics. Using a high-strength outer shell with a bespoke fitted multi-density inner liner, Bell helmets are designed to maintain structural integrity while absorbing impacts and eliminating pressure points for the driver.

Bell's development and manufacturing base in Bahrain is home to a wide range of rally and circuit series helmets tried and tested by its brand ambassadors, who already include Craig Breen and Formula

1 drivers such as Charles Leclerc.

Richard Millener, M-Sport Team Principal, said: "Although we have spent the year working very hard on developing the performance of the Puma



ABOVE M-Sport enters the new WRC era with Bell Racing

Hybrid Rally1 ahead of 2022, safety is still our number one priority. I have been personally impressed with the steps Bell takes during its product development to ensure there is no compromise when it comes to driver protection.

"Bell has welcomed us and our drivers into the product development discussions for the future, with Bell joining us on our most recent Puma Rally1 test, exploring different options and configurations ahead of Rallye Monte Carlo."

Bruno Curletto, Racing Force Motorsport Senior Director, said: "M-Sport engineers, drivers and co-drivers are fantastic partners who will considerably widen our technical base and will enable us to continue developing our products to enhance safety and performance in the rallying world." **TI**

Base Performance Simulators to enhance ROKiT British F4 driver development

BASE Performance Simulators (BPS) has been appointed official Simulator Partner of the ROKiT F4 British Championship certified by FIA.

BPS operates driver development simulators from its base near Banbury, just 20 minutes from Silverstone. In recent years it has become the choice of many championship-winning drivers and teams, looking to arrive at every race with a head start on the competition.

The company is led by three-time 24 Hours of Le Mans-winning driver, Darren Turner, who has over 20 years' experience in developing cutting-edge Formula 1 simulators, which has provided him with a unique insight into the science of racing simulation.

The BPS single-seater simulator has been designed from the ground up to create a fully immersive driving environment. It features a six-metre 180° screen with a Moog motion platform with six degrees of freedom, providing physical cues to enhance the experience and provide realistic feedback. To increase immersion even further for the F4 drivers, the simulator has been fitted with the 2022 British F4 steering wheel.

Live telemetry can be viewed by either a driver's team or a BPS expert, with the facility to take the data away post-session, allowing it to be fully integrated into an existing development programme.

Included within the championship registration fee for entrants next season will be two free sessions on the simulator, as well as a discounted rate for further sessions. The season-long package also includes driver fitness assessments in BPS' in-house fitness studio, enabling drivers to identify and improve on several key aspects of their programme under one roof.

Hugh Chambers, CEO of Motorsport UK, said: "For all of our young driver talent in the 2022 ROKiT British F4 championship they are looking to build the key foundation stones for a professional career in motorsport.

"There are so many elements that can enhance their raw talent behind the wheel in order to be successful, including data analysis, fitness, testing and increasingly


the ability to get the best from simulator work.

"The elite status of Base Performance facilities and service makes them an ideal fit for the championship, and I'm sure collectively every driver on the grid will be able to feel the benefit of their input into their development programmes."

Darren Turner, Base Performance Simulators, said: "It's a given that nearly all drivers are using simulators in some way to improve their performance. For any driver aiming for the top step, a simulator programme is vital, and we regularly see first-hand the difference it can make to a championship challenge.

"We're looking forward to helping the F4 drivers maximise the exciting opportunity they have ahead of them in this important junior series."

Established in 2015, the ROKiT F4 British Championship certified by FIA is the globally-recognised entry point to the FIA's Single-Seater Pathway, offering drivers aged 15 years and above the opportunity to take their first steps on the road to Formula 1.

Utilising the latest in safety and performance technology, the series features identical Tatuus T-421 chassis, powered by Abarth engines and with controlled tyres from Pirelli. The new season will begin at Donington Park, Leicestershire on 22-24 April. 

BELOW Simulation is an increasingly vital weapon in a young driver's armoury



Drew Gibson



HOW *GREEN* WAS MY RALLY

Anticipation, but also apprehension, accompanied the build-up to the start of the World Rally Championship's new sustainable era. So how did it go?

Anthony Peacock reports from Monte Carlo



RALLY drivers, on the whole, aren't well-known for being passionate environmentalists. The only time any tree-hugging goes on during an event is when a car interfaces with a pine at high speed. The sport's rugged reputation is firmly predicated upon keeping it real, which leaves little room for lily-livered eco-earnestness.

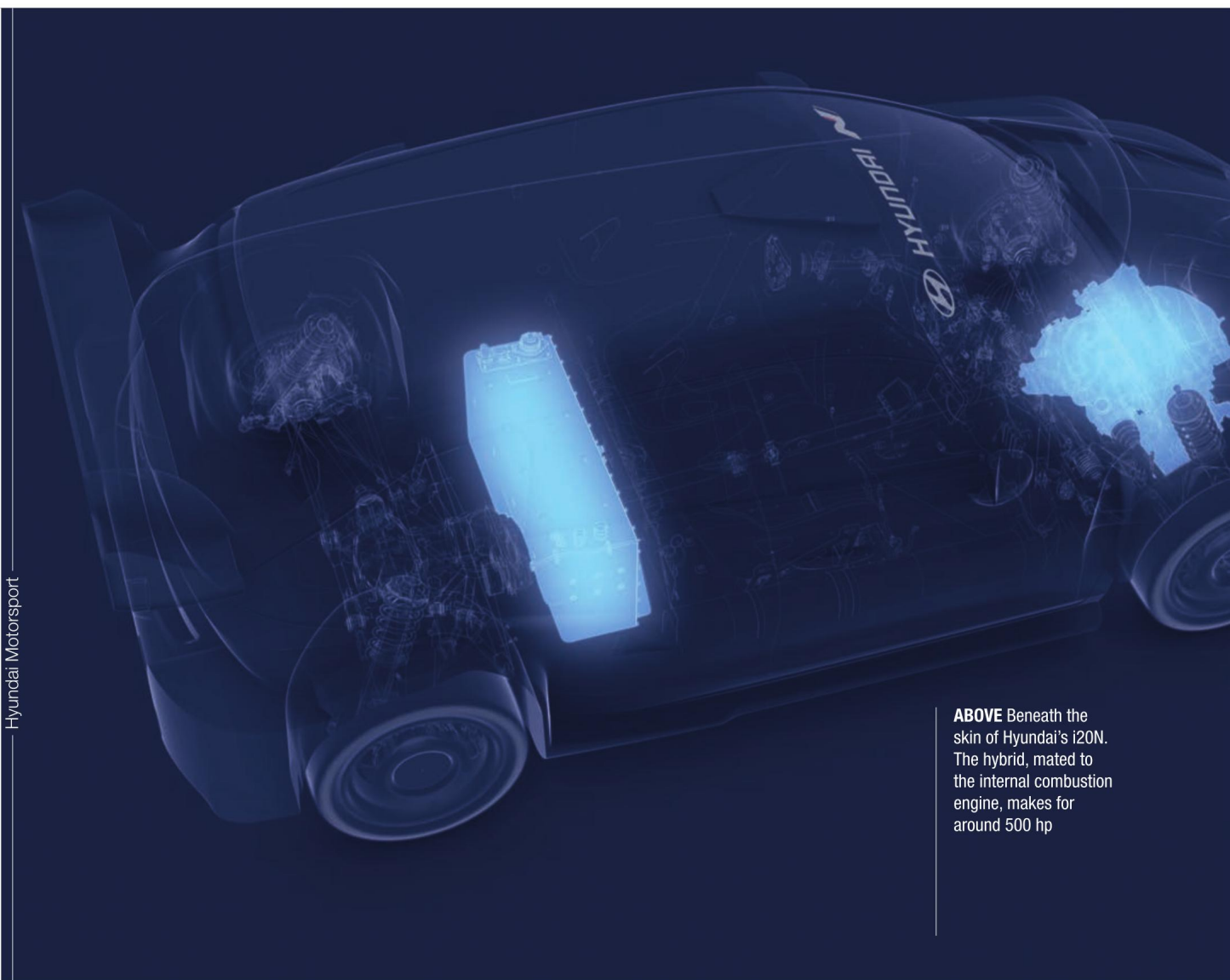
But even rallying – the last bastion of the unreconstructed, hard-drinking, untrammelled motoring hero – is changing. Or rather, the world is changing and the sport is forced to change with it. This year, the WRC introduces a package of measures that have been described by some as a “green revolution”, consisting of hybrid

units and sustainable fuel (supplied by P1 Racing Fuels), alongside other far-reaching technical changes that include a spaceframe chassis – to allow different models of cars to enter – and new regulations. Centre differentials and steering wheel-mounted paddle shifters have gone, suspension travel is reduced to 270 mm, and there are simpler aerodynamics, meaning around 15% less downforce.

Of those, the hybrid unit is the aspect that's perhaps the most talked about, enabling the cars to glide around the service park almost noiselessly – although this did result in a couple of people almost being knocked over in Monaco's harbour at the season-opener – and ►

ABOVE Rallying's green revolution, with hybrid units and sustainable fuel, commenced in style with a fairy-tale win for Sébastien Loeb's Puma. He became the oldest WRC winner in history

Hyundai Motorsport



ABOVE Beneath the skin of Hyundai's i20N. The hybrid, mated to the internal combustion engine, makes for around 500 hp

make their way to the stages on road sections partly using electric power. The full electric range is about 20 kilometres.

The WRC hybrid system is slightly different to the ones that you'll find in other forms of motorsport, as it's somewhat minimalist and all contained within one box inside the car, for safety reasons. M-Sport's Adrien Fourmaux tested that aspect on Friday in Monte-Carlo by launching his all-new Puma off a mountainside. An external light turns red if there's a problem with the electrical system with a risk of electric shock, while the light is green if the car is safe and everything is working normally.

Safest WRC cars ever

Fourmaux's light stayed green post-accident, despite the fact that the rest of the car resembled a pick-up truck. According to figures from the FIA, the new cars – no longer based on bodysells that roll off the production line – can absorb up to 115% more energy in an impact on the roof, as well as ensuring 51% less protrusion in a side impact and 70% less in a frontal impact. The hybrid unit itself is designed to withstand impacts of up to 70G.



WRC/Red Bull

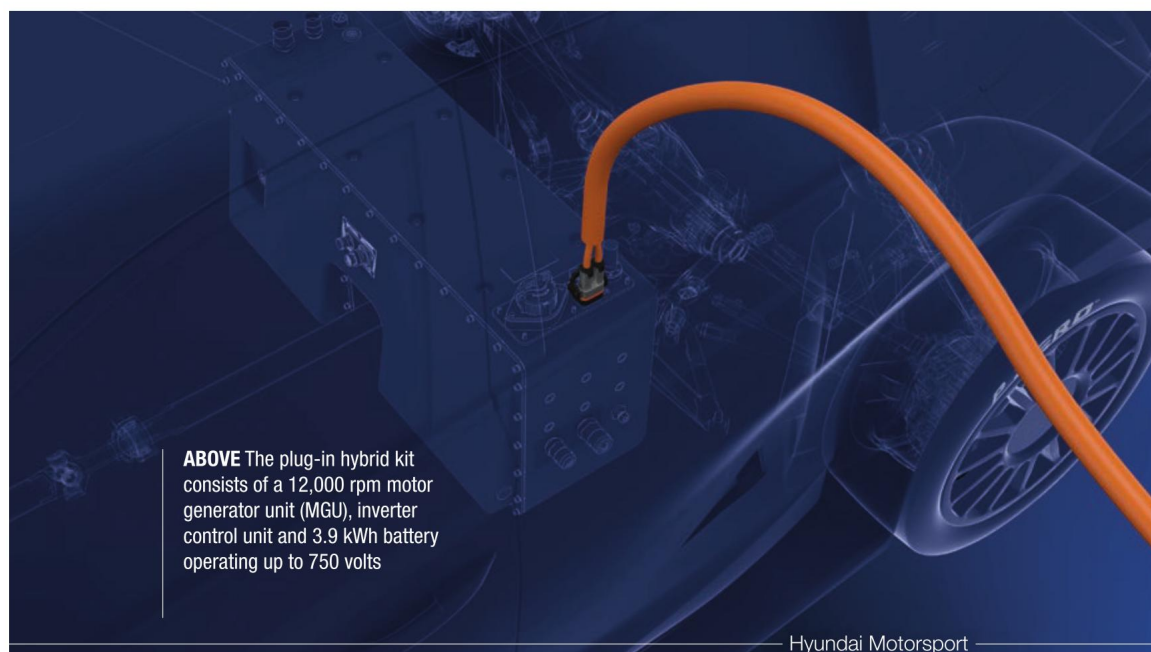
“The latest ‘green’ generation of cars might soon end up being faster than their ‘dirtier’ predecessors”

It's the same unit for everyone, producing 100 kW of electrical energy, and manufactured by a company called Compact Dynamics: a division of Schaeffler, which worked with Audi in Formula E.

Compact Dynamics makes the 134 hp (100 kW), 132 lb-ft (180 Nm) motor-generator and inverter, while Kreisel Electric provides the 3.9 kWh lithium-ion battery pack. Together, these give a 2022 Rally1 car roughly 500 horsepower (372 kW) and 369 lb-ft (500 Nm) of torque (with 130 of that horsepower through the hybrid) for bursts of up

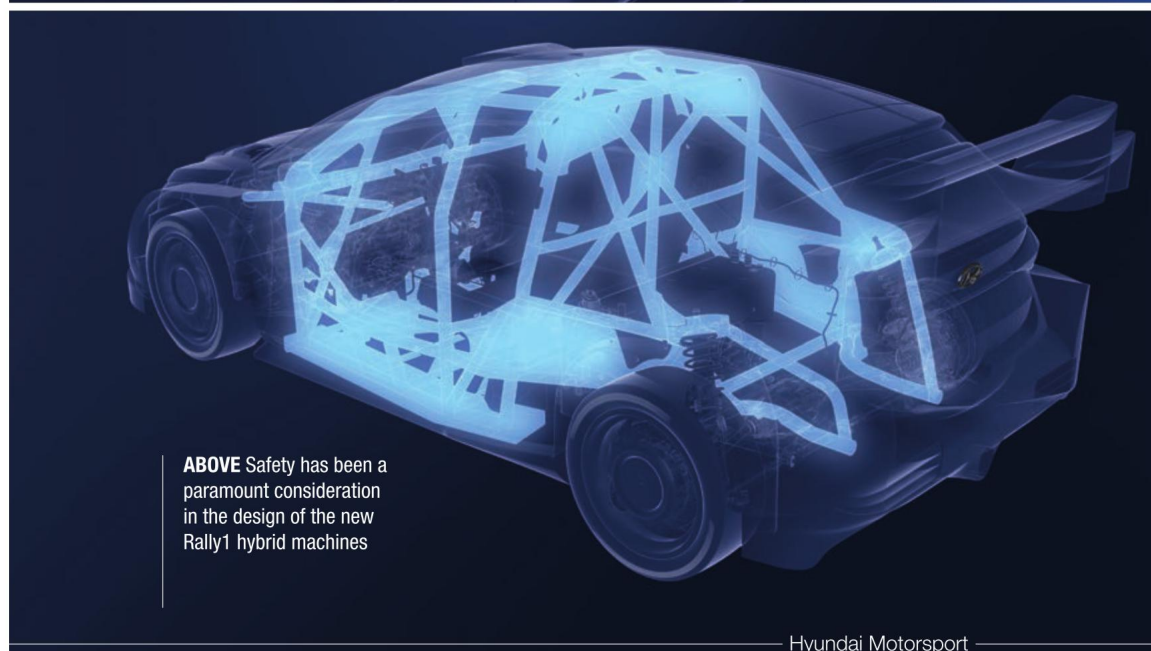
to three seconds at a time. But drivers are required to recover 30 kJ of energy via regenerative braking between hybrid boosts. The battery packs can also be recharged at service halts with dedicated chargers, a process that takes around 30 minutes.

The downside to all this new technology is extra weight, amounting to at least 70 kilograms: one of the reasons why Sebastien Loeb chose the slender Isabelle Galmiche as his co-driver to make a winning return to the WRC. The minimum weight of the cars now comes in at 1260 kilograms, which means that ▶



ABOVE The plug-in hybrid kit consists of a 12,000 rpm motor generator unit (MGU), inverter control unit and 3.9 kWh battery operating up to 750 volts

Hyundai Motorsport



ABOVE Safety has been a paramount consideration in the design of the new Rally1 hybrid machines

Hyundai Motorsport

LEFT It was a scramble for the three manufacturers to get their hybrid cars sorted in time for the first round, but warnings of dire unreliability proved unfounded

“The challenges we have to solve now in motorsport to keep ICEs going are the same ones we’ll have to solve on the road. We’re a test bed for that”

even the Pirelli tyres have to be reinforced to cope with the extra weight and torque.

But has it all made a difference – or at least had the effect that it was intended to have? Tom Fowler, Toyota’s technical chief, wisely steers clear of politicising the green issue.

“As a package, using hybrid and sustainable fuels together is reflecting both a greener solution and what the average person on the road might be buying now and in the future,” he says.

“What sort of vehicles we’ll be using in the future on the road isn’t entirely clear: different manufacturers are going down different routes with hybrid, hydrogen and so on. In terms of rallying, it was clear we couldn’t stay with classic internal

RIGHT The sign of the hybrid times in the paddock

BELOW It wasn’t just the drivers who had to adapt to new ways of working in the hybrid era



M-Sport

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**

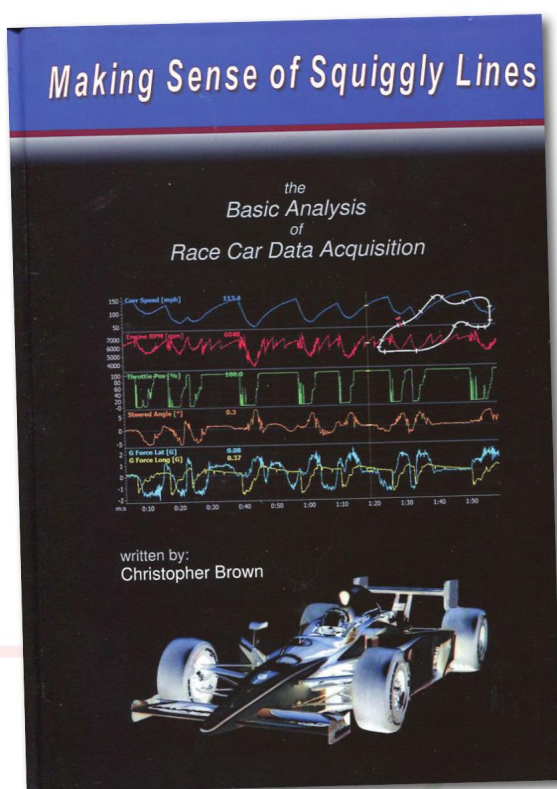


Table of Contents

CHAPTER 1 INTRODUCTION

- 1.1 – Data Acquisition System
- 1.2 – Channels
- 1.3 – Logging
- 1.4 – Data Display Types Chapter

CHAPTER 2 SPEED

- 2.1 – Speed from tire revolutions
- 2.2 – Speed from GPS
- 2.3 – Overlay
- 2.4 – Variance
- 2.5 – Data Alignment
- 2.6 – Braking
- 2.7 – Wheel Slip
- 2.8 – Cornering Speeds
- 2.9 – Straight Line Speed Chapter

CHAPTER 3 RPM

- 3.1 – Over Revs
- 3.2 – Down Shifts
- 3.3 – X-Y Plot of RPM vs. Speed
- 3.4 – RPM Histogram

CHAPTER 4 GEAR

- 4.1 – Finding the Optimal Shift Points
- Chapter 5 Throttle
- 5.1 – Throttle Blips
- 5.2 – Average Throttle Position
- 5.3 – Throttle Lifts
- 5.4 – Throttle Application Smoothness
- 5.5 – Throttle Application – Ideal Line

CHAPTER 6 G-FORCE

- 6.1 – G-Force Longitudinal – Acceleration
- 6.2 – G-Force Longitudinal – Braking
- 6.3 – G-Force Lateral
- 6.4 – G-G Traction Circle

CHAPTER 7 STEERING

- 7.1 – Line Analysis
- 7.2 – Car Handling Oversteer/Understeer

CHAPTER 8 TRACK MAPPING

CHAPTER 9 SECTION TIMING

CHAPTER 10 VIDEO

CHAPTER 11 PUTTING IT ALL TOGETHER

- 11.1 – Summary of Channels
- 11.2 – Strategy for Improvement

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WRC/Red Bull

combustion engines using fossil fuel alone: this change needed to come in order to reflect the direction the world is going in. The 100% sustainable fuel is probably the most interesting part as it's not the sort of fuel you can buy on the road, so it comes with some technical and financial challenges to make it work in motorsport. But the infrastructure we have in the world at the moment means that we can't rely on electric power alone, so internal combustion engines will be around in some form for a while. The challenges we have to solve now in motorsport to keep internal combustion

ABOVE & BELOW While some of the young guns like Kalle Rovanperä (above) confessed that they struggled to unlock the hybrid's potential, more experienced hands like team-mate Sebastian Ogier adapted faster

RIGHT Lab figures suggested the new cars can absorb up to 115% more energy in an impact on the roof, as well as ensuring 51% less protrusion in a side impact. Adrien Fourmaux offered the first demonstration

engines going are the same ones we'll have to solve on the road to make it a viable product for the everyday person. We're a test bed for that, which is very relevant."

Hybrid heritage

The WRC revolution is especially relevant for Toyota, which has a huge heritage in hybrid engineering. The Prius, introduced in 1997, was the world's first mass-produced petrol-electric hybrid car, made famous by Leonardo di Caprio before being adopted many years later by an army of Uber drivers worldwide. Both, in their own ways, did so much to raise awareness of Toyota's hybrid technology. California advertised the concept; the streets of London (or Paris, Tokyo or Milan) proved that it worked.

A cursory flick through eBay will uncover many ex-Uber Priuses (although the official plural is Prii) that have done nearly a million miles – and they will have inevitably been hard ones too. My personal favourite ▶



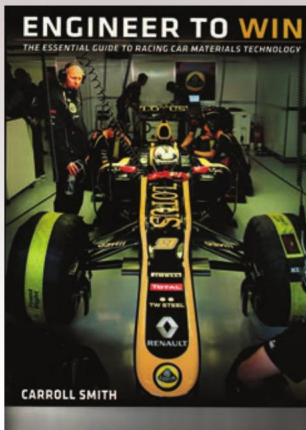
WRC/Red Bull



Essential BOOKS for the motorsport engineer's library:

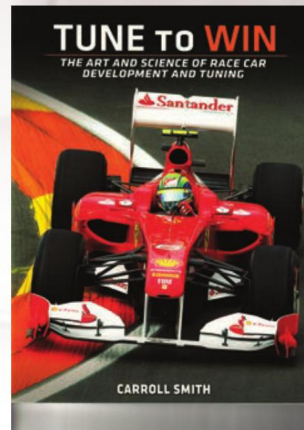
The Carroll Smith collection

Engineer to Win: £25



Current state of the art in racing technology by a foremost expert in the field. Covers all forms of racing cars and includes a thorough analysis of metallurgy, metal fatigue and general materials technology. Details specific components and specific activities such as heat treatments, stress relieving, etc. Plus aerodynamics, ground effects, brakes, tools, and more.

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Store all the answers in your hip pocket! This handy pocket guide written by racing professional Carroll Smith suggests realistic solutions to common race car handling problems. Formatted listing causes and possible effects, and problems and possible causes. Spiralbound, 3 1/2" x 7 3/4," 32 pgs.'

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Uber experience involves the driver who somehow managed to get into the wrong side of the motorway roadworks at night en route to Gatwick Airport and ended up rallycrossing his way to the next junction, passing through a cable trench that was every bit as vicious as anything you might find on Rally Argentina (I remember my head hitting the ceiling). The Prius, by contrast, seemed to shrug off the experience...

So this is tried and trusted territory for Toyota; to the extent that hybrid is now so normal for the brand that they sometimes don't even bother badging it on certain models. When it comes to the new rally car though, Fowler explains that it's actually the company's experience from the World Endurance Championship that has proved more relevant: "The WEC programme is motorsport, and the way in which we need to use hybrid power in rallying is closer to them than the road product, so it's been useful to have access to their know-how from the last 10 years or so."

From a driver's perspective, not a huge amount has changed. Ironically, while some of the younger drivers – such as 21-year-old Kalle Rovanpera – said they struggled to unlock the best from the hybrids initially, it was the older and more experienced hands who seemed to



M-Sport

adapt quicker: notably Sebastien Loeb and Ogier.

The result speaks for itself, as Craig Breen – yet to win a rally or a title – jokingly pointed out from his fine third place in Monte: "Look at this podium: we've got 17 world titles between us!" Not to mention 16 Rallye Monte-Carlo wins...

Loeb himself concluded, from the top step: "It wasn't difficult to manage. It was a lot of power. You can really enjoy it in the exit of slow corners and when you don't have it, you

“It was a lot of power. You can really enjoy it in the exit of slow corners and when you don't have it, you understand how much it gives you an extra boost”

ABOVE The Puma is the best chassis M-Sport has ever built



WRC/Red Bull

LEFT The new breed of cars made a spectacular start in Monte Carlo

understand how much it gives you an extra boost. These cars are a bit heavier, it's true, but I enjoyed it a lot."


Ogier praised the reliability of the new machines: "The teams have done a fantastic job building completely new cars that are completely different from the other ones. I was expecting more issues, there were some here and there, but we could fight like in the good old days and you would not think it was the first time for these cars."

Thumbs-up

Almost without exception, it was an unequivocal thumbs-up for the new formula, which not only allows manufacturers to tick their green boxes, but also opens the door to a wider variety of cars with sharper dynamics. According to Matthew Wilson, who did the bulk of M-Sport's testing, the Puma is the best chassis that the Cumbrian firm has ever built. And you could argue that the new Yaris is even quicker.

This sort of versatility is exactly what's going to be needed under the new regulations, as Fowler points out. "The new car is more complicated in some areas, with the hybrid, and less complex in others, to keep costs down. A lot of the adjustability we had over the last five years has been eliminated, and these were the tools that the drivers used to make the cars perform how they wanted in different conditions. Now the drivers have to think what the best 'average' car is for a rally – or even a season.

"In the past, you could have a specific car for Monte Carlo and then something quite different for Croatia. Now, the challenge for the engineers is to come up with a car that's compliant enough to give good performance in all sorts of different circumstances."

For now, the teams are prioritising reliability and driveability – although as Ogier says, this is at a surprisingly high level already. With new parts homologated under the 'joker' system between now and the end of the year, the latest 'green' generation of cars might soon end up being faster than their 'dirtier' predecessors. And if they don't, it really doesn't matter. The first round of the season already proved that they are just as spectacular. Which in the end, is what rallying is all about. 



LEFT & BELOW

Toyota's road car division was the pioneer of the hybrid road car era, but the WRC squad has profited considerably from the recent racing expertise gained with the systems in the World Endurance Championship



Photos: Toyota Gazoo Racing

SUPERSTARS SLUG IT OUT

NASCAR legend Ray Evernham tells **Chris Pickering** about the formation of the Superstar Racing Experience and offers his thoughts on the introduction of the Next Gen NASCAR

PERHAPS more than any other branch of motorsport, the US stock car scene seems to thrive on big personalities. Those who make a name for themselves can end up enshrined in the folklore of the sport – be that as a driver, a crew chief or a team owner.

Ray Evernham has been all three.

He raced in the NASCAR Wheelen Modified Tour until a major shunt in 1991 left him with a brain injury that compromised his depth perception. By that point he was already working as a chassis engineer for Roger Penske's International Race of Champions series (IROC), but it was as a crew chief to NASCAR star Jeff Gordon a few years later that Evernham's career really took off.

The pair won three Cup titles together at Hendrick Motorsports before Evernham departed to form his own team. Since then, he's also been a TV commentator, a museum owner and a class winner at Pikes Peak (behind the wheel of a car that he created). Few people in the sport have such a broad claim to fame.

Pure entertainment

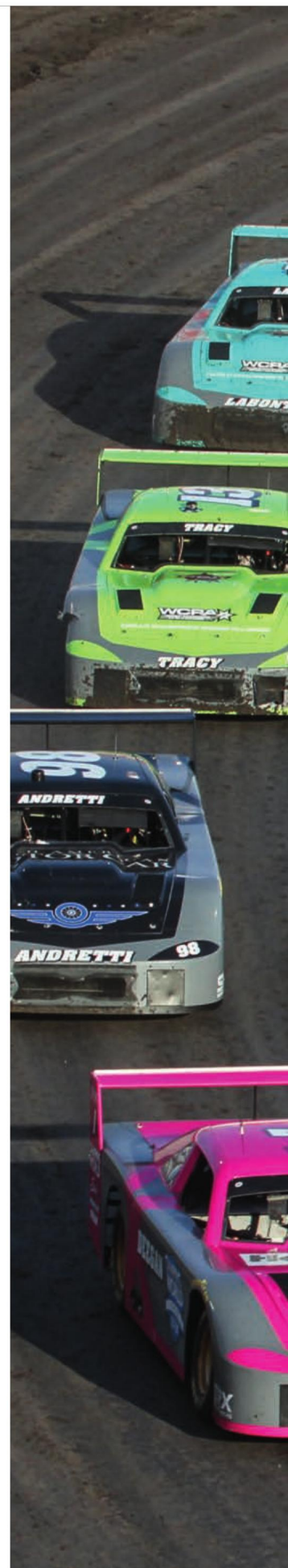
Evernham's latest venture is the Superstar Racing Experience, officially the Camping World SRX Series but better known by its acronym SRX. The emphasis here is very much on the superstar part, with drivers such as Tony Stewart, Hélio Castroneves and Chase Elliott all making appearances in the series' debut season last year.



It's a similar line up for 2022, with a mixture of full-time drivers, part-time drivers and guest appearances. Between them, they cover the worlds of NASCAR, IndyCar, Trans-Am and truck racing, not to mention Late Model dirt racing and rallycross. It's nothing if not eclectic.

And that, of course, is the whole point. As Evernham explains, the concept was inspired by the IROC series where he cut his teeth as an engineer: "Back then it was possible to put all these great drivers together in identical cars as pure entertainment for the fans. As motorsport evolved, for one reason or another, it got more difficult to do that. The number of people watching racing kind of flattened out as we got into the 2000s. It had become very much about the controversy – the cars, the technology, the rules and the sanctioning bodies. And I thought there'd be an opening ►

LEFT Evernham's idea for SRX was inspired by the IROC series, where he cut his teeth as an engineer



RIGHT SRX worked with Goodyear to develop bespoke tyres for dirt and pavement. Part of the brief was to allow a certain amount of degradation, to introduce a strategic element to races



to go back to that pure form of motorsport entertainment – something that would allow the fans to watch drivers from different backgrounds really challenging each other.”

Evernham bounced some ideas around with former NASCAR director George Pyne for several years, before the pair approached TV executive Sandy Montag, along with three-time NASCAR Cup champion Tony Stewart. Together, they took the idea to broadcasting giant CBS and the SRX series began to take shape.

Out of the comfort zone

The plan was to go back to basics and pitch the drivers against each other on a range of dirt tracks and paved ovals – and ultimately road courses too. As well as the big-name regulars, the series’ creators also wanted to draft in ‘local heroes’ who specialise in the particular tracks and surface types. It proved to be a successful concept, with grassroots competitors taking the victory at two of the six rounds in 2021, while the star drivers also had a chance to showcase their versatility. Series co-creator Tony Stewart – best known for racing on the Tarmac courses of NASCAR and IndyCar – picked up two wins in the debut season, both of which were on dirt ovals.

Although the series didn’t visit any road courses in 2021 (and the 2022 schedule had yet to be released as we went to press) it’s firmly part of the plan. To accommodate this, Evernham and his colleagues set out to design a car that could race on

“We don’t want a car that’s so reliant on setup and aerodynamics that the drivers need a computer simulation to tell them how to get the best out of it”

RIGHT Dream ticket: big-name stars from different racing disciplines go wheel-to-wheel in SRX

BELOW The 700 hp Chevrolet LS-based Ilmor 396 engine is a proven unit already used in other stock car series





all three types of track with minimal modifications. What's more, they wanted to ensure that the emphasis was on car control and mechanical grip, with skinny tyres, plenty of power and little in the way of downforce.

"I've worked with some of the best drivers in the world, but at a time when winning or losing could ultimately come down to the car rather than the driver," comments Evernham. "So for this, I wanted to go back to a much more simple formula. We didn't want aerodynamics to be a part of it, so we took the downforce away, and we wanted the car to be somewhat over-powered for the tyres that would be fitted."

Just as important as supporting a broad range of circuits was a variety of different driving styles, he explains: "We've tried to build a car that offers a really broad range of mechanical grip, and we hired test drivers who really understood what we were trying to achieve in Ken Schrader and David Stremme.

"Everybody's got a different style. Some drivers are very smooth, whereas others really like to slide around; some run into the corners really hard, while others back off. And to me, that's always what created the passing. We don't want a car that's so reliant on setup and aerodynamics that the drivers need a computer simulation to tell them how to get the best out of it, because that ultimately ends up with everyone driving in a similar way."

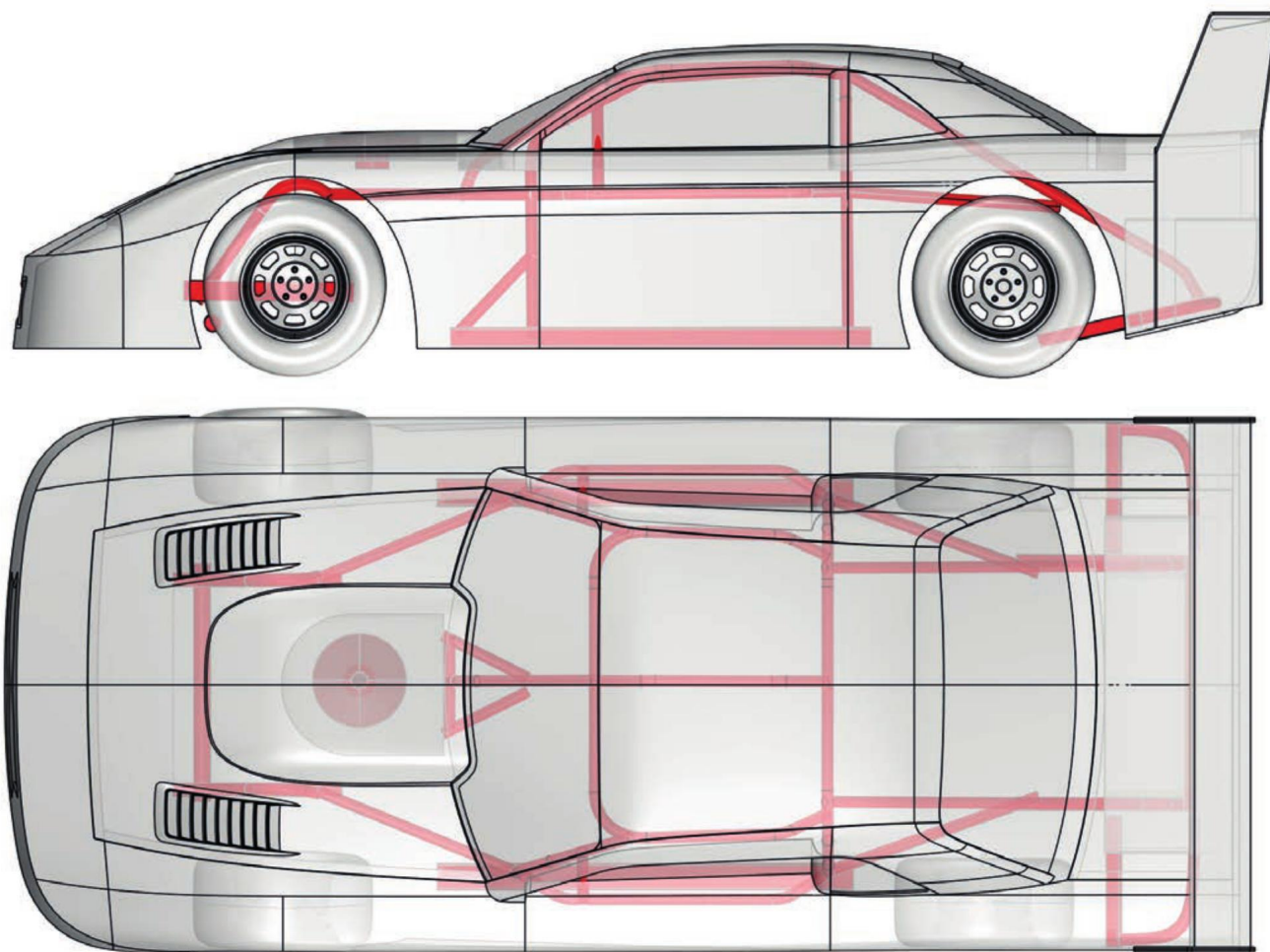
Getting a grip

Likewise, he wanted the drivers to be able to get to grips with the car on tracks and surfaces that they weren't necessarily used to. So, perhaps surprisingly, the SRX car that has so far only raced on dirt and paved ovals was, in fact, designed first and foremost for road courses.

"When you're looking at this sort of format, most people start with a paved oval car and then adapt it for dirt or road courses, but I worked backwards," Evernham recalls. "I began with what was basically a road race car, so it was guaranteed to work well on the road courses. And because it doesn't have an exaggerated left-side weight bias [as found on paved oval cars], it should also be a good dirt car. That leaves you with an 'okay' oval car. This takes away some of the advantage that the oval guys always had in the IROC series, where the road racers weren't generally as comfortable on the ovals."

As an example, he points to the success of Ernie Francis Jr – the seven-times Trans-Am champion and Formula 3 racer – who came second in the SRX championship last year, with a win on the Indianapolis Raceway Park oval.

Traditional dirt cars are very specifically optimised to their environment, with a lot of suspension movement and very different geometry to a paved ►



oval car, he points out: "If this was a pure dirt car, it would have a higher centre of gravity [to get the weight transfer], and it would be lighter with a narrower chassis, the motor further back to get more of a rearward weight bias, and a more complicated rear suspension setup to get the forward bite. Our cars are far more conventional. In fact, I'd love to have a track that mixed those disciplines, with paved oval, dirt and road course elements in one circuit. That would probably be asking a lot of our friends at Goodyear to produce a tyre that could do all of that, but the cars are built to do all those things without any major changes to the setup."

A handful of modifications will need to be performed between road and oval courses, including changes to the left front suspension and the wheel spacers, but the cars will remain largely unaltered. At their heart is a simple tube frame chassis built by Fury Race Cars in collaboration with SRX.

"I went to visit Tony Eury at Fury, and they had a design there that was already 90 per cent of what we wanted, so we just changed a few things," recalls Evernham. "Our main priority was to ensure that it was very safe for the driver and easy to work on. For example, it uses mild steel tubes in the suspension components that can be easily straightened and easily repaired. It uses unequal

length control arms at the front and a three-link axle at the back with coil over shocks. All very simple, and it weighs about 2,800 lb [1,270 kg] with the driver and 24 gallons [90 litres] of fuel."

Unlike the old IROC series, the setup of the cars is not locked down completely. The idea is to give the drivers just enough options on things like brake bias, tyre pressure and wedge settings to help them feel at home in the cars without getting lost in the adjustments.

Strategic element

The SRX team worked with Goodyear to develop bespoke sets of tyres for dirt and pavement. Part of the brief was to allow a certain amount of degradation, in order to introduce a strategic element across the duration of the race.

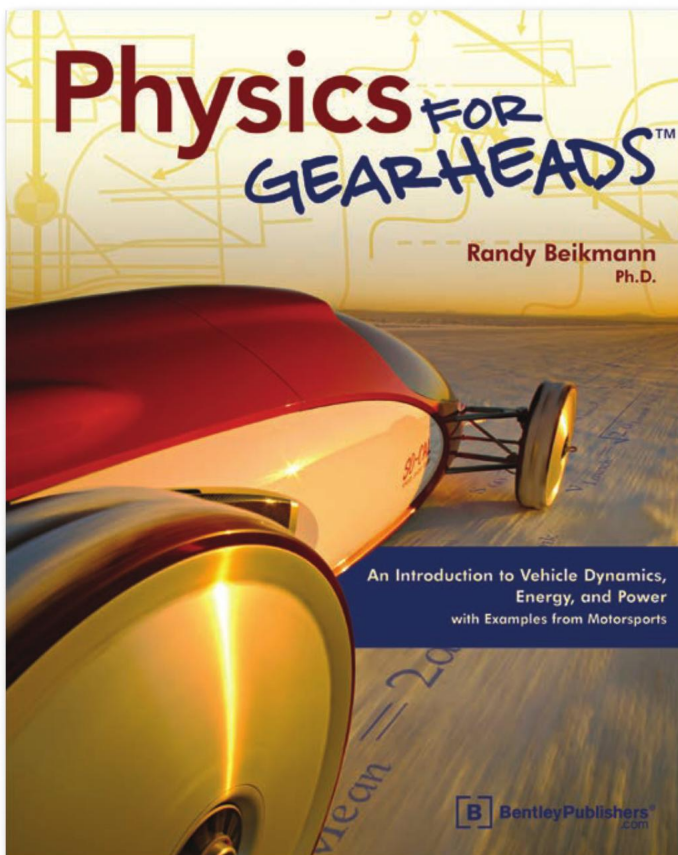
Power comes from a 700 hp Chevrolet LS-based Ilmor 396 engine. This is a proven unit that was already in use in other stock car series. Much of the hardware comes from the Edelbrock Group, including the water pump, timing cover and ignition coils, while the camshafts, pushrods and rocker trunnions come from the group's subsidiary Comp Cams. Another US performance legend, Holley, supplies the fuel injection system and the associated components.

In some respects, the template of the SRX series ►

ABOVE A tube frame chassis, built by Fury Race Cars in collaboration with SRX, is at the heart of the car

Essential BOOK for the motorsport engineer's library:

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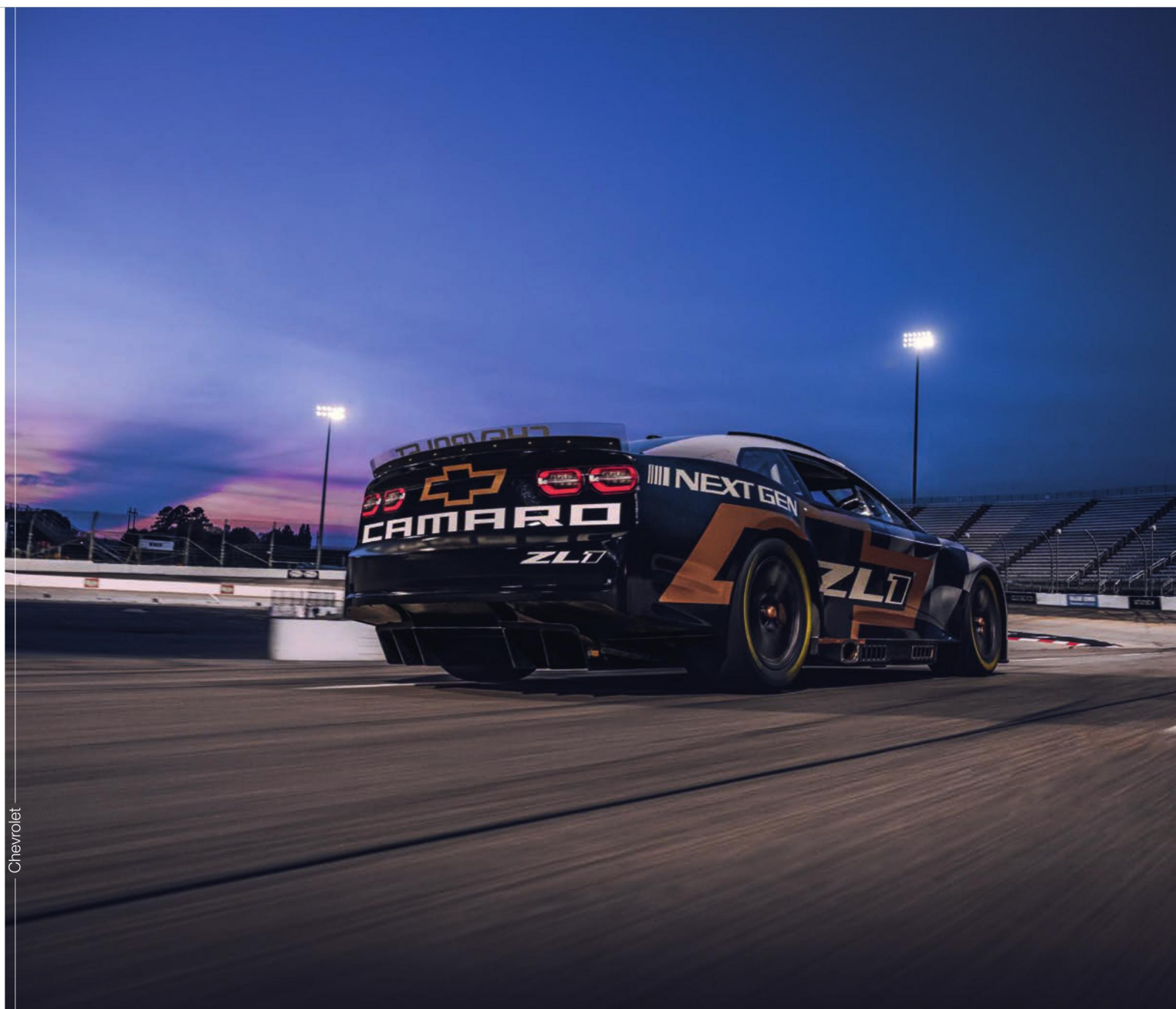
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reflects some of the changes that are being implemented in NASCAR's Next Generation platform. Although NASCAR remains a much higher budget operation with open competition between the teams, it too will feature more commonality between road and oval setups as part of a cost reduction drive.

Evernham has no direct involvement with NASCAR these days, but as one of the series' most successful crew chiefs he still takes a keen interest in it. So does he see the new rules as a good move?

Saving NASCAR

"I think it's not only a positive step, but the *only* step to continue the evolution of the sport. They need to keep the racing safe and they need to keep it

cost-effective enough to bring in new manufacturers and new team owners, so I applaud what they've done," he comments. "I think it was a similar philosophy that saved IndyCar. They had to bite the bullet and effectively introduce a homologated car, which brought back the competition.

"I think NASCAR has made the right decision with the car, and they're also bringing back some of the shorter tracks and focusing on some of the great young drivers that they've got. Now, with that said, there are always some bumps in the road when you introduce something new. So I think people will need to be patient if this car isn't perfect everywhere when it first comes out of the box. I hope people will appreciate that NASCAR is going out

on a limb and making these changes."

From an engineer's point of view, he expects the new cars to be quite different to work with: "Aerodynamically, the car now has pretty much a full belly pan underneath it, which actually simplifies things slightly. But I think the biggest change in terms of the feel for the drivers and the conversations they'll be having with their mechanics will be the transaxle layout and the independent rear suspension. That will probably help them on the road courses, but it may be harder to adapt on the high-speed ovals. It changes the weight distribution and the unsprung weight significantly. The low profile 18-inch tyres will also change things somewhat. But it's interesting to see how many of

these drivers are now doing some racing in other series, so a lot of them will have experience in other types of cars that will help."

SRX, meanwhile, will continue to focus on the pure entertainment side. The series posted impressive TV viewing figures for its first season – despite relatively little promotion, it was the second most-watched form of motorsport in the US at one point during 2021. And Evernham is keen to work with the fans to build on that success: "We want to give the fans as much input as possible on how the series is run. If there's something that people want, we'll try to accommodate it – all they've got to do is watch and then send us a note."

“Next Gen is not only a positive step, but the ONLY step to continue the evolution of the sport”

Part of the allure is the driver line up, with a good balance between current stars and old hands. And this is something that Evernham is keen to push as the series goes forward.

"One of the things we're considering is that we might need to have fewer full-time drivers to bring in more guests," he explains. "We've talked to several motorcycle racers, along with some Formula 1 and IndyCar drivers. And since Chase Elliott came over, we've had several NASCAR drivers reach out

and ask how they can get involved."

Evernham's own personal wish-list includes NASCAR legend Jimmie Johnson and IndyCar star Scott Dixon, as well as former F1 drivers Mark Webber, Jenson Button and Kimi Räikkönen. "I could go on for ever – there are so many great drivers out there, and we've designed the car so it's about pure driving skill rather than specialist experience in any particular area," he comments.

Another factor that could help to broaden the series' appeal to veteran drivers is the choice of venues. The short, relatively low-speed tracks are less physically demanding than super speedways, which may help to level the playing field between older drivers and their younger counterparts. Several of the regular drivers in the series are in their fifties and sixties, including Bill Elliott, who won one of the heats during the final round at Nashville Fairgrounds Speedway.

Different backgrounds

The drivers lining up against the 65-year-old Elliott in the feature race at that event included his son Chase Elliott (2020 NASCAR Cup champion) and the youngest competitor in the series, 19-year-old Hailie Deegan (a full-time racer in the NASCAR Camping World Truck Series). It's this level of variety that makes the SRX series unique, pitching drivers from different backgrounds and eras against each other, wheel-to-wheel on proper permanent racetracks. And with such a wide pool of talent to choose from, 2022 promises to be an even better year. **RT**

ABOVE Evernham believes the concept of the Next Gen NASCAR was vital for the sport to move forward

RIGHT SRX offers drivers enough setup options to make them feel at home, without getting lost in adjustments



RISING TO THE NEXT GEN CHALLENGE

The switch to spec components for the Next Gen Cup car meant overcoming many challenges.

Chris Pickering speaks to the design team behind NASCAR's most advanced transmission ever

THE 2022 NASCAR season is here. And with it, the biggest technical shake up that the series has seen in half a century.

Gone are the old Gen 6 cars, replaced with the safer, cheaper and more production-relevant Next Generation NASCARs. Aside from the engines and ECU, virtually every part on the new cars is fundamentally different from its predecessors, from a symmetrical chassis to independent rear suspension.

The series has also moved to a new spec transmission from Xtrac, in place of the four different suppliers that were approved for the series previously. As with the rest of the package, this focuses on ease of use and cost control, with a string of measures designed to reduce the number of individual parts that the teams will have to purchase, along with a sealed package that will prevent them from spending money on transmission development.

The tender put out by NASCAR in June 2019 was relatively open-ended. It mandated a number of basics, such as the use of a rear-mounted transaxle layout. This was chosen in order to reduce the size of the transmission tunnel, so the driver could be placed closer to the centre of the vehicle, improving side impact safety.

Another interesting point was that the transmission had to be capable of accommodating a hybrid system at a later date (more on that in minute). But much of the rest was left to the suppliers' discretion. The gearbox, for example, could have four, five or six speeds as the supplier saw fit.

Xtrac elected to go with a five-speed manual sequential

layout, in place of the four-speed H-pattern used on the previous cars. Initially, a six-speed option was considered, but it was decided that reducing the axial length would help with the installation of a hybrid system, with the final product being approx 38 mm (1.5") shorter than the NASCAR specification of 30".

"During the design phase, we dynamically modelled the process of removing a cluster assembly in the car," explains Paul Barton, Assistant Vice President of Xtrac Inc, based in Xtrac's North Carolina facility. "When discussing the pros and cons with NASCAR, the conclusion was that it would be better to sacrifice one ratio in favour of package protection for the hybrid system and in-car serviceability."

Local knowledge

Xtrac has been supplying internal parts for NASCAR transmissions and rear gears since 2002, and although the company is headquartered in the UK, it has a substantial presence in North America. This means Barton and his colleagues already had a wealth of expertise to call upon while drawing up the initial specifications for the gearbox.

"We knew from past experience that, for instance, Daytona is a 345 (3.45:1) ring and pinion ratio whereas Martinsville is 620 (6.20:1). And we knew that we'd have to bridge that significant gap of ratios as efficiently as possible," he comments. "We spoke to all the teams that we had existing relationships with and looked at every ratio that they'd run in the two years prior. And then we did a lot of very in-depth analysis on the gear ►

RIGHT NASCAR gearboxes ready for shipment. Xtrac is on target to produce over 300 before the start of the season





“The input drop gears offer a convenient and relatively affordable way to fine-tune the ratios”

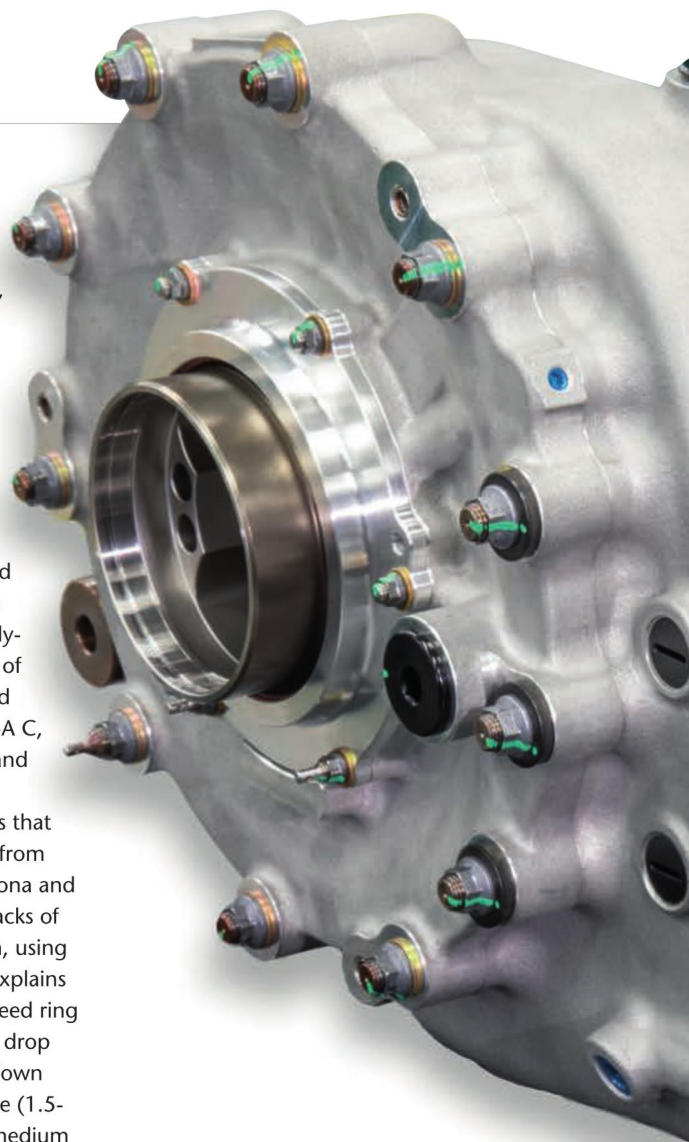
ratios – not only for top gear, but also the intermediate gears – to come up with a matrix that would reduce the quantity of gears to within a small percentage of what anybody’s run at an existing track.”

For the Gen 6 car this equated to about 17 different ring and pinion ratios within the mandatory Ford 9-inch rear drive unit, all known by their ratio numbers (345, 620 etc). These were generally built up as sub-assemblies, with multiple assemblies for each ratio that the teams could use in rotation. The end result was a significant upfront expense for the teams that the Xtrac engineers were keen to avoid with the new design. Instead, they’ve come up with a system that simplifies this to just three ring and

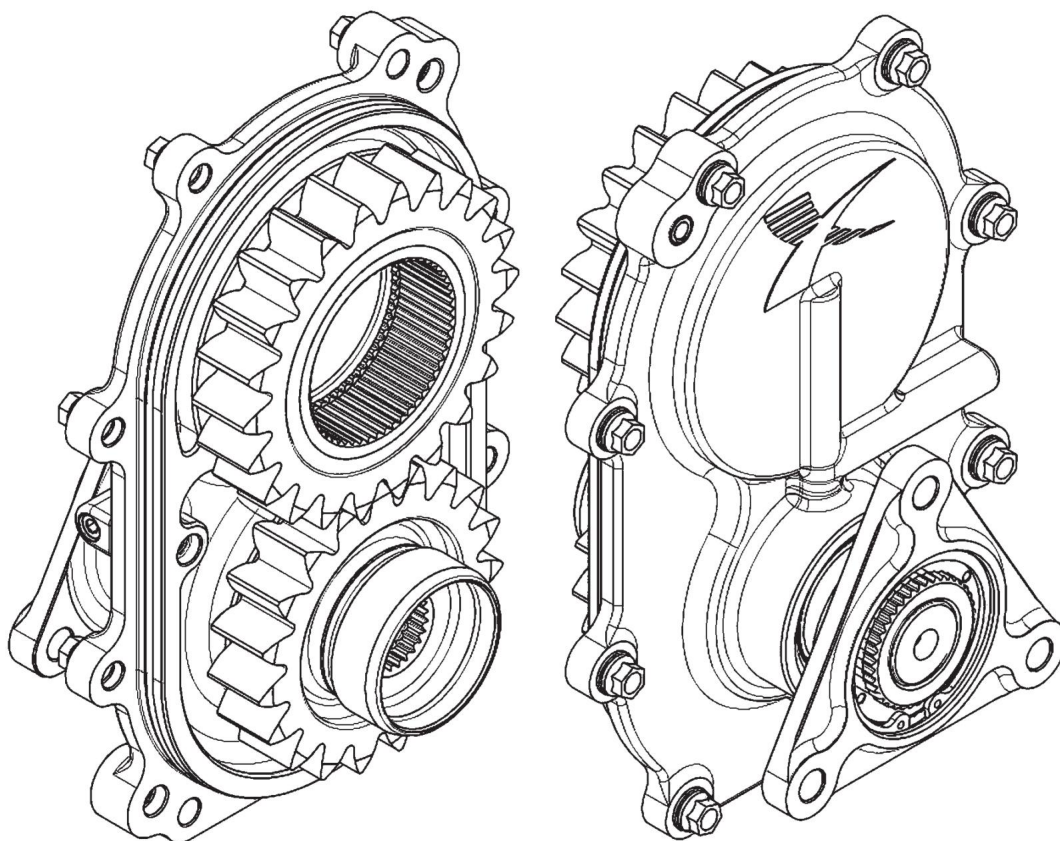
pinion sets, but with a choice of 13 different input drop gears, that are significantly lower cost.

While the rest of the transmission, known as the P1334A, is now sealed to the teams, the input drop gears offer a convenient and relatively affordable way to quickly fine-tune the ratios. Furthermore, because the teams aren’t allowed to swap the ring and pinion sets themselves, Xtrac builds up ready-made transmissions to suit each of the three rear end ratios, dubbed P1334A A, P1334A B and P1334A C, for high speed, medium speed and low speed tracks respectively.

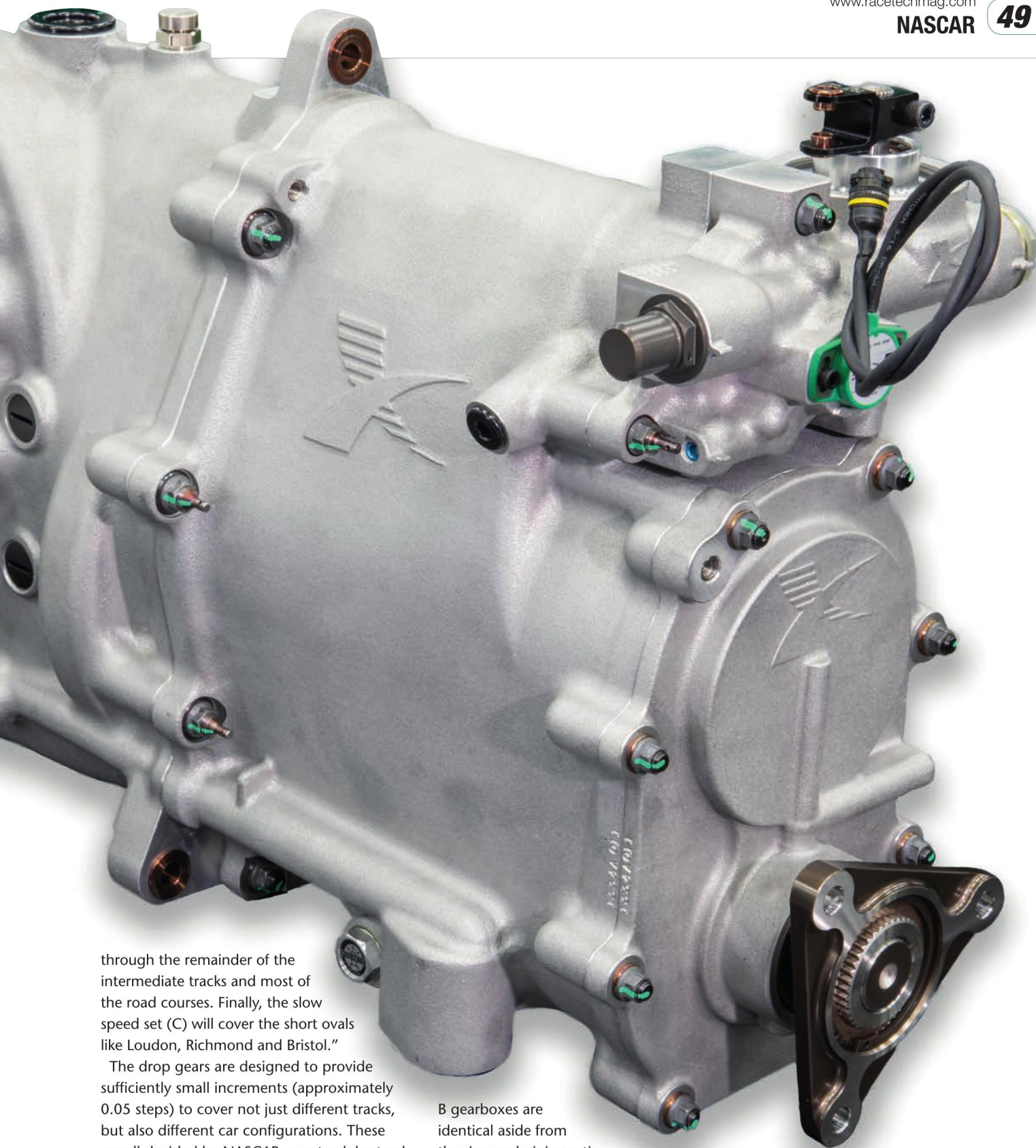
“The idea of this combination is that it enables us to get everywhere, from the highest speed tracks of Daytona and Talladega to the lowest speed tracks of Martinsville and the LA Coliseum, using this smallest number of parts,” explains Barton. “So using the highest speed ring and pinion set (A) with those 13 drop gears will get us from Daytona down through most of the intermediate (1.5-mile oval) tracks. And then the medium speed ring and pinion (B) will take us



ABOVE The P1334A transmission has been designed with an eye on the future and offers an easy transition to possible hybrid drive installation



LEFT The introduction of the input drop gear (positioned right behind the front cover in this isometric view) is pivotal to the Next Gen transmission programme, enabling the same equipment to be used for different track and car configurations



through the remainder of the intermediate tracks and most of the road courses. Finally, the slow speed set (C) will cover the short ovals like Loudon, Richmond and Bristol."

The drop gears are designed to provide sufficiently small increments (approximately 0.05 steps) to cover not just different tracks, but also different car configurations. These are all decided by NASCAR on a track-by-track basis. For instance, if the officials wished to increase the spoiler height on a particular track, they might also mandate a new drop gear to compensate for the increased drag and its effect on the engine rpm.

Another benefit of this approach is that it covers all eventualities in the calendar, Barton points out: "When we were designing this transmission, we didn't know exactly what tracks it'd be racing on in the future. The A and

B gearboxes are identical aside from the ring and pinion ratio.

So if, for example, there's a sudden push for more intermediate tracks, we could convert B boxes to A boxes very quickly, with very few new parts. And it's a relatively quick job for the teams to swap them over on the cars."

On top of this there is a dedicated road course gear cluster, to provide more desirable rev drops as the cars work up and down the gears at tracks such as Watkins Glen, Road America and COTA. In contrast, the cars spend most of their time in top gear on the ovals, with second and third only really coming into play while exiting the ►

pitlane or restarting after a caution. There's also a specific cluster for Martinsville, which is a very short (approximately 0.5-mile) oval with unusually tight corners and minimal banking, where the cars will only use four speeds.

Hybrid future

Initially, Xtrac had envisaged that the teams would carry out the servicing and the ring and pinion swaps themselves, as they did on the Gen 6 cars. However, the Charter owners within the Cup series voted to make the transmission a sealed unit.

"If you look back over NASCAR, it's used the Ford 9-inch rear end for a very long time, and they all looked the same, but internally there was a lot of development going on," comments Barton. "We were certainly always developing lighter, faster

"If it liberated half a horsepower, it would be deemed money well spent by the better-funded teams"

and more efficient gears with special gear topography, coatings and materials, and I'm sure it was the same across the drivetrain. That obviously came with a cost attached, and I think the Charter owners were conscious that there would be a lot of other costs involved with introducing a new car, so they didn't want teams to be spending money on transmission developments too. The only real way to enforce that was to seal the transmission, so they will now come back to us for all servicing."

This decision called for Xtrac to rejig its business model for the proposal,

investing heavily in a new facility within its Mooresville plant that includes three end of line rigs and multiple non-destructive testing machines for both the internals and aluminium castings. "It's been a massive undertaking to move over to a service model like that, but with this investment we're now able to support the entire NASCAR grid," notes Barton.

In terms of design, one of the most significant factors was the provision for some sort of hybrid system. The new powertrain concept – slated for introduction in 2024 – was still very much ►



LEFT The transaxle includes Xtrac's own Salisbury-type torque biasing differential



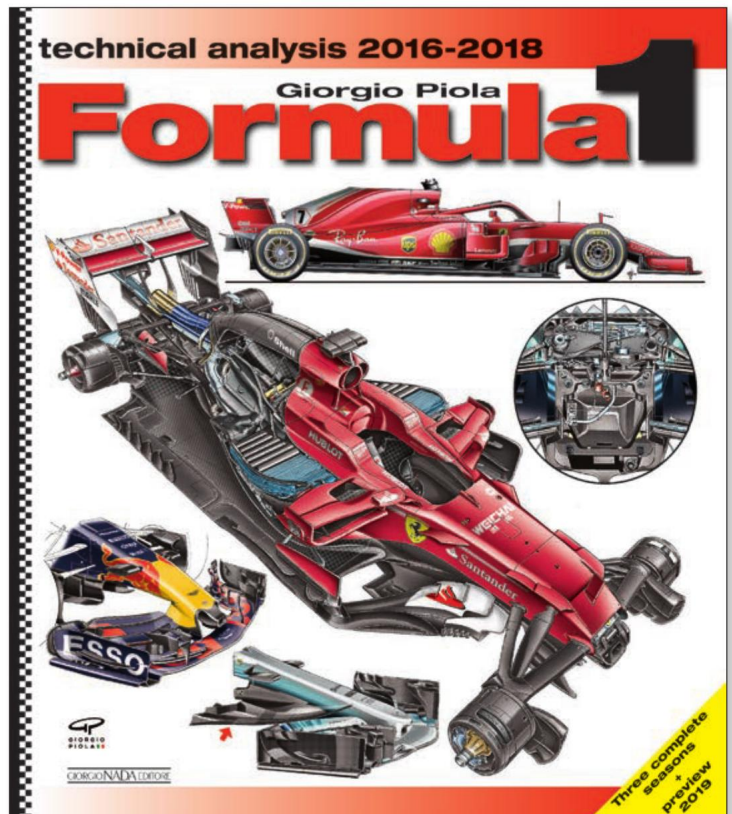
LEFT NASCAR's Next Gen Cup car driveline

Giorgio Piola

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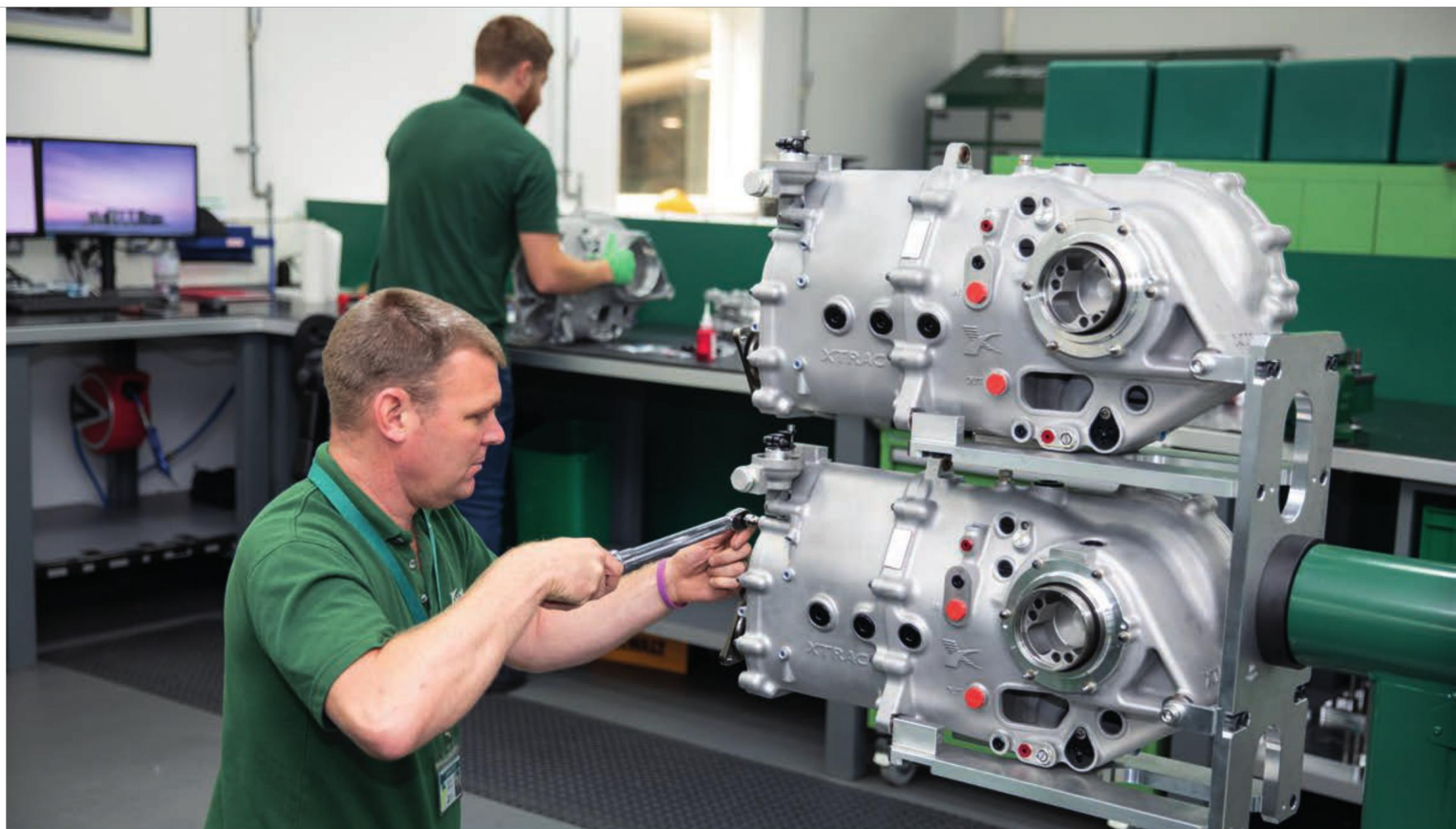


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a work in progress, so Barton and his colleagues began exploring various different options.

"All we really know at the moment is that there is an intention to move in that direction," he comments. "As things stand, that raises more questions than it answers, but here at Xtrac we have a lot of experience with hybrids and EVs, so we used that knowledge to propose what a hybrid NASCAR package might look like."

They envisaged a P2 configuration, with the motor generator unit driving onto the gearbox after the input drop gears. This would allow the teams to change the drop gears without disturbing the MGU or electrical connections, while still giving a torque multiplication through the gearbox.

"It's just our concept for how things might work," Barton points out. "That could completely change if NASCAR or the OEMs wanted to do something different. Obviously, there could potentially be some synergy with the [Xtrac-manufactured] LMDh gearbox too."

For the structural design, they took the worst-case scenario in terms of gear widths and bearing dimensions. The duty cycle was also evaluated for a range of hypothetical options, including up to 200 kW regeneration, push-to-pass style deployment and electric-only running in the pit lane.

Lubrication challenges

Racing on an oval poses some unique challenges when it comes to lubrication. Right from the start, Xtrac planned to use two different oil pickups within the gearbox – one at the back that would be most

ABOVE The P1334A in final build

effective when the car is accelerating and a second at the front right corner of the casing for when the driver rolls off the throttle going into the left-hand turns.

"At high G on an oval the oil isn't moving around as much as it would be on a road course where you're constantly changing direction, so we had to look at a slightly different philosophy," Barton explains. "We wanted to get up and running as soon as possible, so we began testing with an Australian V8 Supercars transmission. There's zero carryover between the two designs, and it's a six-speed transmission rather than five-speed, but it's a similar concept with a longitudinal transmission using drop gears, so it was something we could use for the initial testing."

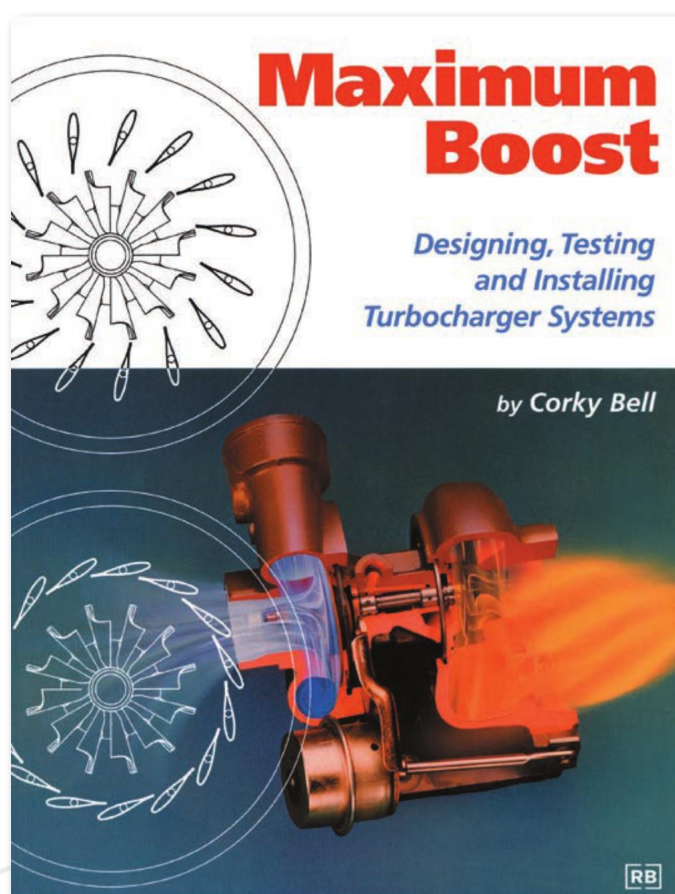
As expected, the V8 Supercars transmission experienced some dropouts in oil supply on the ovals. Later on in the development, Barton and his colleagues also used Xtrac's gimbal test rigs, which are able to simulate sustained high G loads, to ►

BELOW With teams returning transmissions to Xtrac for servicing, the company has invested heavily in a new facility within its Mooresville plant



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observe oil behaviour in the new design. Using G-force data from the teams, they ran a series of lap simulations on these rigs – ultimately using them to determine the oil levels that would be recommended for the finished transmission.

Stock car racing presents a number of other unusual challenges. A classic example of this is the phenomenon of ‘wheel hop’. On the previous generation cars with a live axle, this would occur when one of the lightly-loaded rear wheels locked in a braking zone, while the other continued to turn, creating a sudden torque difference between the two.

“If one wheel locks it can start an oscillation, giving a series of torque spikes on the coast side,” comments Barton. “That leads to a really significant overload. We’ve seen wheel hop so bad that it actually pulls the differential assembly clean off the car.”

Although less likely to be an issue with the new independent rear suspension setup, the wheel hop scenario had

become a benchmark test for NASCAR differentials, so it was one of the specific scenarios that Xtrac chose to evaluate.

“It’s not something that we expect to see on the new cars, but we still wanted to include it in the sign-off,” comments Barton. “We know it’s a common scenario that the teams are going to be keen to look at when they carry out their own validation tests. So when we did our testing we created a sawtooth load profile based on that wheel hop torque figure and repeated that over and over, while running the transmission over-temperature.”

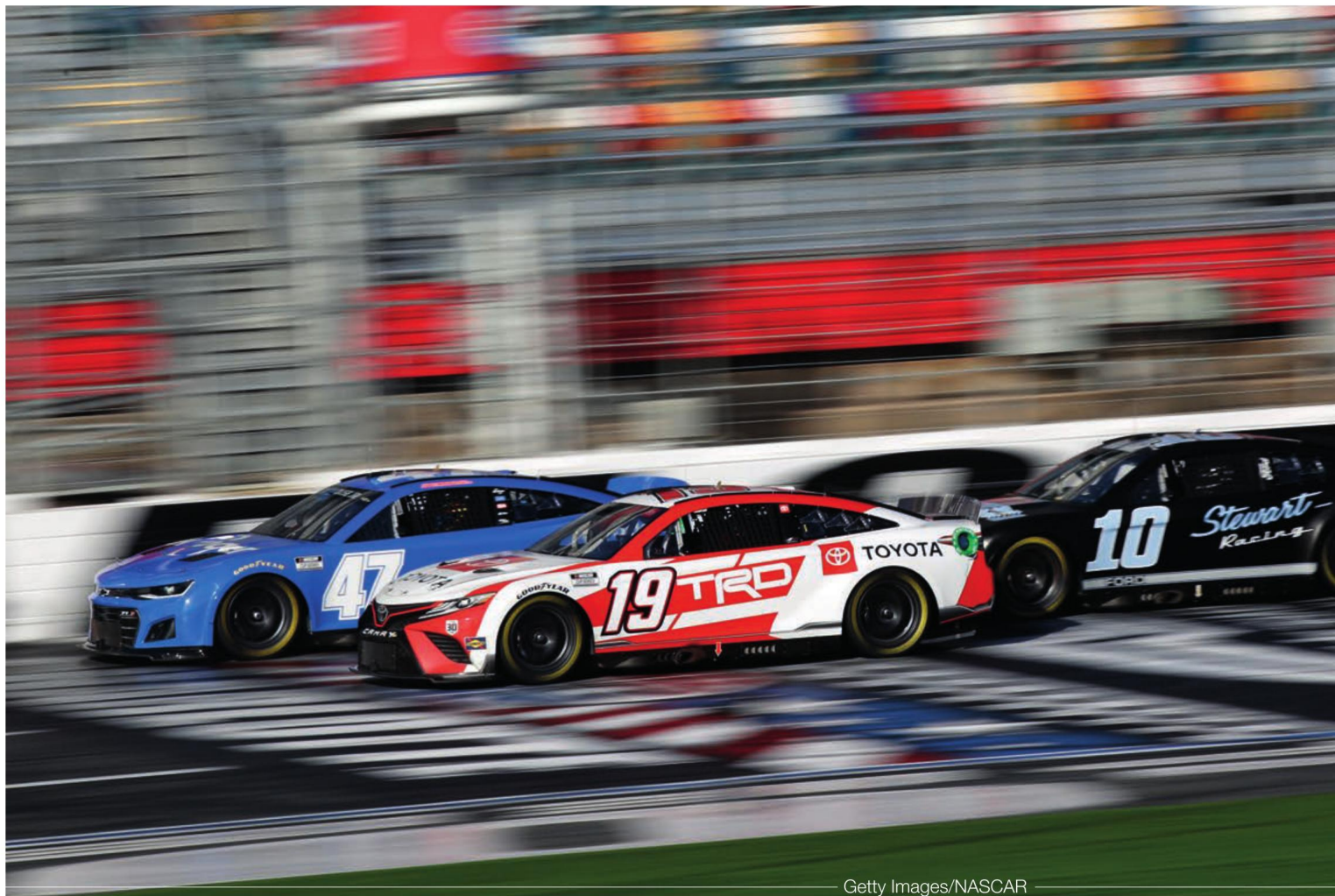
Repeatability

Running assemblies on loaded dynos before they go on the car is standard practice for many Cup series teams. Not only is it part of the team’s quality assurance programme, but it highlights any minute differences that might be able to lend one car a competitive advantage. Such is the level of competition in the series and the technical similarity between

the cars that tenths of a horsepower gained through efficiency improvements can have a big benefit.

“We’ve got very good procedures for building transmissions that are extremely repeatable,” comments Barton. “Nonetheless, as we get to the Chase at the end of the season, the teams will be testing the gearboxes to see which gives the best efficiency due to the amount of time it’s been bedded-in and other factors. At that point, you can bet the best driver within the team will be given the best transmission.”

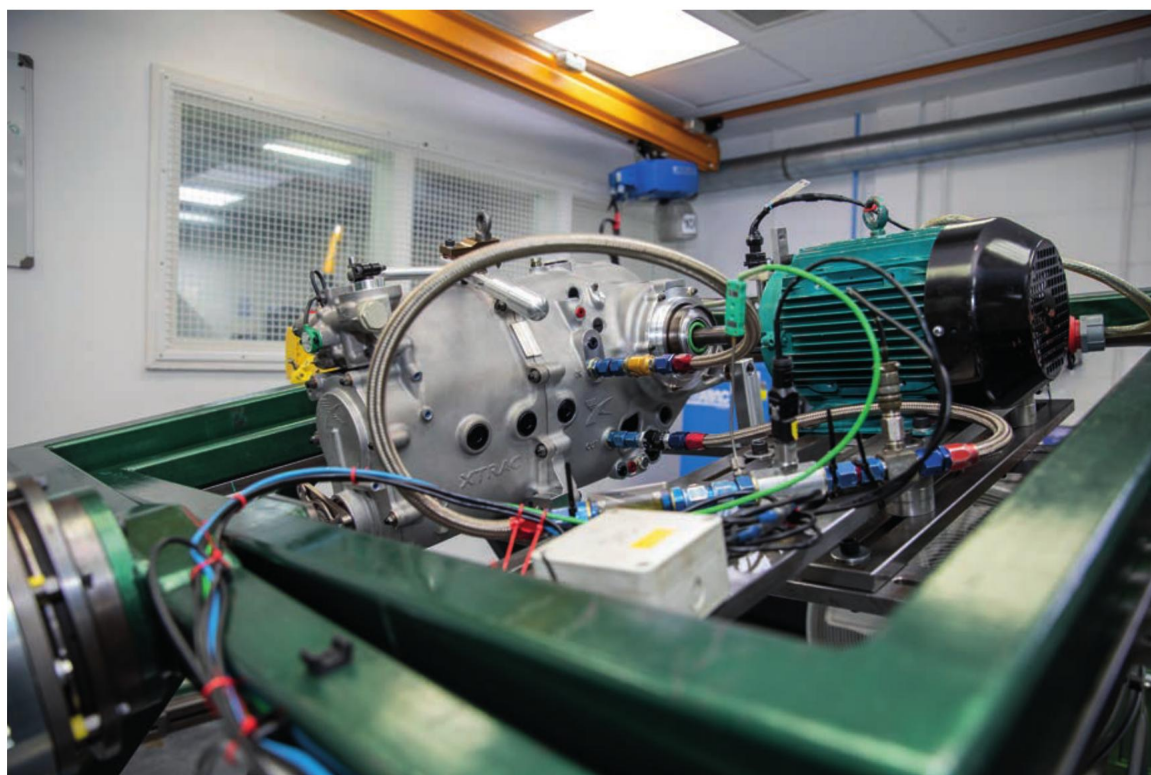
Back at the factory, however, Xtrac has its own processes to minimise any variation from one unit to the next. When teams were allowed to service their own transmissions, there was the potential option of loosening the preload on the tapered roller (or angular contact) bearings used for the bevel gears in the differential. This could lead to a substantial reduction in the unit’s life, but if it liberated, say, half a horsepower, it



Getty Images/NASCAR

RIGHT Xtrac's gimbal test rigs, which are able to simulate sustained high G loads, were utilised to observe oil behaviour in the new design

BELOW With such a large variety of tracks on the NASCAR schedule, the primary focus of the design was to minimise ratio options for the teams, whilst enabling trackside adjustments to overall gearing via input drop gears



would be deemed money well spent by the better-funded teams. The move to sealed transmissions has put a stop to this experimental technique, but it highlights the importance of quality control during manufacturing and assembly.

Xtrac measures the casing and the internal parts in each individual transmission to a very high degree of accuracy. It then uses this information to grind bespoke shims to provide the same level of preload (within a small window of tolerance) for each unit. This is standard practice for a high-end motorsport transmission, but Xtrac takes things a step further, individually dyno testing each of the gearboxes to ensure that they fall within a tolerance for turnover torque.


"Next to reliability, the biggest thing you're looking for with any standardised part is repeatability," notes Barton. "There is always going to be a tolerance on the parts, but we've got processes in place to ensure a very high level of consistency."

The transaxle also includes Xtrac's own differential. It's a Salisbury-type torque biasing differential using

ramps that separate under torque to lock up a set of clutch plates, with an external preload adjustment that provides a degree of setup adjustment to the teams.

"We initially proposed a spool – as used in V8 Supercars – to help reduce the cost, but we also shared a concept with a differential in our proposal as this was optional in NASCAR's RFP," comments Barton. "In the end it was actually the OEMs who pushed for the differential. There are more road courses in 2022 than there have been in the past, so I think the motivation was that a torque biasing differential is more relevant to a road car than a spool or a locker."

Although there are no carryover parts as such, the project has benefitted from expertise in other areas, Barton explains: "There are various ideas we've brought in from our other projects. For instance, in IndyCar we noticed that the dog ring can start walking out of gear at sustained running on an oval if you don't take steps to prevent that. The nitrogen-charged differential preload also came from IndyCar originally, although we use that a lot in sportscar racing now too. We're also using an overlapping barrel, where the next gear in sequence is engaged by a separate dog ring. So, going from first to second, you can start moving the next dog ring while the current one is still engaged, which speeds up the change. That's another concept that came from sports cars."

All of this combined experience has been channelled into NASCAR's most advanced transmission to date; one that should help to reduce operating costs, simplify things for the teams and pave the way for a brave new hybrid future. 

"An overlapping barrel where you can start moving the next dog ring while the current one is still engaged, which speeds up the change"

HOW A MOMENT OF PLAY SAVED PRODRIVE'S DAKAR FROM DISASTER

Chris Pickering discovers how a stroke of luck shaped Prodrive's impressive Dakar campaign with the Bahrain Raid Xtreme team – and reveals their plans to respond to the ASO's tech revolution



AFTER 14 days, 8,404 km and 13 special stages, the 2022 Dakar Rally is over. For Prodrive and the Bahrain Raid Xtreme team, it has proved a successful return to the desert, with second place overall and two cars in the top four.

Built to a heavily-revised set of regulations, designed to provide parity across a range of different powertrains, the biofuel-powered Prodrive Hunter T1+ is a significant step on from the 2021 car. The story of its development is intertwined with the lessons learned from last year's event and the rule changes that have taken place in the meantime.

One of the recurring themes in last year's Dakar was the number of punctures suffered by the T1 4X4 cars, which were required to run 32-inch tyres. Prodrive effectively had to retire star driver Sébastien Loeb when he ran out of spare tyres.

Meanwhile, rivals Toyota reportedly suffered over 100 punctures across its four-car team during the 2020 and 2021 events combined.

The upshot of this was that the T1 4X2 buggies on their larger, more puncture-resistant, tyres had a clear advantage in 2021. Stéphane Peterhansel and Edouard Boulanger in the MINI were able to pull out such a lead over the rocky stages of the first few days that they could effectively ease off

and manage the gap for the remainder of the event.

Prodrive was one of a number of manufacturers in contact with tyre supplier BF Goodrich in an attempt to address this problem – even as the 2021 event was unfolding. The conclusion they reached was that the rules simply didn't allow enough sidewall height for the weight and performance of the cars.

Various alternative options were discussed, including a 35-inch tyre, but it was agreed that the simplest solution was to switch to the 37-inch tyre already in use on the buggies. This uses a fractionally bigger wheel rim (17 inches rather than 16 inches) but the vast majority of the extra diameter comes from the sidewall, which means it can be engineered to be far tougher for the same level of grip and compliance.

Shortly afterwards, the manufacturers also became aware of some of the technical specifications of Audi's RS Q e-Tron project. Despite its four-wheel drive platform, this had been designed to run the larger tyres of the two-wheel drive buggies, along with a number of other advantages, including greater width, increased suspension travel and a tyre deflation system. Initially, the other manufacturers assumed that this would be a technology ►

LEFT Sébastien Loeb's BRX Hunter in full flight across the dunes



demonstrator built outside of the technical regulations in a similar manner to the Garage 56 entries at Le Mans. However, once it became clear that the Audi would be eligible to compete for overall honours, the existing T1 manufacturers started to raise concerns about its potential advantages.

"A lot of the details surrounding the Audi came to light around the time of Dakar last year. And it became pretty obvious that if they turned up with all this kit, no one would be able to touch

it," comments Paul Doe, chief chassis engineer at Prodrive.

In many respects, the Audi with its sophisticated series hybrid powertrain signalled the future direction of the Dakar, as laid out by the FIA and the ASO. This highlighted a wider challenge that needed to be addressed, with multiple types of alternative powertrain expected to be competing by 2026.

"Collectively, we agreed that we'd need more commonality in the rules if we were ever going to balance all these

different technologies," recalls Doe.

"That's essentially how the T1+ regulations came about, as a single set of rules for the chassis. And there's a lot of similarity now between our specification in T1+ and what Audi is running in T1U."

In short, the T1+ and T1U regulations set out to equalise the main factors that limit the car's performance beyond its powertrain. That includes the total width of the car, along with its tyre size, suspension travel, minimum weight and the electronically-governed maximum



BELOW The T1+ specification Hunters all benefitted from AP Racing's brake discs, mountings, master cylinders and calipers, as well as an innovative, bespoke pedal box. The Coventry-based manufacturer also provided a bespoke 184 mm clutch to the programme

speed. By moving both 4X4 classes to the 4X2 tyre size it was also hoped that they would solve the puncture issues.

"Once you've got the same basic capabilities in the chassis, in theory all you need to do is match the straight line acceleration of the different types of powertrain," notes Doe. "That's not to say they'll all be the same – there's still the potential to engineer a competitive advantage with things like weight distribution or suspension design – but it provides a level playing field."

Agreement reached

The T1+ regulations established an important technical framework for the future, but the clock was also ticking for the development of the 2022 car.

Work on the revised design had begun almost immediately after the Dakar, but Doe and his colleagues found themselves having to second-guess the regulations to an extent as the fine details were still being drafted in the background. The minimum weight of the wheels, for instance, wasn't finalised until quite late on, so the team had to hold off on finalising the wheel design until the last minute before testing.

Aside from the tyres, one of the most significant changes was the vehicle width (up from 2 metres in T1 to 2.3 metres in T1+). This increased width has advantages when it comes to suspension dynamics and obstacle clearing, but it was also deemed a necessity if the car was going to carry two spare wheels in the new, larger size.

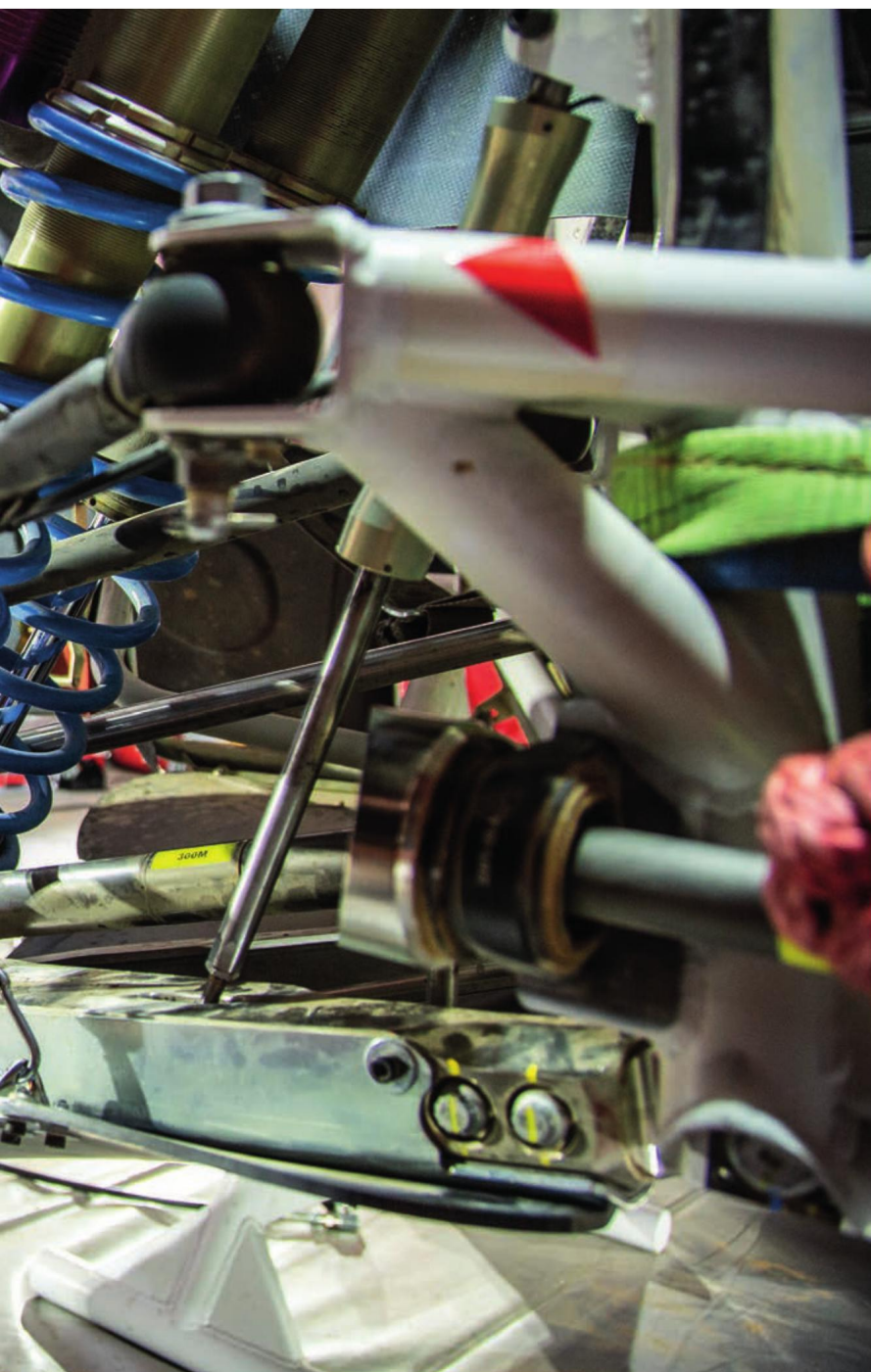
The suspension travel is another key change, with wheel articulation up from 280 mm to 350 mm, Doe explains: "We were really limited on suspension travel under the old regulations. Over this sort of terrain, 280 mm isn't really enough, and we felt it was another factor in the puncture situation. You have to run quite stiff if you don't have much wheel travel, which makes it hard to absorb all the energy through the dampers."

“We knew we had a big problem. It seemed like a disaster”

One potential headache with the increased suspension travel was the impact this would have on the driveshaft angles and the bearing loads. However, the extra vehicle width more or less compensated for these, maintaining a similar overall geometry.

Nonetheless, Prodrive was keen to implement some changes to the suspension design, having broken a wishbone during testing for the original T1 car, and again on the Dakar itself in 2021. The data from both these incidents was analysed and fed into the load cases for the revised wishbone design.

"We did a lot of analysis on the original design, drawing on our World Rally Car and World Rallycross expertise, among other things. But the one use case we hadn't considered was an impact directly into the wishbone itself [by grounding the vehicle at high speed], so that gave us some extra scenarios to evaluate," comments Doe. "When it came to designing the wide track suspension for the T1+, we not only strengthened the wishbones, but we changed their profile to deal with exactly this sort of scenario in mind." ►



The design concept behind the wishbones is somewhat unusual. Instead of a tubular construction, they're machined out of solid aluminium (with a shape that's faintly reminiscent of the plastic wishbones used on remote control cars).

"We were actually told by the team principal of one of the other main teams that we'd never get an aluminium wishbone to work," says Doe. "Aluminium is certainly not an obvious choice because of its ductility, but the rather unusual shape that we wanted to achieve would have been an absolute nightmare with fabricated steel. And using aluminium meant we were able to leave quite a lot of material in there and still keep the weight under control. We're pretty happy with the result."

Elsewhere, the larger wheels and a reduced speed limiter for 2022 (170 kph down from 180 kph) meant that the gearing needed to be adjusted. Fortunately the design of the differentials, with a drop gear on the input, allowed this to be done without changing the gearbox. Another advantage of this was that the propshaft could continue to be run at a relatively high speed (and hence a lower torque than would be required to transmit the same power at reduced rpm).

Another knock-on effect of the bigger wheels was the opportunity to run bigger brakes. Technical partner AP Racing designed a new caliper to sit inside the 17-inch wheels, along with a new 355-millimetre disc.

New uprights were also required, so Prodrive took the opportunity to redesign the wheel bearings, which had proved somewhat problematic on the original design.

"The original parts were more like a beefed-up World Rally Car arrangement, but this time we've taken a lot of learnings from our Le Mans projects. We've invested a bit more in the cost of the parts, but the end result is something that lasts literally 10



ABOVE The Hunters pursued Toyota Gazoo Racing's Nasser Al-Attiyah for more than 8,000 kilometres

times as long," comments Doe. "We got through the event okay in 2021, but it was hard at times, and one of the things grinding people down was that we were rebuilding the wheel bearings every day. This time around we didn't have any issues with them at all."

Main structure

The main structure of the steel spaceframe has remained largely the same. A few tubes were actually removed as analysis of the cars from last year's event suggested those parts of the structure weren't contributing a great deal to the overall strength, but they were adding extra packaging constraints.

"We try to get the fundamental architecture of the powertrain, such as the position of the engine, gearbox and differentials, nailed down from day one, because that sort of stuff is hard to change," comments Doe. "The spaceframe can then be designed around that powertrain layout – which is quite a luxury compared to the usual projects we're working on that have to be packaged within a production-based monocoque shell."

To an extent, the layout of the spaceframe defines itself once the key hardpoints have been defined, and the general aim is to keep things as simple as possible, he explains: "The main priorities are housing the occupants and fuel cell safely and then mounting the powertrain and the suspension. Almost by default that process results in a structure that's quite adaptable. If, for instance, we were approached by an OEM, it would be quite easy to modify the chassis to take a totally different body shell. We might have to tweak the shape of the safety cage to accommodate a different windscreen shape or something like that, but it's a concept that's inherently easy to adapt."

In the case of the Hunter T1+, it also made the process of remodelling the vehicle for the wider body comparatively straightforward. Ex-Jaguar and Aston Martin design legend Ian Callum returned to restyle ►

BELOW The second-generation biofuel is calculated to have saved 28 tonnes of CO2 emissions during the course of the event



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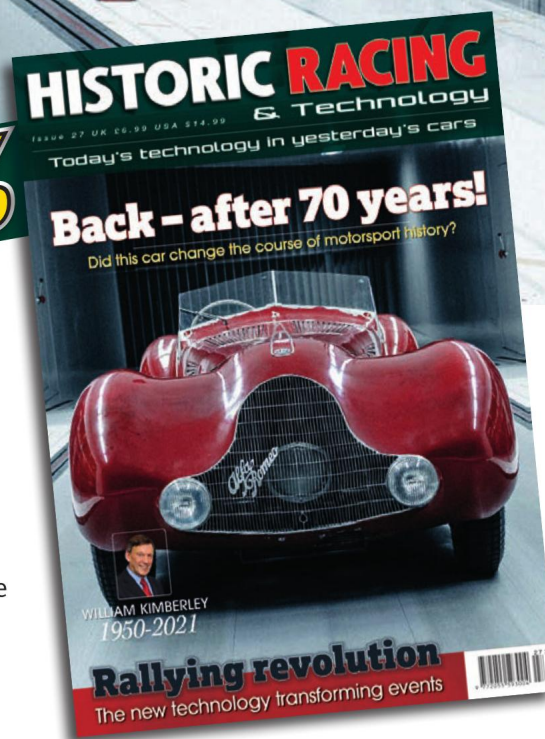
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LEFT & BELOW
Suspension travel was a key change over the car's predecessor, with wheel articulation up from 280 mm to 350 mm

the body for the new regulations, although it retained the same basic concept.

The carbon composite panels for the cockpit, the doors and the cooling system were carried straight over from the narrower T1 car to minimise tooling costs and CFD time. However, virtually everything else

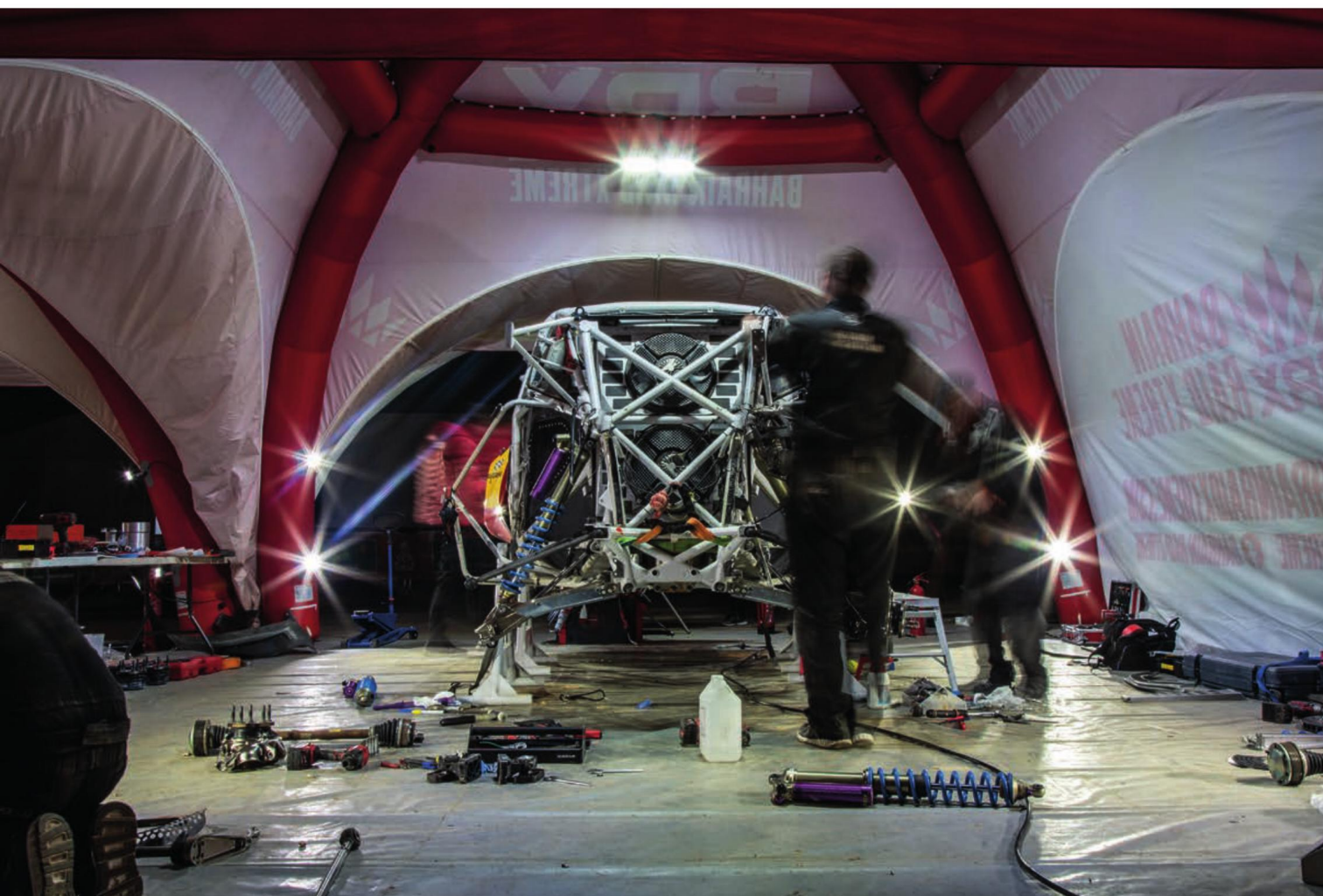
was subtly remodelled – not just to tweak the styling for the wider track, but also to improve access and serviceability.

"A lot of the original bits came together with zero panel gaps and hidden fixings and things, which were quite fiddly. So on the new car we worked closely

with Callum Design to come up with something that would maintain the style but make things easier to fit," notes Doe.

The only significant element of the car not to receive any hardware changes was the powertrain. Tucked away in the rather crowded engine bay of the new Hunter sits the same 3.5-litre twin turbocharged Ford EcoBoost V6 as you'd find in its predecessor. What is new is the fuel, with a second-generation biofuel blend developed by Prodrive and Coryton Advanced Fuels that's said to reduce the net tailpipe emissions by an impressive 80 per cent. This necessitated changes to the calibration to support a slightly richer lambda value and a higher fuel flow rate. Initially it had been thought that a larger fuel cell might be required as a result, but the maximum length of the stages was reduced this year to accommodate the T1U cars, which meant it has been carried over unchanged.





Testing times

For the very first test of the T1+ car, the team headed to the Sweet Lamb Motorsport Complex in Wales. The day had passed without a hitch, when driver Nani Roma began eyeing up a set of motocross jumps next to the track. On his suggestion, the team spoke to the organisers and got permission to take the near 2-tonne Dakar racer over the jumps, whereupon one of the differentials exploded.

"It literally broke the casing in two, and then the following day we broke another one on the other end of the car. It was at that point we knew that we had a big problem," comments Doe. "To make things harder, transmission parts typically have very long lead times once they've gone through all the heat treatments and other processes."

The parts would need to be stripped down and inspected by a transmission specialist to fully understand the problem, so Doe drove straight to Portsmouth and caught an overnight ferry to France. He then continued on to Sadev in St Prouant, where the issue was found to be stress concentrations in the casting.

The cars were imminently due to head out to the UAE for the next phase of the test programme, but the decision was taken to put things on hold until a solution could be found.

"We've got a really good relationship with

Sadev and they set about doing the FE analysis to understand why it had failed. In the meantime, our designers back in Banbury set about designing a replacement," Doe recalls. "We knew the lead times would be too long to get a casting done, so we had to switch to a fully machined solution. That was literally done in about 24 hours and sent over to the Sadev engineers to carry out their own analysis."

Not only was the solid billet material stronger, but the machining process allowed the engineers to employ a different geometry. Within 24 hours, the analysis had been completed and the production drawings drawn up. The biggest problem was actually finding a supplier who could source sufficiently large billets at short notice amid the twin challenges of Brexit and Covid. Nonetheless, the new casings were manufactured, shipped out to Sadev for assembly and returned to the UK in around a week, after which the team went straight back to Sweet Lamb and attempted to break them again. It was a Herculean effort, and one that paid off. Despite the drivers' best efforts, the differentials remained intact throughout testing and the Dakar itself.

"It seemed like a disaster when we first had the issue, but now we look back on it as an example of really good collaborative work with a supplier," comments Doe. "We were able to utilise the strengths of different people, turning things around ►

ABOVE Virtually everything on the car was subtly remodelled not just for styling, but to improve access and serviceability



in a really short time. And had Nani not had the idea to try those jumps in Wales we probably wouldn't have noticed it until much later in the test programme, and we wouldn't have been able to recover in the way that we did."

Take two

After something of a baptism of fire on last year's event, Prodrive's return to the Dakar with the Hunter T1+ in 2022 was to prove a rather more relaxed affair, not to mention a more competitive outing for the crews.

Sébastien Loeb and Fabian Lurquin provided the stiffest challenge to the Toyota GR DKR Hilux of Nasser Al-Attiyah and Mathieu Baumel, finishing second overall and picking up several stage wins along the way.

Nani Roma and Alex Haro Bravo showed

good pace in the second Hunter, but they finished well down the order following a high-speed rollover on stage four that left Haro Bravo with a broken rib for the remainder of the event. Meanwhile, the Prodrive-supported customer entry of Orlando Terranova and Daniel Oliveras Carreras put in a strong performance, with fourth place overall and a win on stage six.

Loeb and Lurquin's Hunter broke its propshaft fastenings on stage 3, reducing them to front-wheel drive only for the next 250 km. That aside, however, the event was largely free of mechanical issues.

"We're pleased with second overall, but the problem with Seb's car was very unfortunate as I think we could potentially have done even better," comments Doe. "The problem was traced to a process issue with a part that's been on the car since the very beginning of the T1

project. It's the first time we've had any problems with it in that whole time and we managed to resolve it immediately, but it cost us quite a lot of time."

The team's first Dakar in 2021 had been a constant stream of late nights, with the support crews not finishing until the early hours on what was optimistically described as the rest day. In general, though, things went smoothly this year.

"It was mostly just standard stuff. We put together a job list beforehand, which included inspecting or changing various parts during the course of the event, and we just ran through that list. There was very little stress," comments Doe. "I think we did a good job of learning from our first event last year.

"The conversion to T1+ was quite an expensive exercise – for us and the other teams – but I think we were lucky to some extent, because we were able to fix 90 per cent of the weaknesses from the original T1 car during that process."

Some of the revisions for the new car fell outside of the T1+ changes. The wiper system was one area of improvement, while others included changes to the cabin's air conditioning system, the underbody protection and the onboard jacks.

The future

The encouraging results in this year's Dakar should stand Prodrive and the Bahrain Raid Xtreme team in good stead for the forthcoming World Rally Raid Championship and beyond. However, they face tough opposition and a changing world in the cross country scene. By 2026, the FIA and the ASO want all Priority drivers to compete with an alternative powertrain technology, which means that the T1+ manufacturers are already having to consider their options.

"In the future we're all going to have to run a T1U of some kind, but those regulations are still very much in their infancy at this stage," comments Doe. "At the moment, they're very much focused around the Audi's range-extended architecture, but the FIA and ASO have made it clear that they don't want to restrict teams to any one technology."

There are already several hydrogen projects – both for combustion engines and fuel cells – which are going to pose an interesting challenge for the regulations, he points out: "Getting enough hydrogen

LEFT Loeb lost time when the Hunter broke its propshaft fastenings on stage 3, reducing him to front-wheel drive only for 250 km

“We’ve been working on a parallel hybrid version of the car”

onboard the cars to do the sort of distances we do now isn’t really practical. It’s possible that they might refuel halfway through the stage like the bikes and the T3 buggies do, but filling up with gasoline is different to trying to get 30 kilos of high pressure hydrogen into a car in the middle of the desert.”

Electrification is likely to remain a significant part of the solution, and it’s this concept, along with its sustainable fuel, that Prodrive has been focusing on.

“For quite a while now we’ve been working on a parallel hybrid version of the car. This will integrate a high-power electric motor and high-voltage battery into the powertrain to recover energy under braking and redeploy it under acceleration,” comments Doe. “This is quite a different concept to the range-extended car that Audi’s got, so we’re working with the FIA on what it would need to do in order to be accepted.”

Understandably, the FIA is keen to avoid anything that could be deemed a token effort. Doe stresses that Prodrive won’t be looking at a 48-volt mild hybrid or anything along those lines, but a high-power system – likely to be capable of driving on

electricity alone for the various 30 kph and 50 kph slow zones dotted along the route.

“We’ve done our initial dimensioning and simulation, so we know roughly what we want to do, and we’ve begun talking to suppliers for the hardware,” he explains. “The next step is really to define the spec in fine detail and start designing the battery, but we can’t do that until we’ve got the decision from the FIA on the regulations.”

Developing a hybrid version of the car for the 2023 season, which kicks off in well under 12 months’ time, is unlikely to be a competitive option. Instead, the team is aiming to go hybrid for the Dakar in 2024, with testing – and perhaps some competitive events – beginning in 2023.

In the meantime, there’s also the new World Rally Raid Championship to think about, which began with this year’s Dakar. The next round is the Abu Dhabi Desert Challenge, so the vehicles will be remaining in the Middle East, where they will be stripped, inspected and rebuilt. Needless to say, the Prodrive engineers will be keeping a close eye on the findings and feeding those back into the car’s ongoing development.

Where exactly that will take them in the future remains to be seen. But the Hunter’s strong performance at this year’s Dakar and the team’s track record in other disciplines shows it has huge potential. Don’t be surprised if the squad adds to its trophy cabinet next year. **RT**

LEFT Loeb is not a man accustomed to celebrating second position, but he acknowledges that over the world’s most inhospitable terrain second was still a fantastic achievement

BELOW The next version of the Hunter could feature a high-power hybrid system



A GLIMPSE OF *THE FUTURE*

One of the most significant events of this year's Dakar Rally occurred on a day when no cars even left the bivouac. **Hal Ridge** reports on the launch of GCK Motorsport's e-Blast H2, the first-ever cross-country car designed with an integrated hydrogen fuel cell

FOR a man determined to win every race he starts, Guerlain Chicherit's retirement from the 2022 Dakar Rally will have frustrated, even hurt, the Frenchman.

But, the overall outcome of his GCK Motorsport team's first official entry to the world's most famous cross-country rally ultimately didn't hinge on the final result. Not this year anyway.

Driver and team entered the Saudi Arabian event with a learning and data collection objective. Of course, success would



have been nice, but that was secondary.

After all, arguably the biggest moment of the fortnight for the team was during the mid-rally rest day, when the covers were pulled off the first iteration of its e-Blast H2, the first-ever cross-country car with an integrated hydrogen fuel cell, set to debut at Dakar 2024.

The team, part of Green Corp Konnection, launched its plans during last year's Dakar, with an all-electric vehicle, the e-Blast 1.

Twelve months on, the squad is on course to deliver on its targets. With the

team's chassis based on the ex-Peugeot Sport rally-winning 3008 DKR, a new bi-turbo, 3.5-litre Ford engine was fitted for Chicherit's full-time return to cross-country competition in January. And while Chicherit's 2022 steed had greener credentials by running on biofuel, it's not a patch on what's to come.

The e-Blast H2 revealed in Riyadh isn't the finished product, but a step into the future, with Dakar promotor ASO forging ahead with plans for competitors in the elite car and truck classes having to meet new ultra-low emission standards for

2026. Its ultimate target is for all cars and trucks to use alternative energies from 2030.

GCK's prototype hydrogen car is fitted with a 250 kW fuel cell, but currently only four kilograms of hydrogen, just to make a step forward in the development process. Once validation running has been completed, and the car has returned to the team's Clermont Ferrand base, it will ultimately be fitted with a tank of around 30 kg capacity.

"We are meeting the exact timeline and planning that we announced last year to ►



ABOVE The inner workings of the e-Blast H2 were displayed during the rest day

be ready for 2024. We can divide that planning into three stages," explains team manager Sebastien Lesonneur. "The first was last year where we came out with the electric car fully powered by batteries. This car allowed us to quantify the requirements in terms of energy and make a validation of the powertrain, our electric motor, the gearbox, the inverter, all the powertrain parts which will be retained in the H2 programme.

"This year we have gone to step two with the first integrated fuel cell inside with a low amount of H2. Then we will introduce the right amount of hydrogen, we think around 30 kg, and from the second half of the year we will start an intensive testing programme."

The fuel cell is being co-developed between GCK and technical partner FEV, a German engineering company. While GCK

"The challenge is more the tank integration, which takes a lot of space"

Motorsport is busy with developments in France, FEV is running the fuel cell "almost 24 hours a day, to validate its reliability," Lesonneur notes. "The final target is clear: to race with this car in 2024 and be the first team to fight for the win with a zero-emission car."

Adapting Peugeot's DKR concept to accept the electric powertrain meant significant changes to the rear of the chassis. Peugeot's V6 engine was ditched in favour of a 250 kW motor,

two-speed paddleshift transmission and 150 kW batteries – all developed under the GCK umbrella [the batteries, for example, by Ion Battery Systems]. The addition of the fuel cell, and especially the 700 bar hydrogen tank, has made for more work still.

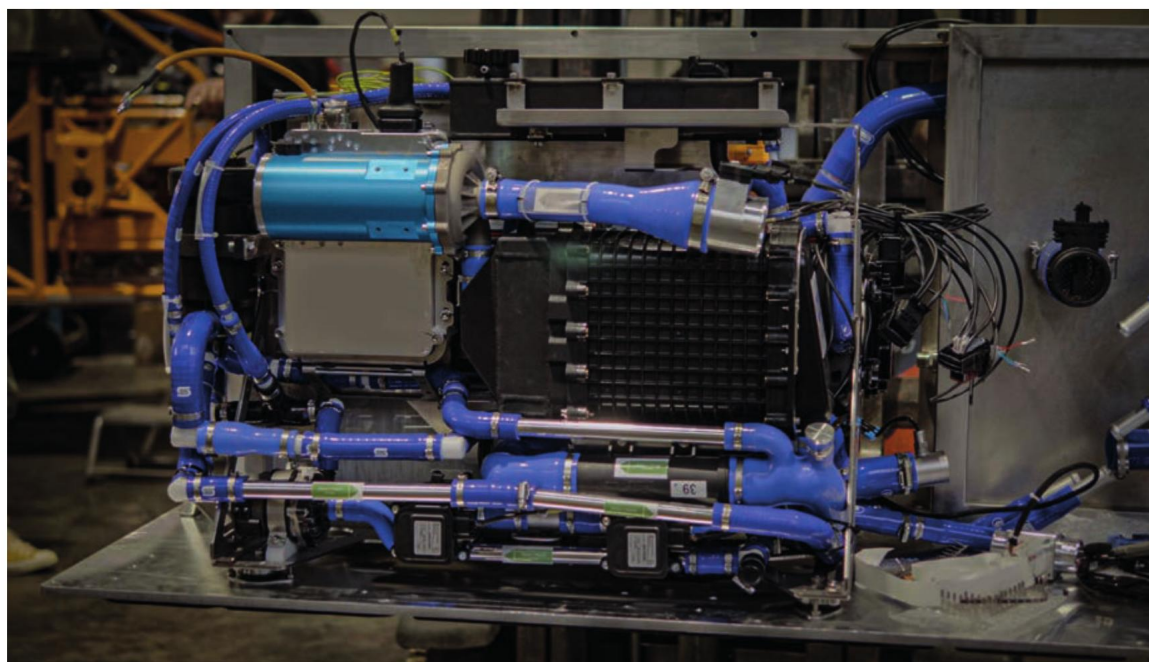
The next stage in the project includes increasing the chassis' external dimensions at the rear to fit the larger tank. The chassis' geometry, however, remains, including double-wishbone, three-way adjustable double-damper per wheel suspension, four-piston Alcon brakes and uprights.

Compact part

"It's a huge amount of work to be honest, even if the fuel cell is a compact part which is almost equal in terms of dimensions to a standard engine," says



RIGHT The internals are currently very much work in progress as the team refines the concept of a hydrogen fuel cell



ABOVE The fuel cell is being co-developed by GCK and technical partner FEV

Lesonneur. "The challenge is more the tank integration, which takes a lot of space. Our design is already done, and the chassis will remain basically the same, but we will use a type of double-frame behind the main roll cage to integrate the tank, behind the fuel cell and the powertrain, so the car will be slightly longer. For both capacity and safety."

That tank capacity and 200 kW fuel cell will provide enough energy for the car to complete 250 kilometres at race pace. Currently at the Dakar, motorcycles and cars in the SSV category have a stop at 250 kms in stages to refuel, which can act as a regroup for cars too. GCK is one of the voices pushing hardest for the

Dakar not to change its format for the introduction of alternative energies and is planning to use that stop to re-fill the hydrogen tank on the e-Blast H2.

"The target is to not change the format of the Dakar at all. It must remain an endurance race," says Lesonneur. "It's a bit early to give an exact answer on the topic of how long it will take to fill the tank, but definitely it will be inside the 20 minutes they use for the motorbikes and SSVs. Like I said, we will be ready to race with the car in 2024 but there is big work to do, for everybody. For the ASO to be ready to bring the green hydrogen that we must use, and for the FIA to clarify the regulations. ►

LEFT The e-Blast H2 is on course to debut at Dakar 2024





“FEV is running the fuel cell almost 24 hours a day”

ruleset, and it was Toyota and Prodrive that claimed four of the top five positions.

While the cars were fitted with black boxes in a bid for the FIA to introduce Balance of Performance to perfect the difference between the different machines, GCK has an eye on the rules too.

Buggy heritage

The GCK Thunder raced by Chicherit this year retains the Peugeot DKR chassis’ heritage by running in buggy, rear-wheel-drive specification. That concept is being adopted by the e-Blast H2 too, now fitted with a 300 kW motor, driving the rear wheels. For that reason, when asked if the e-Blast H2 will remain in buggy trim in its final specification, Lesonneur says: “The first car in 2024 will be based on the buggy, but then maybe the reality of today is not the reality of tomorrow. We will stay in close contact with the FIA to get the balance of performance right, the same discussion as this year [regarding buggies and the T1+ cars]. We must all work together, because if we keep the two-wheel-drive in exactly the same configuration in terms of damper travel, drivetrain power and weight compared to a four-wheel-drive car, then it makes no sense [to remain with two-wheel-drive]. We have decided to use [two-wheel-drive] because we have these chassis and experience of these chassis, but now it will depend how the regulations will move in the next months and years.” ▶

The regulations to which Lesonneur refers are not just surrounding the propulsion method. For 2022, as part of the ASO working with the FIA to be included in the new FIA World Rally Raid Championship, rules were changed in a bid to bridge the gap between the two-wheel-drive buggies that have been so fast in recent years, and the four-wheel-drive machines.

The new T1+ regulations largely maintain their four-wheel-drive roots but benefit from some of the perks enjoyed by the buggies in recent years, including an increase in overall width to 2.3 metres, an increase in suspension travel to 350 mm, using 37” wheels instead of 33”, and a minimum weight of 2,000 kgs. Cars built by Prodrive, Toyota Gazoo Racing and Martin Prokop’s team adopted the new

ABOVE Adapting Peugeot’s DKR concept to accept the electric powertrain involved significant changes to the rear of the chassis

BELOW This year’s GCK Thunder was powered by an advanced sustainable fuel that reduces race GHG emissions by at least 65%





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Back to the future in World RX

IN a separate strand of GCK's Dakar plans, the outfit is also making its return to the World Rallycross Championship in 2022 as the discipline switches to all-electric cars at the highest level.

But, while the Dakar programme is all about developing technologies for industry outside motorsport, the team's World RX challenge will be fitted with a homologated four-wheel-drive electric kit, developed by Austrian firm Kreisel.

GCK is using the rallycross project as a marketing and communication tool for its GCK Exclusiv-e company, retro-fitting electric powertrains to existing vehicles. As such, it will run an all-electric Lancia Delta in World RX 2022.

The World RX kit will feature a 250 kW motor on each axle, two inverters and 52.65 kWh battery, developing 500 kW (680 horsepower). Teams will fit the kits into existing steel-body cars, some that have already competed in World RX and some that are new builds for purpose.

The first round of World RX 2022 – which also features changes to the sporting format – is set to take place in Sweden in July to give teams time to build the new cars. **RT**



ABOVE & LEFT The Kreisel Electric RX kit will underpin the Lancia Integrale, as it will every other car on the 2022 World RX grid



It's clear that for a totally independent effort, this is a high-investment project. But it's not a flash in the pan. Nor is it just about a grand ambition to compete in the world's most challenging endurance race.

GCK is using its cross-country activities as a test bed – as motor racing has for decades at manufacturer level – to improve its components, created in-house within the GCK group, to be used in commercial industry.

None of the powertrain components are fully signed-off for the 2024 effort yet, because perfecting them in the time available is key to their future implementation in retro-fitting the concept into heavy-duty industry scenarios. Such as, for example, the snow-moving machines in the French Alps near group owner Chicherit's home.

"We need a fuel cell which is not



“The final target is clear: to be the first team to fight for the win with a zero-emission car”


existing in the market at the moment with high power,” he says. “Every component that we will use in motorsport is exactly the same we will use in the industrial business. Motorsport is the laboratory for our industrial activity, and we test and prove the reliability during such a big, complicated race as the Dakar. Then we can copy and paste what we have in the race car into our industrial business.”

Steep learning curve

That learning process began in earnest this year with the GCK Thunder. Chicherit set top 15 times despite six years away, while the team found their feet working on the gruelling event in harsh environments and collected data on the terrain that will only help

with their efforts when they return next year. Then it will run the e-Blast H2 for selected stages of the Dakar for the first time, in year four of GCK’s five-year plan to go hydrogen-powered racing in 2024.

“We are in the learning phase with the team, to bring the team as fast as possible to the top level to be able to win. You need the right team, driver and co-driver, and the right car. If you don’t have all these items, you will never win,” concludes Lesonneur. “The target [this year] was to collect data but also to perform, to show that GCK Motorsport is on the way to being one of the biggest teams in rally-raid in the future.”

It will be a steep climb to achieve that target, with several other hydrogen efforts in the works elsewhere, and the might of Audi, Prodrive and Toyota currently topping the times in the Dakar as it is today. Nevertheless, GCK is at the forefront of a brand-new era for motorsport. If it achieves its targets, it could be right up there with the biggest David and Goliath stories in motor racing history. 

ABOVE The e-Blast H2 perfectly captures the spirit of the Dakar’s energy transition plan

OPPORTUNITY KNOCKS



Does the rules reset for 2022 offer a chance for giant-killing feats? **Sergio Rinland** looks ahead to judgment day

IT'S a defining moment for Formula 1. We have heard plenty from the new regime about their ambition to improve the racing. Now, finally, we will get the opportunity to see the rule-makers actually test their ideas with the design of the new cars, rather than the traditional method of second-guessing how designers will interpret the rules and hoping for the best.

Now, at last, we have designers and engineers with current F1 experience writing the rule book. Better still, they have been able to test, through simulation, the consequences of those changes. It makes for a far better chance of the new regulations achieving the outcome they have been designed for.

Even though the 2021 season will go down in history as one of the most competitive and dramatic of all-time, thanks to the efforts of Lewis Hamilton and Max Verstappen, it remains a fact that fighting wheel-to-wheel and overtaking in the traditional way has been virtually impossible.

The new regulations will try to amend that but, 'just in case', the Drag Reduction System (DRS) has been left as it is...

I used to love it when a rule change came along. Such upheaval has always presented an opportunity to leapfrog the opposition if you were as good as you believed you were!

In those days, the design and build of a new car was a six to eight-month exercise. Nowadays, the process takes more than a year. That means the teams with bigger resources should still be ahead, so don't bank on the pecking order changing that much.

It took many years for Red Bull and Honda to claw back the advantage with which Mercedes entered the hybrid era in 2014. That period coincided with enormous progress from McLaren and mild improvement from Williams, as well as the stagnation of Ferrari.


Will the new regulations allow that scenario to change? Will McLaren get up there with Mercedes and Red Bull? Will Ferrari finally get it right? Bearing in mind that the power unit will remain virtually unchanged, it is all about whether the car designers and aerodynamicists can understand and work the new regulations better than the opposition in order to pull a surprise.

In my day, that was a possibility. We had less tools at our disposal, so whoever could 'see the air' better, would start with an advantage. We could be more creative, because the rules left a few grey areas to exploit. We didn't have to ask the FIA if our idea was within the 'spirit of the regulations'; we just did it and argued later.

Today, the regulations are written with the help of lawyers. The 'FIA virtual team' will leave fewer grey areas to explore, so pulling a 'surprise' will take months and months of simulation, CFD and wind tunnel testing, accelerating the convergence to the right solution. In a way, today it is a bigger challenge to make a difference than it was in my era.

Today, hundreds of engineers work on the problems, instead of only a handful of them having to use more of their imagination. Today all design decisions are based on data, data and more data; everything is tested to the 'nth' degree with all kinds of variations and interactions, basically combining 'everything with everything' thanks to very powerful simulation tools – the virtual world does not leave many imponderables!

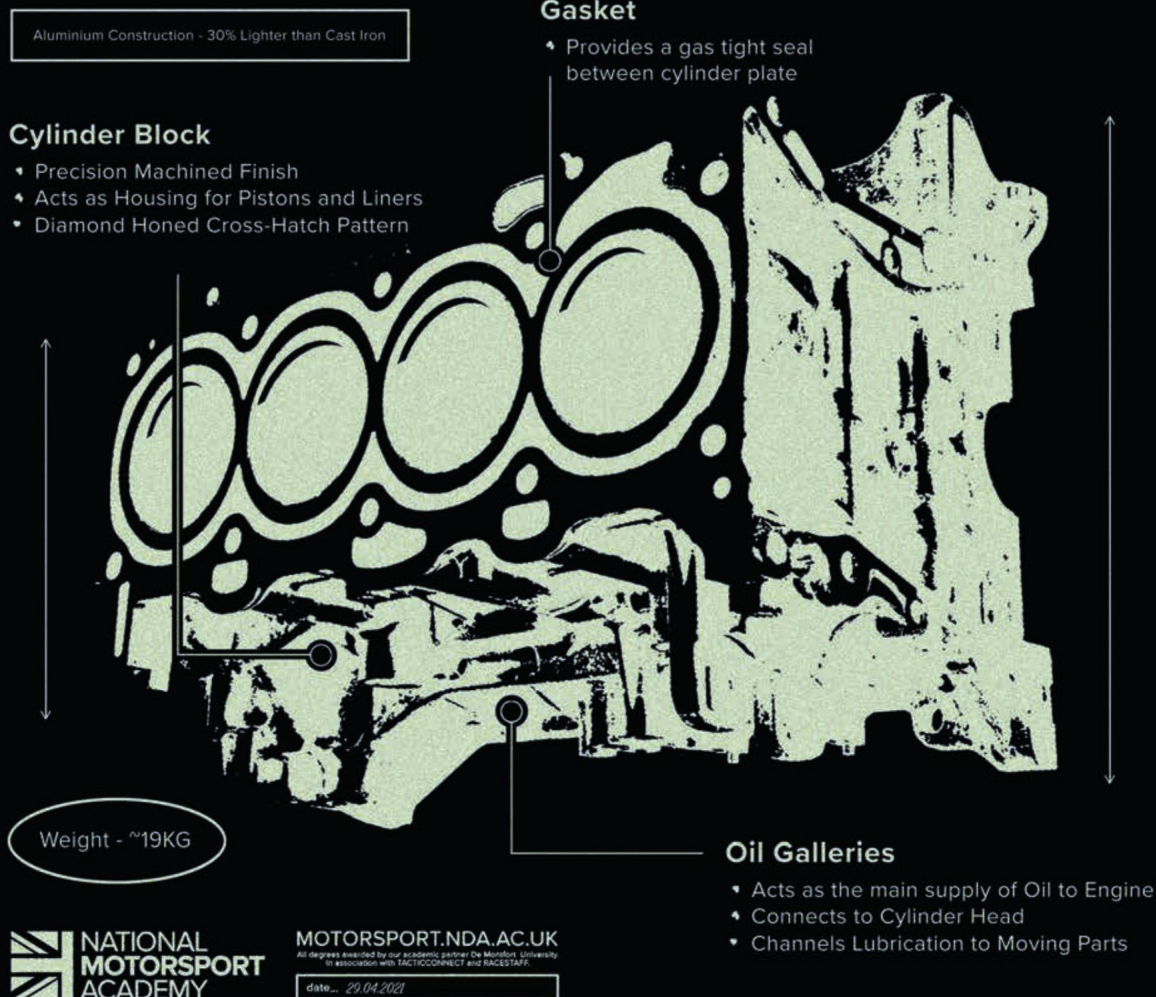
According to reports, the 2022 cars will rely more on ground effect than the wings for downforce, hence reducing the wake behind and allowing wheel-to-wheel racing without losing as much downforce as before. The front wing has been designed not to help the underbody and rear wing, but with an eye to minimising the harmful wake behind the car.

Will those changes be enough? Judgement day is only weeks away: I cannot wait to see! 

BELOW Never before have the rule-makers created the car they want to see teams design, then simulated the likely ways in which teams will seek to circumvent the rules



Photo courtesy of F1



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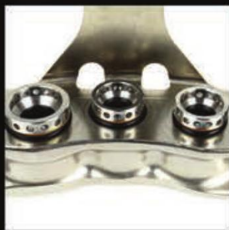
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