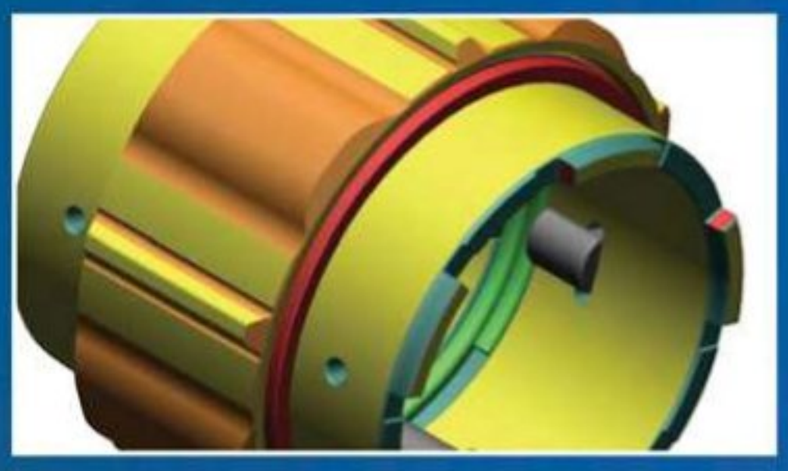
Leading-Edge Motorsport Technology Since 1990

Racecar engineering™

March 2012 • Vol22 No3 • www.racecar-engineering.com • UK £5.50 • US $12.50



Xtrac IGS

How gearbox company developed seamless shift

Aston Martin GT3

V12 power for the discerning gentleman driver

TC2000 gets radical

2.7-litre V8 motorbike engine set for South America

Toyota TS030

Designing the high-tech hybrid

9 770961 109098 03

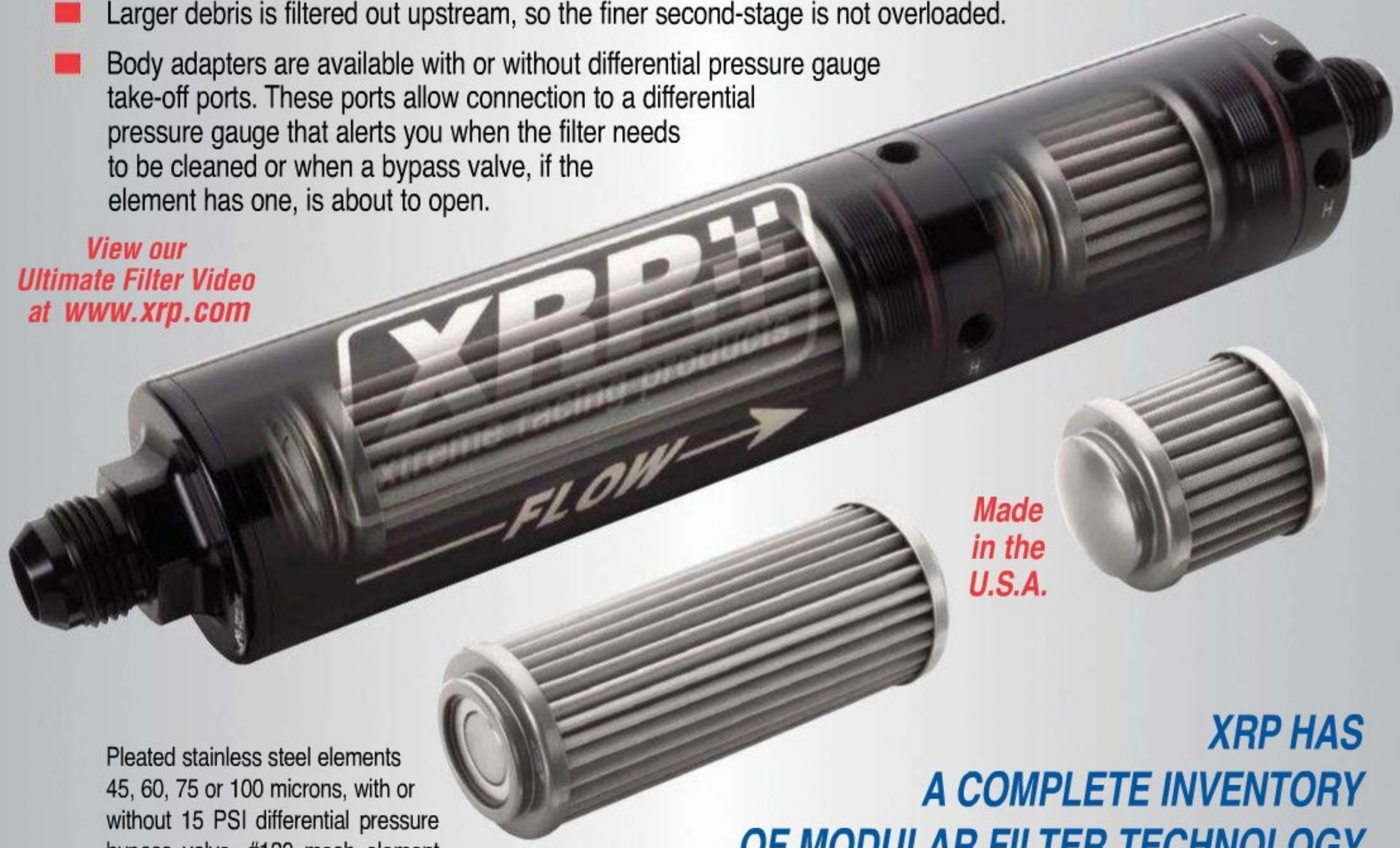
THE NEW MULTI-STACK

THE ULTIMATE IN STAGED FILTRATION, XTREME PROTECTION AND HIGH VOLUME FLOW

As always, XRP took a great product and made it better. Our modular in-line filters are now stackable, allowing multiple micron filtration ratings. Any number of our long and short elementsand adapters can be assembled in any combination for staged filtration. Sizes -6 through -20; AN or clamshell ends.

- Stack 2, 3 or more body sections, long or short. Combine a variety of filtration rates.
- Larger debris is filtered out upstream, so the finer second-stage is not overloaded.
- Body adapters are available with or without differential pressure gauge take-off ports. These ports allow connection to a differential pressure gauge that alerts you when the filter needs to be cleaned or when a bypass valve, if the element has one, is about to open.

View our Ultimate Filter Video at www.xrp.com



Made in the U.S.A.

Pleated stainless steel elements 45, 60, 75 or 100 microns, with or without 15 PSI differential pressure bypass valve. #120 mesh element available for suction applications.

XRP HAS A COMPLETE INVENTORY OF MODULAR FILTER TECHNOLOGY FOR A VARIETY OF RACING APPLICATIONS

SPACE SAVERS

AN or Clamshell ends.
Clamshell or threaded bodies.
10, 20, 40 or 100 micron elements.

SUCTION STRAINERS

#120 mesh filter element.
Metric or AN ends.
Gas or alcohol.

SO MANY OPTIONS

Clamshells on body.
AN or clamshell ends.
AN accessory port for temperature probes, bypass regulators, etc.

Do you have our current catalog, quick-reference product guide and adapter fitting poster?

XRP®

Log on to www.xrp.com for catalog downloads & new product updates

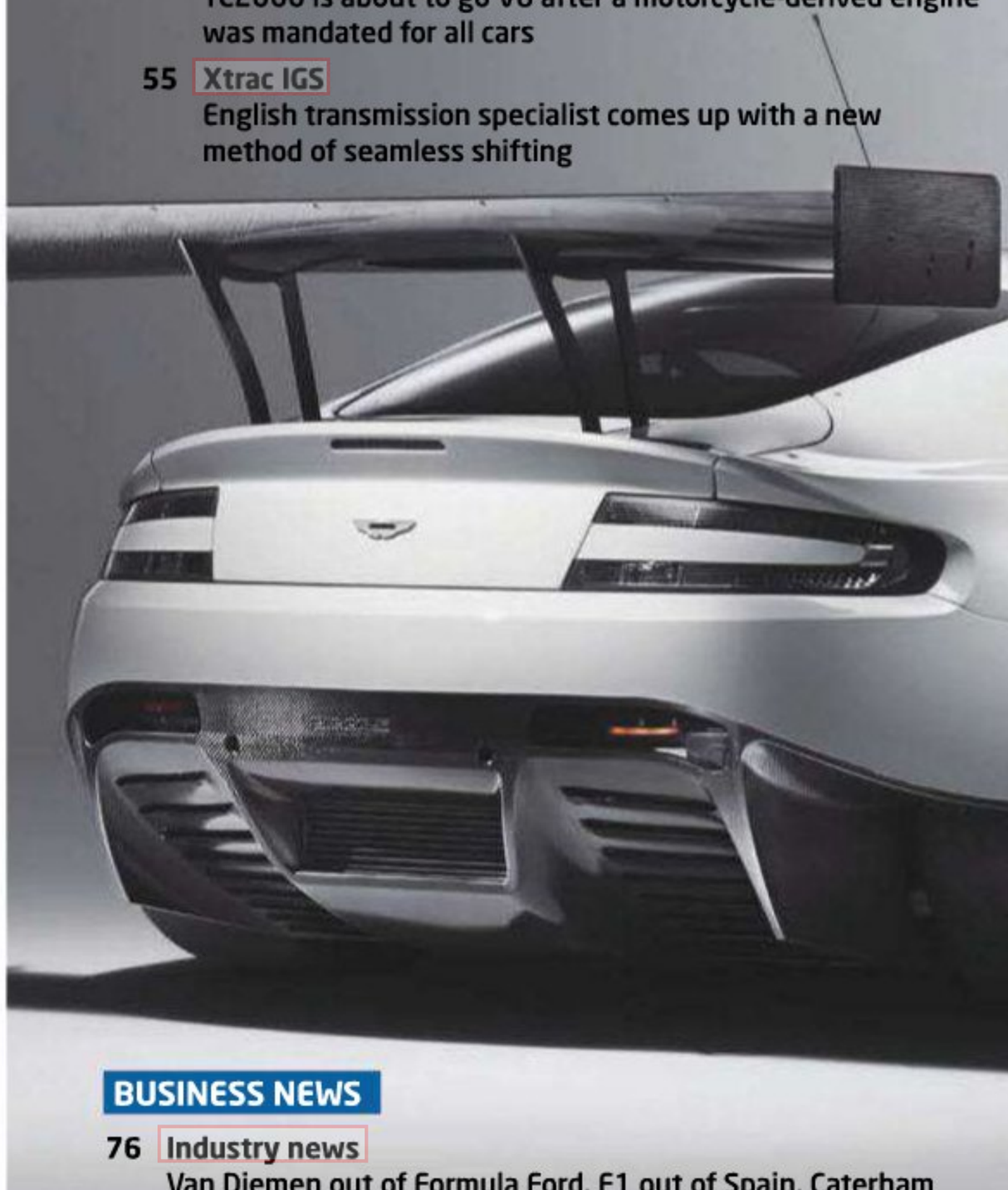
Follow us on

THE XTREME IN RACECAR PLUMBING

IN THE U.S. XRP, Inc. sales@xrp.com
tel 562 861 4765 fax 562 861 5503

IN EUROPE & UK JLS MOTORSPORTS motorsport@lister.co.uk
tel 44 (0) 121 525 5800 fax 44 (0) 121 553 5951

CONTENTS MARCH 2012 VOLUME 22 NUMBER 3



QUALITY AND RELIABILITY

HIGHER FLOW RATES
LESS FRICTION
MORE POWER

With more than 40 years of experience manufacturing high performance racing valves, Supertech utilizes the finest material and design to make available the most durable, high performance racing valves on the market today. Supertech valves are forged, CNC machined, and hand polished for strength and reliability.

All Supertech parts are measured against the strictest tolerances in the industry and utilize finite element analysis, enabling us to provide a high performance product, without sacrificing durability. Regardless of your high performance needs, Supertech is the best choice for you if quality, durability and performance are vital to your needs.

SUPERTECH
3580 Charter Park Dr. San Jose, CA. 95136 USA (408) 448-2001
www.supertechperformance.com

FIA rules KO

Rules are there to be bent, but how much is a bend?

Sir Joseph Whitworth was one of Britain's most important engineers. He studied under Maudsley making machine tools before setting up on his own. Whitworth's long list of credits includes making guns that shot further and more accurately than anyone else, developing a method for making flat surface plates and, of course, developing the first standardised and interchangeable system of screw threads that still bear his name to this day.

Whitworth's core concept was accuracy in measurement, which is what we would term today 'enabling' technology. It is no exaggeration to say that Whitworth moved engineering forward by a degree of magnitude in accuracy.

It is, I believe, still a general rule that technology advances by first improving standards of measurement and accuracy. I did a modest research project with a Formula 1 team some years ago looking for mathematical improvements in their pit stop strategy. After analysing data from previous seasons, it became clear that simply increasing the measurement resolution from hundredths of a second to milliseconds would not only cure accumulation errors but instil a general philosophy of increased accuracy.

Usually at this time of year I look in earnest at the next season's FIA F1 Technical Regulations, and it occurred to me to apply Whitworth's rule to that excellent and sometimes entertaining read. We all know rules are to be bent, but how much is a bend? No limit is absolute so what is the tolerance allowed? My attention was thus drawn to this:

3.15 Aerodynamic influence: ...any specific part of the car influencing its aerodynamic performance... must be rigidly secured to the entirely sprung part of the car... must remain immobile in relation to the sprung part of the car.

Which should presumably rule out winglets mounted on unsprung wheel carriers, or did the rule makers actually mean to say:

...must be rigidly secured to the entirely sprung part of the car if they are mounted on the sprung part of the car, or must be rigidly secured to the entirely unsprung part of the car if they are mounted on the unsprung part of the car.

Which would allow winglets, you tell me?

"Reasonable and intent are both subjective weasel word hostages to fortune"

My favourite oddity for many years has been within the engine specifications:

5.1.5 All engines must have 8 cylinders arranged in a 90° 'V' configuration and the normal section of each cylinder must be circular... The sealing interface between the moving valve component and the stationary engine component must be circular.

'Circular' is demanded but specified without engineering tolerances. It is impossible to create a circular anything and measurements would show no cylinder bore or valve seat as circular but as holes and edges with measurable deviations from circular. I found three other untoleranced references to circular in the rules.

The same problem applies to the untoleranced demand for an exactly 90-degree V configuration. Rounding to 90 degrees would presumably then allow Vs from 89.5 to 90.5 degrees to be quibbled at will, even though the FIA Technical Working Group fully understands engineering tolerances as the rules quote them later eg

5.3.2 Cylinder spacing must be fixed at 106.5mm (+/-0.2mm).

And further oddities abound:

5.5.1 The only means by which the driver may control the engine torque is via a single chassis-mounted foot (accelerator) pedal.

WRi2

By the time cars get to scrutineering it is too late, the damage is done

Now, forgive me for being picky but, if the engine is in gear, then a dab on the brake pedal will 'control the engine torque', albeit only in a damping direction, but still clearly not via the single chassis-mounted foot (accelerator) pedal. One suspects the rule makers actually meant to say:

5.5.1 The only means by which the driver may control the engine torque demand is via a single chassis mounted foot (accelerator) pedal.

After all, they use 'torque demand' elsewhere in the rules.

Suspension also seems a moot point:

10.2.1 With the steering wheel fixed, the position of each wheel centre and the orientation of its rotation axis must be completely and uniquely defined by a function of its principally vertical suspension travel, save only for the effects of reasonable compliance which does not intentionally provide further degrees of freedom.

Reasonable! That scourge of the law courts. Who defines reasonable? The rule maker or the rule taker? Your own team or another team with an axe to grind? Intentionally! Ouch. The base of criminal law: 'Was there an intent, m'lud, to commit compliance? Ho no, m'lud, we only 'ad compliance by h'accident. The suspension just 'appened to collapse the 2mm we needed to stall the h'aero.'

And does one ever know what someone's intent was? 'It was not me intent, m'lud, to gain advantage on h'a yellow flag when I h'asked the driver to crash...'

'It was not my intent to defraud Ferrari, m'lud, when me trouble 'n' strife popped down to t'copy shop wit' car data books like...'

Reasonable and Intent are both subjective weasel word hostages to fortune and, of course, should never appear in any technical engineering document. Whitworth would not have been amused...

Accelerate Your Business

Rottler & Roush Yates announce partnership with delivery of the Rottler F69A CNC Block Machining Center to Roush Yates Performance Engine Group in November 2011.

"The F69A takes us to the highest levels of technology in block machining!"

– Doug Yates

ROUSHYATES

Rottler F69A
Multi Purpose
Machining Center

"When we learned of the Rottler F69A's capabilities we knew right away this was going to be a major component to take our production to the next level. The addition of the F69A will significantly improve our through put in the shop by cutting down set up times, eliminating the need for multiple machines, and the need for us to send blocks to our other facilities for separate operations. In addition to the time savings, the versatility will allow us to move between different block types quickly, allowing us to meet the varying needs of our customers while providing consistent quality."

– Jon Giles, Roush Yates Performance Engine Group General Manager

ROTTLER
THE CUTTING EDGE

8029 South 200th Street Kent, WA 98032 USA +1 253 872 7050
1-800-452-0534 www.rottlermfg.com
www.youtube.com/rottlermfg www.facebook.com/rottlermfg
email: contact@rottlermfg.com

Right place, wrong time

Sam Collins on the state of the motorsport show scene

From the moment I told people that I would be travelling on to Indianapolis after the PRI show, everyone I spoke to was keen to hear what I thought of IMIS.

IMIS stands for the International Motorsport Industry Show, but really the first word of that is aspirational at best, and it would be more accurate to call it the Indianapolis Motorsport Industry Show. The new kid on the trade show scene is really a regional show rather than international, as the name claims. Indeed, of all of the exhibitors, fewer than 15 were from outside the USA. This was made painfully clear by the very nice, but ill-informed lady at registration who asked me which state England was in... Indeed, the registration form was not exactly geared up for those from outside the USA. But being a regional show is not always a bad thing, especially if that region is Indiana.

Having said that, among those walking the congested aisles were some very senior figures in US motorsport, making attendance worthwhile for the few high technology firms exhibiting. As you might expect, the bulk of exhibitors were focussed on the large and varied circle track and drag racing markets local to Indianapolis, but at least one British firm secured some very high level meetings that it would have otherwise not have achieved.

For those who had attended the PRI show a few days earlier, there was not much new to see, but for those who had not been in Florida, there was really quite a lot, and that is really the problem with this ever-increasing annual spate of shows over just a few winter weeks. The treadmill starts with the small but very high end PMW Expo in Cologne, Germany, which has pretty much cemented its place on the calendar as a must-attend industry event, though the gala awards bash has seemingly lost a lot of its credibility in the last two years. That, though, doesn't stop everyone still turning up for the food, networking and endless beer on offer.

Some people go to SEMA after that, but it's not really a motorsport show, so the next major happening is PRI, which never disappoints and, although Orlando is an air-conditioned, soul-less, artificial purgatory with a pleasant climate, it is really very good for networking. But another show just a few days afterwards is a bit too much for European firms, especially with Autosport International just five weeks later and the small matter of Christmas and New Year in between. The long and the short of it is that there are just too many shows in too short a space of time.

Whilst the brand new convention centre that hosts IMIS is far and away the best venue for any of the trade shows and there is ample cost effective (and nice) hotel accommodation nearby, Indianapolis in December is a less-than-inviting place with sub-zero temperatures and a bleak appearance. It is also not an easy place to get to, with few, if any, direct flights from Europe.

I know Birmingham, England in January is not much better, but Autosport Engineering is well established as a crucial networking event.

IMIS certainly has its place. It is not a bad show by any means. In fact, it is a very good show (and you can quote me on that) but I think it is held at the wrong time of year. Perhaps it would be better placed early in the month of May, when there is a real buzz about the town, with the impending 500-mile sweepstakes. My feeling is that if IMIS wants to truly be international then it has to move to a date more suitable for those from overseas. May is the logical month and, were it to move to then, companies would be falling over themselves to attend. So I implore the organisers to move the show to May and really reinforce Indianapolis' claim to be the world centre of hardcore racing technology.

"I implore the organisers to move the show to May"

Indianapolis has a lot going for it as a venue for a motorsport technology show, it just needs to time it better

"The only big difference between Formula 1 and Le Mans is the mileage target"

Hybrid heaven

Toyota returns to Le Mans, drawing on years of hybrid development and extensive Formula 1 experience to build an innovative hybrid Le Mans Prototype

BY SAM COLLINS

Toyota was one of only two teams in Formula 1 (the other being Ferrari) that built its own car in its entirety, from chassis to engine to gearbox. It was a philosophy the team had from the start and, to achieve its goal, built a vast 33km² factory in Cologne, Germany in which to do it. But when the manufacturer pulled out of grand prix racing at the end of 2009, the facility was left somewhat redundant. Packed full of cutting-edge R and D facilities, Toyota Motorsport GmbH (TMG) could not stay dormant for long and many of the F1 engineering staff stayed on awaiting the next challenge. Soon, other F1 teams were taking advantage of the capabilities on offer, but there was still the desire amongst TMG staff to go racing again.

Then, in October 2011, it was announced that TMG was developing an all new Sports Prototype, and the philosophy of creating the entire project in house would be carried over. The result is the highly innovative new Toyota TS030 LMP1. As an example of just how integrated the project is, 86 per cent of the composites work has been done in house, a far higher amount than on similar cars such as the Audi R18 (composites by Dallara) and the now-retired Peugeot 908 (composites by Capricorn).

FORMULA 1 INFLUENCE

The Formula 1 influence in the TS030's lineage is clear when its design is studied in detail. Many features found on Toyota's TF109 and never-raced TF110 grand prix cars can also be found on the new Sports Prototype, from exhaust exits clearly based on those used on the 2009 F1 car to a steering wheel taken directly from the following year's model.

The design and development programme also owes much to the knowledge built up by TMG in its previous incarnation as the Panasonic Toyota Racing Formula 1 team. 'Really, for us, the only big difference between Formula 1 and Le Mans is the mileage target,' explains Pascal Vasselon, the project's technical director. 'Most of the processes that we put in place for Formula 1 are being used for this project. For example, the aero development process. Whilst the regulations are different on what you can do, the process itself is a direct copy and paste from Formula 1. We start with CFD, then correlate that with scale tunnel testing, then we start to correlate with the full-scale car later on.'

SCIENCE IS SCIENCE

Evidence of this process could be seen at Le Castellet after the TS030 made its public debut in late January. Stains left by the bright green flow vis paint used frequently by F1 teams were all over the asphalt surface of the pit lane.

'At the track we do the same as we did in F1, too. Before the roll out, we did simulations in terms of lap time, suspension characteristics, that kind of thing. We came to [Le] Castellet with damper settings, torsion bar settings and they worked out of the box. It is just vehicle dynamics. It worked in F1 and it worked here. It is a science, and a science is the same in whatever you do,' enthuses Vasselon.

Whilst the methodology of design is pure Formula 1, the budget for car development is not, despite TMG's entire facility being put at the disposal of the Le Mans project engineers. 'We are not running a 24 / 7 wind tunnel programme,' admits Vasselon. 'TMG's tunnels are quite busy with customers, especially those racing in Formula 1, so we had to slot in around that where we could.'

Circuit development time ahead of the car's debut in the Spa 1000kms is very limited, so much of the car's testing has been carried out in component form utilising TMG's R and D rigs. 'Mileage targets are what we work to for reliability, then we look at performance on the rig. We have a policy of doing an endurance test on the rig before running on track. We are targeting 10,000km for the gearbox. In Formula 1 we had a target of 3000km. But it is the same processes, the same rigs and even the same people in many cases.'

UNSURPRISING SUSPENSION

Even some of the mechanical design elements can be traced directly back to open-wheel cars. Whilst Toyota declined to show off the car's suspension at Le Castellet, Vasselon did reveal a little information about the layout. It is, unsurprisingly, a double wishbone set up with pushrod-actuated dampers. 'You would not be so surprised with the suspension design,' he said. 'It is inspired by the F1 cars. Why step backward by doing something different? From a kinematics standpoint we are looking at the same thing.'

It is no great surprise that the TS030 is fitted with Michelin tyres of exactly the same size as those found on the Audi R18. Toyota ran Michelin tyres in Formula 1 for a number of years and Vasselon himself was once the head of Michelin's Formula 1 programme, and spent 16 years as an engineer at the firm. But neither of these were the major reason for choosing the French rubber, according to the former tyre maker. 'I think that if you want to win in LMP1 there are not really any other options. Michelin have won pretty much everything for the last 10 or 15 years.' (Mazda was the last organisation to win Le Mans using another tyre makers products, on Dunlops in 1991).

'We are using the baseline Michelin tyres, with no special things made for this car. At the initial roll out we discovered that we do not need anything special to start with, and can set competitive times on existing tyres. But we may need some different compound development in the future.'

"everything started from looking at the performance of the others"

When Toyota was in Formula 1, Vasselon and his engineers spent a lot of time analysing the performance of its competition and, when the Le Mans programme was still in its infancy, TMG staff attended the Le Mans 24 Hours with the sole intention of gathering data and finding out what the state of the art in Le Mans Prototype design was. 'We analysed what happens at Le Mans - things like top speeds - and with all of this data you can simulate the expected performance of the others. From that, alongside some reverse engineering, you can derive a set of targets for all areas of the car, including things like acceleration and top speed.

'By looking at this data you can even extract some aero efficiency targets, drag targets and downforce targets. We went as far into detail as we could, but everything started from looking at the performance of the others,' admits the Frenchman.

Some of the choices made were for very pragmatic reasons. For example, the driver sits on the left-hand side of the cockpit, which for a Japanese car is unusual. 'It is a question of visibility,' explains Vasselon. 'If the driver sits on the left his visbility to the right is better and to the left it is more limited. At Le Mans you have more right-hand corners than left, so we put him on the left of the car.'

One of the next steps in the car's design phase was to determine the wheelbase. Here the engineers once again fell back on their ample experience. 'Our own experience of high-speed, high-power aerodynamic cars is quite big, so that was our starting point. From there, it is not much use to look at what the others have done as you have your own targets. So to find the wheelbase we did a specific study combining the effect of it on aero performance, aero stability and, for this car, weight.'

POWERTRAIN

Whilst serious chassis design work on the TS030 started in early 2011, the powertrain

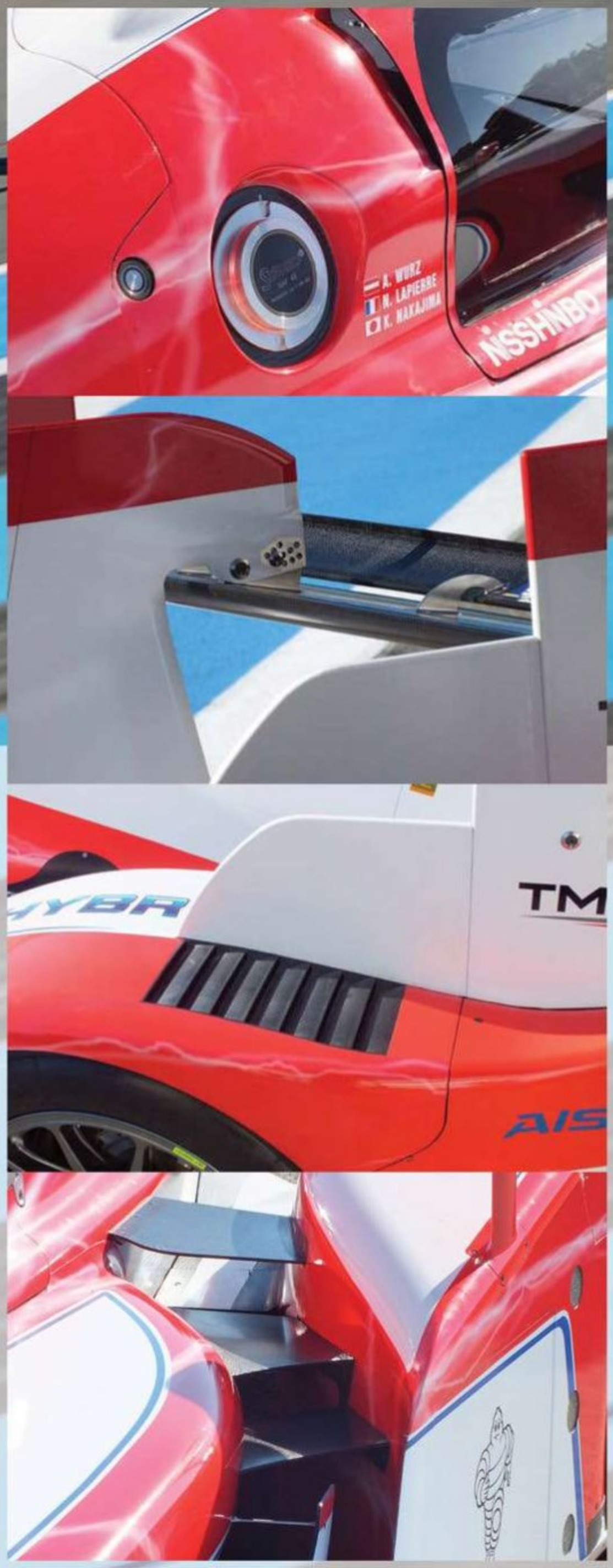
development started much earlier. Almost all of the focus from the Toyota Motorsports Division's hybrid department, headed up by Hisatake Murata, has been focussed on the development of a purpose-built hybrid drive system. Winning the Tokachi 24 Hours race with a hybrid Supra in 2007 was a critical moment. Then Japan's leading racecar constructor, Dome, was contracted to assist in the development of a hybrid system for Le Mans. A prototype was fitted to Dome's open-top S101.5 LMP in late 2008, but the system reportedly weighed 200kg and was too bulky to be a viable solution.

Under pressure from the motor manufacturers, the ACO opened up the premier Le Mans Prototype class to hybrid technology in 2009, but there were few takers. In 2011, the regulations were freed up further and it was enough to make Toyota commit to racing the new powertrain. The critical part of the 2012 regulations are fairly open. stating that: 'Energy recovery systems are free, provided they respect the following rules:

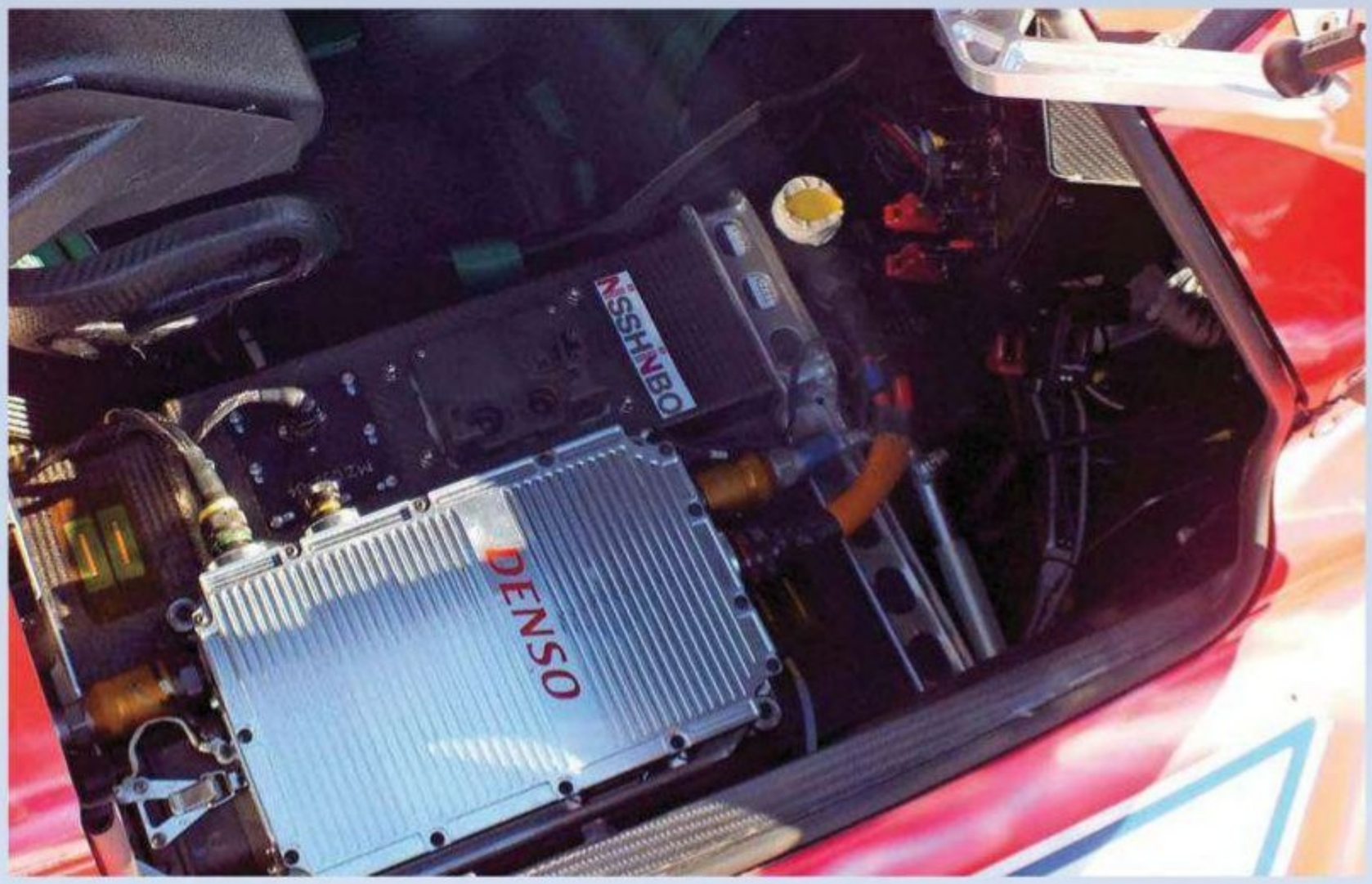
- *Recovery and release of braking energy from the brakes, either on the two wheels of the front axle, or on the two wheels of the rear axle.*
- *Regarding braking energy recovery, only electric systems and mechanical or electromechanical flywheel system are allowed.*
- *Recovery of the energy of the exhaust gasses is allowed*
- *Any other system recovering energy that would be lost without using it, on condition that the measurement of the released energy is possible and proved is allowed.*
- *The car's minimum weight is identical to that of the other LMP1s using conventional powertrains: 900kg.*

CAPACITOR STORAGE

Toyota committed to the project fully and started development proper on the TS030. Whilst Hope Racing was the first hybrid ever to race at Le Mans in 2011 with its flywheel storage-equipped ORECA 01, and Audi has employed an electro-mechanical system on its R18H, Toyota favoured the



Formula 1 details and experience abound on the new Sports Prototype, from suspension design to exhaust exits to some of the aero testing programme. 'We start with CFD, then correlate that with scale tunnel testing, then correlate with the full-scale car,' explains Pascal Vasselon, the project's technical director. Even the track testing methodology is based directly on that of the old Panasonic Toyota Racing F1 team, even if the budget for the whole racing programme is not



Alongside its all-new 3.4-litre Le Mans-spec V8, the TS030 has two hybrid motors, both capacitor based, one located at the rear and the other at the front. Both are currently being evaluated for optimum suitability

electronic route. 'Flywheels were not really an option for us,' explains Vasselon. 'We studied both batteries and capacitors and, at the moment, the best compromise was capacitors. It is a combination of the weight and regulations.'

The last major motorsport programme to develop a capacitor-based storage solution was BMW Sauber with its KERS-equipped F1.09. That car was not a success, but technology has moved on since then.

'Capacitors have high power but low volume compared to a lithium battery, which has big storage but no power,' explains Murata. 'We evaluated both systems [and decided] capacitor is better than lithium battery for our usage. We found that the lithium battery has a big resistance, which causes heat. With this new type of capacitor it is much better and we are already working on better cooling and packaging solutions.'

Weight was a major factor in the decision to use the new capacitors made by team partner, Nisshinbo. The system tested in the Dome was too heavy and, despite the weight coming down substantially, Toyota admits openly that it is still an issue.

'Our hybrid system is huge and heavy,' admits a surprisingly candid Murata. 'We have to keep to the minimum weight of 900kg. Usually without the hybrid system, the car is around 750kg-800kg. The heaviest sub-system on the car is the hybrid, but we also carry ballast.'

Installing the system on the car without compromising the vehicle dynamics was a major challenge for the chassis team at TMG, but a simple solution was arrived at: 'We have [a] passenger in the car! These cars are fortunately two seaters so, on the left is the driver, on the right is the capacitor box,' explains Vasselon, hinting that the two may weigh roughly the same.

'Le Mans Sportscars are ideal to develop the hybrid systems as you have the space to put it in the car.'

One area of the system that Toyota has yet to finalise could create a major difference to the car's dynamics. The new regulations stipulate that the hybrid system can be front mounted, effectively making the car four-wheel drive. However, if the system acts on the front wheels it cannot activate below 120kph, whilst at the rear it can run at any speed.

Both a two-wheel drive

"The best compromise was capacitors. It is a combination of the weight and regulations"

POWER UNDER WRAPS

An all-new engine was developed for the TS030, built purely to race at Le Mans rather than to replace Toyota's existing RV8K race engine. Little is known currently about the 3.4-litre V8, other than it was developed by Toyota in Japan rather than at TMG in Cologne and is claimed to be a substantial technological advance over the versatile but aged RV8K used by Rebellion Racing in its pair of Lolas, as well as by other Toyota and Lexus teams running in Formula Nippon and Super GT. *Racecar Engineering* understands the new engine has a lower crankshaft height (approximately 18mm lower) compared to the RV8K-LM. It breathes through a single 43.3mm restrictor, but performance figures are being kept under wraps for now.

TECH SPEC

Toyota TS030

Class: Le Mans Prototype (LMP1)

Bodywork: carbon fibre composite (TMG)

Windscreen: polycarbonate

Gearbox: Transverse, six-speed sequential (TMG); aluminium gearbox casing (TMG)

Driveshafts: constant velocity tripod plunge joint

Clutch: multi-disc

Differential: viscous mechanical locking unit

Suspension: independent front and rear double wishbone, pushrod-actuated

Springs: torsion bars

Anti roll bars: front and rear

Steering: hydraulically-assisted

Brakes: dual-circuit hydraulic; Brembo monoblock light alloy calipers front and rear

Discs: carbon ventilated, front and rear

Wheels: OZ Magnesium forged
Front - 14.5 x 18in
Rear - 14.5 x 18in

Tyres: Michelin radial
Front - 36/71-18
Rear - 37/71-18

Length: 4650mm

Width: 2000mm

Height: 1030mm

Fuel capacity: 73 litres

Powertrain: Toyota Hybrid System - Racing (THS-R)

Engine: 90-degree V8, normally aspirated

Fuel: petrol

Engine capacity: 3.4-litres

Valves: four

Air restrictors: one x 43.3mm

Capacitor: Nisshinbo

Front hybrid motor: Aisin AW

Rear hybrid motor: Denso

An opportunity to become part of historic motorsport's future

Our aim is to create a high-profile centre of excellence where the finest historic and motorsport-related companies can thrive, share ideas and practical advice in an environment specifically tailored to the needs of the historic car world. Through interaction and collaboration each company will be able to enhance the reputation of the others. Situated just off the A21 and within easy reach of the M25, *Marley Lane Business Park* will become a focal point for the historic and motorsport world.

Flexible development opportunities are available for future tenants, with two units currently available and planning permission already in place for further buildings covering approximately 30,000 sq ft.

If you would like further information on how to become part of this motorsport centre of excellence, contact Site Manager, Jan Boakes on 01424 870600 or jan.boakes@zapaconsulting.com

MARLEY LANE BUSINESS PARK

Marley Lane Business Park
Battle, East Sussex TN33 0RE

system and a four-wheel drive system have been developed for the TS030 and both have the capacitor storage in the passenger compartment. The rear-wheel system is mounted on the transmission casing and has been developed by Toyota group company, Denso, whilst the front motor, which seems to be the more experimental option, has been developed by Aisin AW. Both systems are being evaluated on the car and there is a complex web of trade offs as both have advantages and disadvantages.

'Of course there is a direct correlation between the front motor and the aero balance target,' Vasselon points out. The front motor requires cooling and driveshafts influence the airflow on this critical part of the car. 'We are still investigating. It's a balance between pure performance and weight. We are not going to run at the same weight with the two systems, and it is part of the performance too, as with one of the systems you can either run over weight or with less ballast,' he continues.

The TS030 chassis has clearly been designed to be able to accommodate the four-wheel drive system and the wheelbase and overall weight distribution has taken that into account. 'When we use the rear system we have to put ballast in the front. The ACO does not limit the weight of the hybrid system, but it is difficult to keep to the 900kg, and the ballast is actually very small,' explains Murata.

Toyota is not totally happy with the regulations as they stand. In early drafts the technical regulations permitted energy storage of 1MJ but, in the final regulations issued late in 2011, that figure was halved, largely thanks to Peugeot lobbying.

ENERGY RELEASE

'The final details came late, but the framework of the rules was done a long time ago. We could prepare the car to go in that direction but it did not go exactly where we were expecting it to go,' explains Vasselon, with an air of reluctant acceptance. 'We were in favour of much bigger energy release between corners, and we are a little bit disappointed that we only have 0.5MJ of storage, but we understand and accept the ACO decision. We wanted 1MJ, bigger energy release, bigger impact of the hybrid system on performance and, with our system, we are able to cover a range of energy releases.'

The system has three driver-controlled modes, adjusted by a rotary switch on the steering wheel. Mode A sets up the hybrid system (and one assumes the engine map) for maximum performance, giving the TS030 the ability to easily drop below 3m30 around the circuit at Le Mans, whilst mode C is set for maximum fuel saving, allowing the car to run longer stints. Mode B is a halfway house between both. It is likely that there are other mapping adjustments that can be made to get the best traction from the systems also.

Despite being so new, the Toyota (and ORECA) engineers are already getting used to running the hybrid on track and Vasselon feels assured that the monocoque itself has longevity, even though it is possible that next year another all-new car will roll out of Cologne. 'We could do several seasons with the same monocoque,' he says. 'We improved our correlation in terms of mileage testing with the TF109 during the Pirelli tyre testing programme. We found out it was possible to do very long mileage with our monocoques, so it is still to be decided if we do a new design for next year or continue with this one.'

No one knows how long the TS030 will be racing. Even TMG do not know as the programme's budget is signed off on an annual basis, but the enthusiasm for the project is clear. Toyota Europe turned one of the early TS030 test days into a PR event with a very large number of guests, showing that the car company is full engaged with the motorsport programme. The team, too, feels confident of the car's capabilities. 'Realistically, this year we want to be the fastest hybrid,' smiled Vasselon, in a clear reference to Audi's Sport's new R18H.

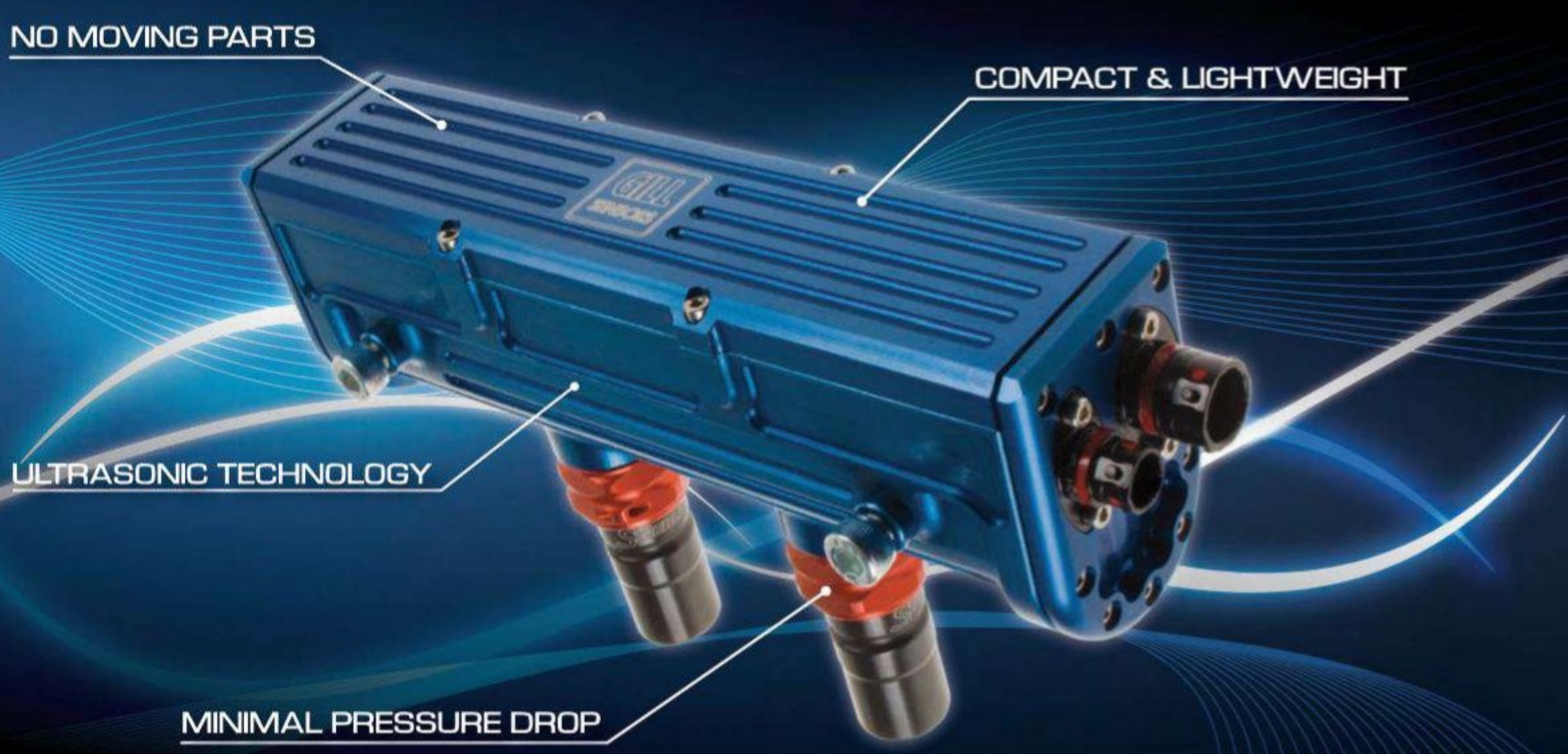
"Realistically, this year we want to be the fastest hybrid"

AUTOSPORT INTERNATIONAL Engineering Show
Autosport Engineering
Best Technical Innovation 2012

Racecar engineering
Graham Jones
Innovation of the Year 2012

PRECISION FLOW ANALYSIS

At last, a solid-state, highly accurate Fuel Flow Sensor designed specifically for use on a Race Car



The Gill **Ultrasonic Fuel Flow Sensor** is lightweight, compact and robust, designed specifically to withstand the extreme levels of vibration experienced on a race car.

The sensor uses our proven ultrasonic measurement technology to detect bi-directional fuel flow rate to 0.3% accuracy in real time. With no moving parts to interfere with the flow path you can be assured of highly accurate data on which to base your analysis.

For more information visit gillsensors.com/flow

+44 (0)1590 613400 · info@gillsensors.com

GILL SENSORS

www.gillsensors.com

DRIVING THE TS030

Left-hand drive seating position is a big change for Wurz, as is the different power delivery of the hybrid engine. Cockpit is a very tight squeeze

'It was cool to drive the car for the first time. Just leaving the garage on the electric power is very futuristic, then when you let the clutch go and the internal combustion engine kicks in it is like an old friend has returned! When we put on the slick tyres I could feel that the car generates a very good amount of grip, so I think we have a good base and I think we can turn this into a really fast car. I am definitely very happy, but my nature is to also be analytical so I know there is still a lot of work to be done.

'Compared to the Peugeot 908, it feels different for many reasons. First of all you are sitting on the left-hand side of the car, not the right, which is a big difference.

"power output is very different, it influences your driving style"

'In the driver seat for the knees and leg positioning, it is quite good – 10mm more than the Peugeot at least – but in terms of space at the top, elbow, shoulder and head space it is much more squashed. I was scared of it at first but, once I had driven the car a bit, I was okay, but there is less space than there is in a Formula 1 car, so you can tell how tight it is.

'When you are operating on the limit, the delivery of torque and power of the diesel at low revs with a turbo is very different to a normally aspirated engine. You drive with power over a bigger band, so not so much torque but a different power shape. With high performance cars you can steer not only with the steering wheel but also with the throttle, so if your power output is very different, it influences your driving style. When you change the driving style, you change the tyres so, like everything in racing, it is a chain of small adjustments, but for a driver it is a big thing.

'Under acceleration you really feel the hybrid system. It is a lot of little horses pushing when you want the power, which is very good. We are still optimising the system and it has caused a few problems with traction, but now the systems are communicating better and we can already see the improvements coming.'

Alex Wurz

PAGID RS

Brake control from green light to chequered flag.

Congratulations to Michael Shank Racing, drivers AJ Allmendinger, Ozz Negri, John Pew, Justin Wilson and the entire crew for winning the 50th anniversary of the Rolex 24 in their Ford Riley Daytona Prototype!

When it comes to brake modulation and control with ultimate reliance, PAGID RS is the choice of winners: in addition to the winning team MSR, numbers 2-6 of the top runners also finished the race on PAGID RS! So did 60 % of the entire field in all classes.
Race winners won't settle for anything less.

www.pagidracing.com · info@bremsentechnik.de
+49 6003 82 910

bt® Bremsen Technik

Four of a kind

With GT1, GT2 and GT4 variants already in the stable, a GT3 version of the venerable Aston Martin DB9 was the next logical step

BY LAWRENCE BUTCHER

One would think that, in the midst of an economic downturn, race series catering to well-off gentleman drivers would find it difficult to flourish. Yet this is exactly what is happening, and the market is awash with competitive GT3 cars, from prestige marques including Porsche, Audi, Ferrari and BMW, to name but a few. It therefore seemed logical for Aston Martin, who have had great success with their range of modern GTs, to get in on the action. The result is the Vantage GT3, a louvred coupé packing a 6.0-litre, V12 punch.

Aston Martin's customer racing programme already

includes the Vantage GT2 and GT4 programmes, so the GT3 was a natural progression for the company. The biggest problem was squeezing the V12 engine into the small engine bay, a problem already faced by the DBRS9, which competed in both the US and Europe in 2006.

'On the road car the engine is high up and far forward, so we needed to address that,' said Aston Martin's chief engineer for GT projects, Dan Sayers. 'We did this by moving the engine further back and down in the chassis. To achieve this we extended the wheelbase by 60mm, so it is in fact longer than both the GT4 and GT2 versions. The result is we've been able to meet our targets.

'We started with the DBRS9, which has a standard crank, valvetrain and so on. The biggest difference with this engine is the valvetrain, which was the weakest link, so we have done a lot of work to develop it.'

BOP REQUIREMENTS

Another big change was the addition of the dry sump system so the engine could be placed lower in the car. Restrictors have yet to be fitted to meet the balance of performance requirements, but Aston Martin Racing is currently working on the dyno to address this.

Heat management issues in the development of the car meant that the team were forced to use side exhausts, but that led to other problems, specifically getting it through the sound regulations. Running the exhausts under the car would not only reduce clearance, but the exhaust would have to run over the diff and the driveshafts, causing heat soak problems. Running the exhausts out of the side mean that coatings have yet to be investigated and, after 2000km of testing, there hasn't been a problem to date.

'The cooling obviously is pretty critical. Given the size of the engine there is not a lot of room in there, though moving the engine back freed up a lot of space for the radiator,' explains Sayers. 'Because the regulations are quite free, you can almost do what you want. Having said this, you still need to get everything homologated, which is a process we are nearing the end of at the moment. It always helps if you approach the governing body early and are up front about things, rather than suddenly turning up with something they are not expecting. Then you can have trouble.'

The rollcage is basically bolt in and is the same one used in the GT2 and GT4 cars. It is not connected to the suspension turrets, thanks to the inherent stiffness of the chassis. The fuel cell has moved from the back to inside the rollcage, and is in the same position as on the now retired GT1 car, which won the teams' World Championship title with French team, Hexis Racing, last year.

The rear suspension was based on what is in the GTE car, and uses a new, lightweight rear frame that re-positions the gearbox and reduces driveshaft angles to help aid durability.

'At the front we now run a bespoke upright (where previously it was a standard road car item), a part we have also carried onto the GTE car,' says Sayers. 'These are forged aluminium. Before, we suffered to a degree with brake lock-off and we needed to address that. It was down to flexibility in the upright, which had to be cured, especially for durability in endurance races.'

Aston Martin has removed the torque tube assembly between the engine and the transmission, and instead rigidly mounted the engine and gearbox and developed a composite propshaft. Not only is this arrangement lighter, but also enabled the development team to move the engine further back in the chassis, helping to shift the weight distribution towards the rear by a phenomenal five per cent.

"The biggest difference with this engine is the valvetrain"

"developed extensively in CFD, and backed up by track testing"

Though the Aston Martin has quite a heavily re-worked engine, the emphasis is on reliability and cost containment

One of the inherent problems in the GTE car is its aerodynamics, and teams running the car at high speeds, especially at Le Mans, have consistently complained about the drag, leading to a lot of work to overcome the problem. The GT3 car was therefore developed extensively in CFD, and backed up by track testing.

'We spent quite a bit of time trying to optimise it, especially in terms of drag, as the road car is quite a draggy vehicle,' says Sayers. 'We have done a lot of work with the arches at the front and in the area of the splitter and front bumper. We have also worked to reduce pressure under the arches using vents. These also help to cool the exhausts, which, as you can imagine, are packaged very tightly.

'All of the wiring and loom design is done in house, while the ECU is from Pectel and we use a Cosworth dash. We have been able to save a significant quantity of weight in the loom alone. One of the things I am most pleased about is the fact that when you take the bonnet off, you look at everything and it all looks very tidy and well engineered.'

DRIVER AIDS

The DBRS9 was notoriously had to drive and did not have the driver aids road car users enjoyed so, with an eye on the expected drivers, Aston Martin produced the new GT3 car with ABS, traction control and paddle shifting as standard. The car still produces in excess of 600bhp, a figure the Grand Am team in America decided was unnecessary in anything other than a professionally driven car, but Aston Martin has used its endurance racing experience to help make the car more appealing to the gentleman driver.

'We have designed it as an endurance car,' says Sayers. 'I know that a lot of our competitors have a big add-on spares package for endurance racing, but we have tried to avoid that. So, ideally, you can buy it and go and race the Nürburgring without having to spend £50-100,000 ($77,400-155,000) on an upgrade package.

'The last V12 had 5000km service intervals, which we know is not enough. All the competitors are increasing theirs considerably, thanks to starting with a good base unit and not doing a lot with them to start with, whereas we have done a lot of work on ours. That 5000km was originally limited by the valvetrain, so we hope now that will increase to nearer 8-10,000km. When people are looking for a car to purchase, running costs are obviously significant, so we want to keep them down.

'With all the new parts, we have tried to make them in a way that can be carried onto the GTE car. Using the same platform makes things much easier and makes parts interchange between series feasible, further helping in terms of costs. In the past we have made components in batches of one or two and that is now changing. It is still not huge numbers, in the region of five to 10, but it makes a difference.'

It certainly seems the Aston Martin engineers have given due consideration to the people they are aiming this car at, and the result is sure to be a competitive, cost-effective racecar in this flourishing and ultra-competitive market. And let's not forget the power of that prestigious badge on the nose.

"The last V12 had 5000km service intervals, which we know is not enough"

TECH SPEC

Aston Martin V12 Vantage GT3

Class: GT3

Engine: road going V12, with uprated valvetrain and dry sump oil system
Power >600bhp
Torque >700Nm

Transmission: Xtrac six-speed sequential with semi-automatic paddle gear shift; limited slip ramp / plate differential; carbon fibre propshaft

Chassis: lightweight aluminium; steel rollcage to FIA safety standards; high-speed onboard pneumatic jack system

Suspension: double wishbone with uniball bearings; two-way adjustable dampers front and rear; optimised geometry for lower race ride height

Steering: hydraulic power-assisted

Fuel system: 110-litre fuel cell to FIA safety standards; twin quick-release couplings

Brakes: six pot front and four-pot rear calipers with ventilated steel discs; manually adjustable front / rear brake bias; adjustable motorsport ABS and traction control

Wheels and tyres:
Front: 12.5 x 18in; 30/68-18 tyres
Rear: 13 x 18in; 31/71-18 tyres

Cockpit: six-point safety harness; adjustable seat and pedal box position; carbon fibre dash; Cosworth display and shift lights; lightweight battery; fire extinguisher system

Body and aerodynamics: Removable carbon fibre body panels and aluminium roof; front splitter; adjustable full width carbon fibre rear wing; aerodynamically optimised bumpers, side sills and rear wings

Weight: 1250kg (dry)

The fortnight before

Former Ganassi chief engineer, Andy Brown, looks at how to practice and qualify at Indianapolis, and what could be done to improve the run up to the 500

BY IAN WAGSTAFF

Apart from the kudos that can be gained, qualifying for the Indianapolis 500 does not have the significance that it has in Formula 1. This is such a long race that it has been possible to do well from anywhere on the grid, as Scott Goodyear proved in 1992, coming from the back to finish second. However, there are so many unknowns about the new DW12 that it may be this year is different. One thing is certain, none of the front runners can afford to be complacent about their grid placing.

Former Ganassi chief engineer Andy Brown: 'Al Unser jr once told me, "the Indy 500 is endurance racing with a difference." Back then, the team's character was tested throughout a month of practice, as much as the staying power of their equipment on race day. This is now less of an issue as the event has been trimmed to one week of practice and one weekend of qualifying, but the teams must stay focussed on their goals. There is still time to become sidetracked and confuse yourself. Indy is a great lesson in patience.'

"If the driver is not awake before the 8am practice, he usually is by the end"

Changes to the track and cars meant that, even prior to this season, overtaking on race day had become difficult and it had become increasingly important to qualify near the front. The apron – the area below the white line in the turns – used to be accessible to the cars at racing speed and people still get misty eyed about the Mears / Michael Andretti battle of 1991, when the two drivers traded the lead in the race, passing each other by using the apron to provide more than one lane through the corners. Fast forward to 2002 and the racing had become more processional, evidenced by the 'spectacle' of second-placed Giaffone not being able to pass a lapped car in order to challenge the leader. Other measures designed to slow down the cars also reduced overtaking. These included artificial drag generators on the trailing edges of the rear wing end plates and a 'drag plate' mounted between the rear wing pillars, or downforce reduction ideas such as removing the flat panels on the inside face of the wheel rims. This increased turbulence in the

wake, further reducing the level of downforce on the trailing car.

'The result of all this is it has been pretty much single file through the turns at Indy in recent years, although the removal of these artificial devices last season resulted in more passing.'

THE MONTH OF MAY

So, what things are to be considered when setting goals for the fortnight that was once the 'month of May'? 'We cannot be certain yet what will happen with the 2012 cars on race day, so track position is important from the start,' says Brown. 'I find Pole Day the most stressful experience in 28 years in professional motorsport

'The first challenge is morning practice, a half hour of green track time for each half of the qualifying draw (the draw is held the day before, simply by pulling numbers out of a hat).

'The first half of the field drawn goes into the first practice session, then the others into the second. The first session starts at 8am. The track has not been open earlier than 12 noon on any previous day, so the colder ambient and track conditions tend to make the car 'loose' [oversteer]. If the driver was not awake before the 8am practice, he usually was by the end!

'You could adjust for these conditions, but when qualifying comes around at 12 noon, you are adjusting back to warmer weather settings. You are also trying to arrange for 'clean air' ie no traffic in front of you, in order to see if you have set top gear correctly (wind speed and direction make a huge difference around Indy). You can gauge when to release your car based upon the position of other cars on track, but there is nothing you can do if a car comes out on track just in front when you have just started a simulated qualifying run. It is too easy to throw it all away in this session.

'When it comes to qualifying, you ideally want an early draw and to go before the track heats up and lap times increase. With three attempts per car per day now allowed, you might as well always take the first attempt.

'An alternative would be to pass up the opportunity of a first attempt, wait until the qualifying line has gone through once and the track opens again for general practice, fine tune car to the conditions and then present it for a qualifying run. This sounds fine in theory but, if someone blows up or has an accident, oiling the track, then you are in trouble.

Engine manufcturers may object to race practice after qualifying, due to short lead times on rebuilds of the practice engines

THE FAST NINE

The plan is to be amongst the fastest nine by 4.30pm. You do not need to have a car that is fine tuned enough for the pole for your first qualifying attempt, just one that's good enough for the top nine. If you think your first attempt did not produce a fast enough time, the option is to practice again once the first round of qualifying is over, and then attempt to qualify again. Or attempt another run without practice if the track never becomes available between qualifying runs. You had better be sure though, for although you are allowed three attempts per car, once you present for another qualifying attempt, your existing qualifying time is deleted.

'If you are in the Fast Nine session, again you might as well take the first attempt rather than wave off and wait until 6pm, especially as in the Fast Nine session you do not have to lose your existing time should you decide to run again.

'Second day qualifying is for those that did not make it through on day one, but those who did pass the test will take advantage of open practice time during the day to do some much needed full tank work. This is another reason why it is essential to qualify on day one.

'The only practice session left after qualifying is over is 'Carb Day'. This is the race warm-up session, held two days before the race. The track is only open for two hours, and most teams try to limit their mileage. The cars are now in their intended race trim, having been fully rebuilt with fresh components.

TYRE STRATEGY

'The correct use of tyres during the run up to the race is crucial. How many sets should be saved for qualifying? In addition, how many should be used on 'dummy' qualifying runs, leaving how many for race set-up work?

"you ideally want an early draw and to go before the track heats up"

Rototest

www.rototest.com

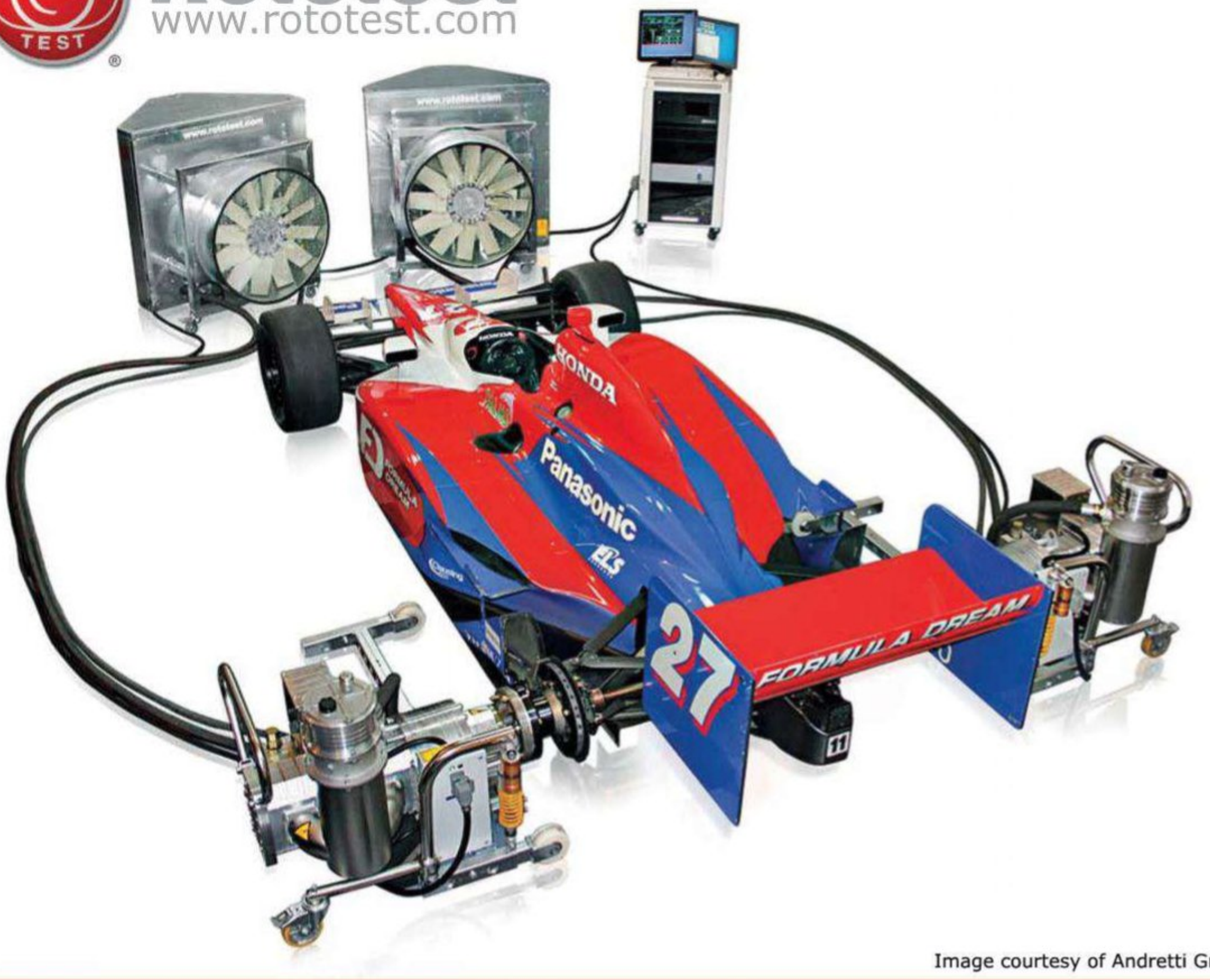


Image courtesy of Andretti Green Racing

Powertrain measurements **Redefined**

Flexible & Productive (1Q operation)
Complete vehicle testing with engine dynamometer accuracy
Considerably more cost-effective than traditional test systems

Dynamic & Regenerative (4Q operation)
Full drive cycle capability with inertia simulation
Cutting edge test system for hybrid/electric car development

'Remember, you are allowed three qualifying attempts per car per day. If you make the Fast Nine, any qualifying attempts in this session will see you granted another fresh set of tyres, but practice runs in this session do not. In addition, you will also need at least two sets of stickers (allow three) for the early morning session before qualifying, and some sets for further practice qualifying runs should you decide that the first attempt was not good enough.

'For Pole Day you might want to allow at least nine sets of stickers. I heard of some teams (especially those expected to get into the top nine) allocating 10 sets. My last year's article on race strategy noted that it is not unusual to hold back 10 sets of stickers out of the total allocation of 33 sets for use in the race. And so for a front runner, it is imperative to qualify on day one, as the above means they will only have 13 sets left for the first week of practice.

'All qualifying runs have to be made on stickers for, even after one heat cycle, the rubber loses a significant amount of grip, such that it is impossible to set the car up correctly. Alternatively, you can scare the driver with one 225mph-plus moment after another running used tyres, so that when you do get back on fresh rubber his head is no longer in the game.

'So, having used three sets of stickers on 'Fast Friday' and possibly as many as nine sets on the Saturday, you now have maybe 12 sets of tyres lying around with just one qualifying run – seven laps – on them. These are just too many laps to make them useful race sets, although I would usually hold back and mount one or two of these sets for the race in case of emergencies – having a seven-lap old set of rubber is better than having no tyres available.

"Be careful not to psyche yourself out of the game"

QUALIFYING SPEC

'With only two sets per day to play with in practice, it is still possible to take an early look at qualifying spec. One strategy is to start when the track opens at noon with the car in qualifying trim, try possibly two practice qualifying runs, and then go back to the garage to convert the car into race trim. It is good for morale to set a good time at the start of the session, which will stay near the top of the charts for most of the day – but the reverse is also true of course. Be careful not to psyche yourself out of the game.

'The weather is always a factor at Indy in May. More often than not, at least one full day of practice will be lost due to rain, in which case two sets per day can quickly become six sets in one day, and you should have a strategy in place for this. Loss of a day or more has become more critical with the shorter timetable. However, the current schedule may be even more of a detriment to the 2012 race owing to the introduction of the new car. In initial testing on ovals it has proven difficult to find a decent set up unless significant downforce levels have been run. The associated drag then makes the car too slow – politically at least. Add to this the fact that very little of the oval testing has been conducted with more than one car running at a time.

'The DW12 has been lapping since last summer and while, as I write, new components have recently been introduced, they have yet to be run on an oval.

'The situation is made worse because Indy is the first oval race on the 2012 schedule. The new components should help the oval car, but the only time that a significant number will run together for the first time could be the opening week of practice for the 500. This is unless a mooted Indy Open Test takes place before then. One other way to improve the situation could be by arranging for 'race practice' at Indy after qualifying.'

The old format of two weeks of practice used to allow teams that qualified on the first weekend time in the second week to work on race practice – invaluable with the new car – but two weeks of practice may be deemed too much in this cost-conscious era. Would the second week really cost the series more than the damage that could be caused by a terrible race event due to a field of ill-handling cars?

'If two weeks of practice is too much, why not open the track for race practice on the Tuesday / Wednesday after the qualifying weekend, still leaving a full day for race prep before Carb Day?

'The engine manufacturers may object to race practice after qualifying, as many of the practice engines will have to be turned around for use at Milwaukee the week after the 500. In that case, reverting to two weeks of practice may be the only viable option.

'Race practice after qualifying would see the cars running in weather conditions closer to race day itself. An early test in cooler conditions can over-emphasise the grip level that will be available in race conditions. After a week of qualifying practice, and a weekend of qualifying, the track should be in good shape to perform race practice.'

PERFORMANCE SUSPENSION

IMPERIAL RANGE

METRIC RANGE

TENDER | HELPER

OFF ROAD

COIL SLEEVE

BUMP STOPS

PERFORMANCE PERFECTED

- Ultra-Lightweight for Reduced Unsprung Mass
- Maximum Travel in Combination with Smallest Block Heights
- Exceptional Block Resistance and Durability
- Precision Tolerances-The Tightest in the Industry
- Precision Parallelism and Squareness Tolerances, Maintained Under Loaded and Unloaded Conditions to +/- 1 Degree
- Lowest Side Loads and Load Centres Precisely Aligned to the Spring Axis
- Highest Linearity and Guaranteed Rate Consistency Within 2% of Advertised Rate
- Each Spring is Individually Tested and Rated

Eibach produces the finest race car springs in the world. Period. When other springs sag, or need frequent replacement, the top race teams inevitably turn to Eibach and wonder why they didn't choose us in the first place.

But don't just take our word for it, actions speak louder than words. Our springs have taken teams to 2011 championship victories and podium finishes at Le Mans, BTCC, CTCC, DTM and WRC.

Eibach: The Choice of Champions.

Eibach SPRINGS

United Kingdom
Eibach UK | Phone: +44 14 55 - 28 58 51 | eMail: sales@eibach.co.uk

eibach.com

Collective thinking

A hybrid racecar designed and built from scratch in six months to showcase the capabilities of a group of French motorsport companies

BY SAM COLLINS

One of the few parts to come from outside the Magny Cours area was the EV powertrain from TMG in Cologne. The bespoke 1.0-litre engine is by ORECA

The co-operative movement can be traced back to Scotland in the 13th century. It has lasted to this day and, in its latest incarnation, has seen a new competition car designed and built in a very short time.

The *Association des Entreprises du Pôle de la Performance de Nevers Magny Cours* (PPNMC for short) was set up to promote the expertise and capabilities of the companies based around the Magny Cours race circuit in France. It was little known until it showed up at the PMW Expo in Germany with a striking new racing school car.

'This car is the first thing produced by PPNMC,' reveals Bertrand Decoster, president of the co-operative. 'Our organisation consists of 24 companies, employing around 400 people. We needed to do something to promote our region and what we can do here. So we decided to design and build a new car.'

Within six months, the assorted companies created a car for the local racing school from scratch. The design phase took just 12 weeks, fabrication nine more and the final assembly one month. What makes this even more impressive is that the car is a hybrid.

'We realised that we had to stay ahead of the future, but full electric racecars have already been done, so we decided to go with a hybrid.'

"We want to export this business model around the world"

Despite having considerable experience in all areas of competition car design, the member firms of the PPNMC had no real working knowledge of electric car powertrains, so they found a willing partner in Toyota Motorsport Group (TMG) in Cologne, Germany. The German-Japanese outfit supplied an EV powertrain with 200kg of batteries, and very good performance. But, as a racing school car, it also needed good range, so the PPNMC companies developed a range extender hybrid system. ORECA built a bespoke, 1.0-litre, three-cylinder engine, and the combination

Overall design philosophy was for a reasonably big, closed two seater, but current Formula 1 thinking is clearly evident in the front-end aerodynamics

gave the car the capacity to run all day.

'We needed something that linked Magny Cours with the rest of the car.' continues Decoster. 'If you look at the car, the styling takes some cues from Formula 1 – things like the wings, the end plates and you have bargeboards, too. But of course this is a closed two seater. One of the demands the school placed on us was that the car should have two seats, be reasonably big, but not too big, and be able to be used when it was cold or raining.'

To deliver the car, the co-operation started with some former rivals, such as Ligier and Mygale, teaming up to develop the chassis and bodywork.

'Six core companies played a major role in this car: ACE did the aerodynamics; Ligier the tube frame chassis; Mygale the composites; ORECA the internal combustion range extender engine; Sodemo the electronic integration and Danielsson Engineering the foundry and casting work,' explains Decoster. 'Developing the hybrid system also gave us technology transfer back to Magny Cours, and about 10 other companies from Magny Cours have participated with products and supplying parts.'

The target sales price for the new car, dubbed the Noao, is 125,000 euros (£125,050 / $162,700), but there is more to the project than just the car. 'It can't just be a standard sale of cars, which are just more expensive than a normal car, we want to prove that there is a new generation of corporate customers, and we want to establish the business model of a more futuristic racing school car. We want to export this model around the world.'

The Noao, which made its first track tests in late November, weighs in at just shy of 1000kg and its hybrid powertrain puts out around 260bhp.

Decoster and the others hope the car will be capable of lap times in the region of a Formula Ford or even a Formula Renault.

TECH SPEC

PPNMC Noao

Class: racing school

Wheelbase: 2600mm

Track (front and rear): 1575mm

Length: 4220mm

Width: 1800mm

Height: 1170mm

Weight: 990kg

Max speed: 200kph

Range: 100km

Recharge time: one hour

Nominal output power: 90kW

Peak output power: 167kW

Nominal torque: 220Nm

Peak torque: 400Nm

Batteries: three lithium-ion, nominal voltage ~ 500V DC

Limited slip differential gear ratio: 2.9

Engine: three cylinders, 998cm3, direct injection

Maximum power: 50kW

Generator nominal power: 54kW at 4500rpm

Chassis: tubular fabricated in high quality, aircraft-specification tubing,TIG welded with epoxy painting

Bodywork: glass fibre and honeycomb sandwich composite

Wings and hard top: pre-preg carbon composite

Suspension: double wishbone with spring dampers, pushrods, rockers and anti-roll bars

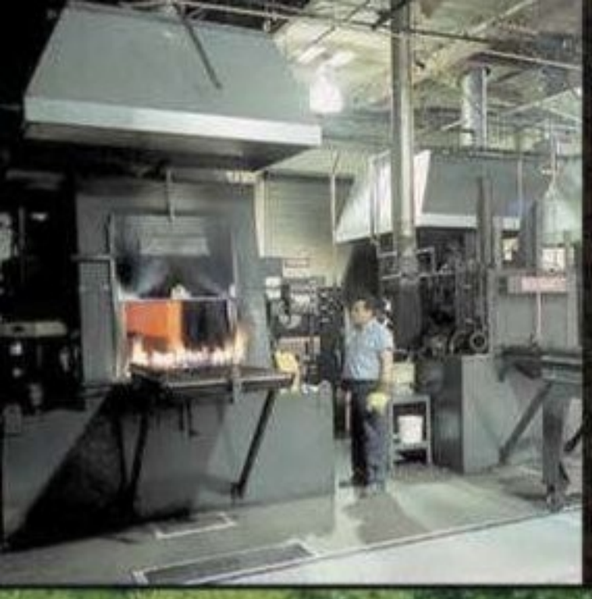
Uprights: aluminium castings

Brakes: four 280mm ventilated brake discs; four-piston calipers; dual braking circuit and brake balance adjuster

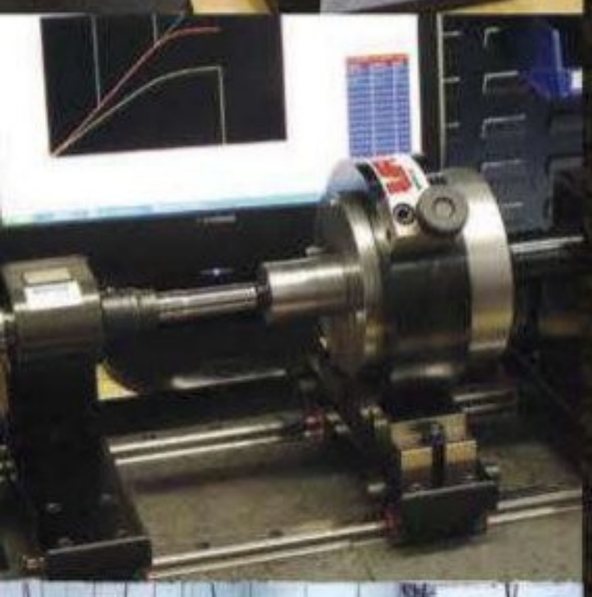
Wheels: 18 x 8in aluminium monobloc rims

Tyres: 225/35-R18

Safety: front crash box fabricated with aluminium honeycomb panels; roll hoop; collapsible steering column; FIA standard 4.65kg extinguisher system; six-point safety harness



WE HELP YOU TO
Push The Envelope



There are those who equate success in racing to the ability to "push the envelope" further than your competitors. Innovation has its rewards.

When it comes to fasteners, one firm is eminently qualified to provide you with the design, engineering and manufacturing support needed to advance your programs to the next level with complete confidentiality; ARP.®

For over 40 years, ARP® has helped race teams, engine manufacturers and professional builders in all forms of motorsports the world over to achieve race-winning performance and dependability.

And while we're best known for manufacturing engine related fastener components, ARP® has the expertise to design and manufacture a variety of application-specific fasteners to meet your needs. Our on time delivery record is second to none.

Our 100-page catalog contains the automotive aftermarket's largest selection of off the shelf, application specific performance fasteners. If you don't see what you need in the catalog, please contact our factory technicians for personalized assistance.

Our R&D capabilities are extensive, our factory is AS9100 and ISO-9001 certified, and we share your passion for winning.

ARP®
automotive Racing products

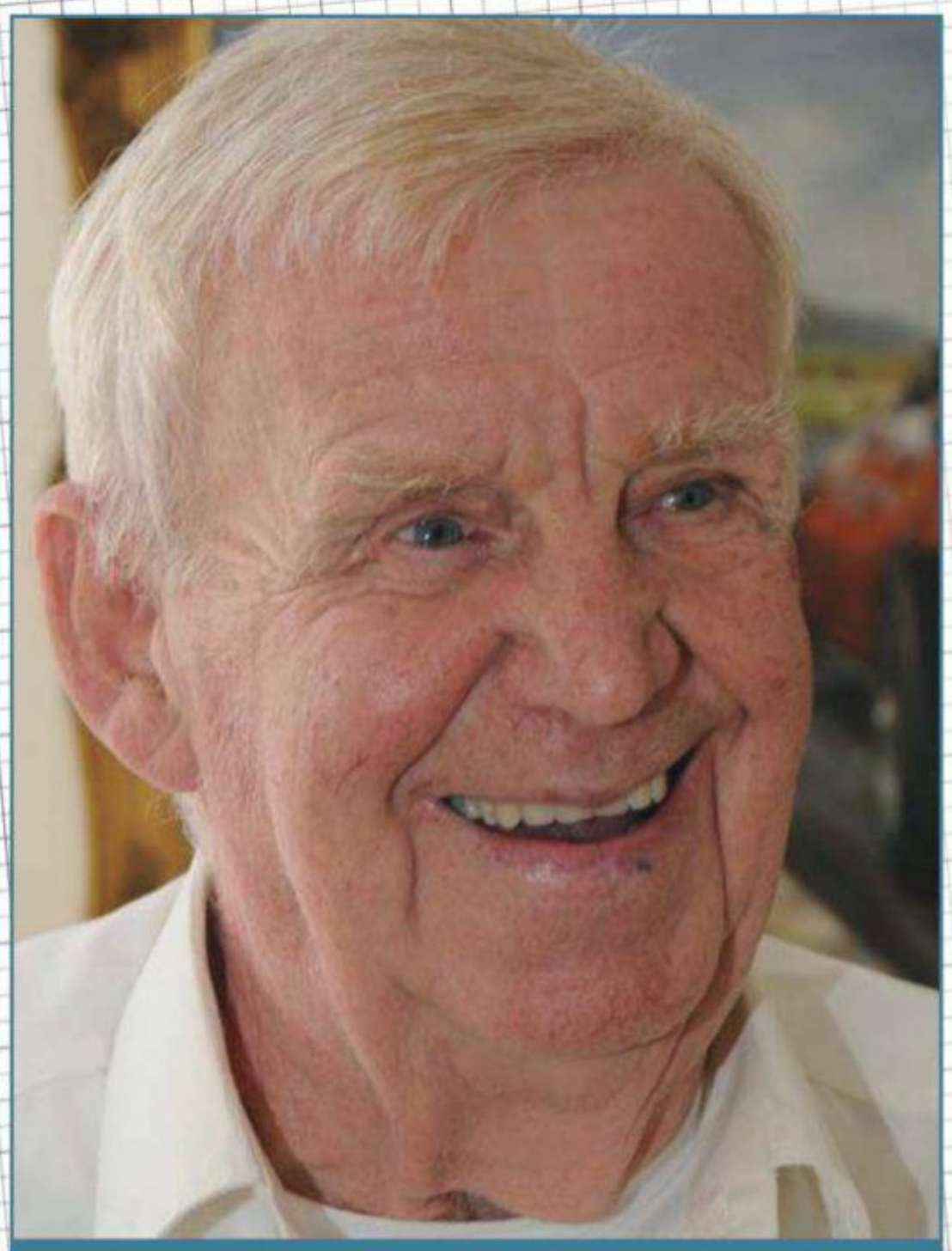
ISO 9001 Registered · ANAB · AS9100 Registered

Made In USA

1-805-525-1497 • www.arp-bolts.com

1863 Eastman Ave., Ventura, CA 93003, USA • Local: 805-339-2200 • Fax: 805-650-0742

THE DESIGNERS
TONY ROBINSON



"We were not into aerodynamics before 1968 when we started sticking wings on two stupid bits of goal post"

He claims he was never a designer, yet managed to build a grand prix car to rival those of Lotus and an Indy car capable of running with the front-running teams

BY IAN WAGSTAFF

In 1962, Formula 1 cars were not announced in a blaze of press conference glory. When Colin Chapman arrived at the Dutch Grand Prix with his Lotus 25, its innovative monocoque construction came as a surprise to virtually everybody. It certainly did to Ken Gregory, boss of the British Racing Partnership (BRP). Gregory had purchased four spaceframed Lotus 24s for the season, assured by Chapman that they were the latest thing in grand prix racing. Now, the Lotus 25 had made them and every other car on the grid, obsolete. Realising that he now needed a monocoque to compete, and unable to buy one of the new cars, he turned to his chief mechanic, Tony Robinson.

Robinson was one of the most experienced and respected mechanics in Formula 1. He had started working with the legendary Alf Francis on the Cooper-Altas and then a Maserati 250F for Stirling Moss. When Moss ceased running his own cars, Robinson went to work for 250F privateer, Bruce Halford. With the exception of the driver, Robinson was the team. So when Gregory and Stirling's father, Alfred Moss, formed BRP in 1958, Robinson was the natural choice to become chief mechanic.

Robinson will say that he was never a designer. However, he was about to create a monocoque grand prix car that was to win a race in its second season, and an Indy car which, despite the fact that he never saw the inside of the Speedway, ran as high as third in the Indianapolis 500. The experience gleaned led to him being sought by Cooper, Brabham and Abarth.

A couple of years before, Robinson had adapted BRP's Lotus 18, lowering the dashboard and instructing Williams and Pritchard to construct bodywork similar to that which Chapman would use for the 18's successor, the 21. It was an early attempt at aerodynamic improvement in F1. He was also with Cooper when wings began to appear in grands prix, and is fascinated by the aerodynamics of modern F1 cars. 'We were not into aerodynamics before 1968 when we started sticking wings on two stupid bits of goal post...' he says today with a smile. Before then it could be seen that BRP's Lotus 19 Sportscars seemed to handle better than its Lotus 18 single seaters '...but we were never intelligent enough to work out why. If we had have been we would have understood downforce and gone straight to the top of the pile.'

Ultimately, it would be politics that would prevent BRP from reaching those heights. In 1962, the team simply needed a car that would keep it competitive, and Robinson looked at the Lotus 25. It was virtually a fuel tank with an engine and four wheels. Built of riveted alloy panels of varying gauge and fabricated sheet steel bulkheads, it was shaped like a miniature bath in which the driver reclined almost horizontally. Others were to follow suit, but BRP was to be the first.

"one of the most experienced and respected mechanics in Formula 1"

Having been the one, with fellow BRP mechanic, Stan Collier, to cut Stirling Moss from the tubular steel frame of his Lotus 18/21 following his horrific accident at Goodwood, Robinson could see more than one benefit from building a monocoque. It would be a safer car. It also seemed logical. If you built a tubular frame car, you had to build an aluminium fuel tank and, if you were going to do that, he says, 'you might as well get rid of the chassis and build the car as a great big fuel tank.' In effect, this is what the monocoque racecars of the time were. Robinson reckoned that there would be no great building difficulties, once he had satisfied himself that the car would not break in half. He makes it seem incredibly

Though outwardly similar to the contemporary Lotus 25 from which it unashamedly drew its inspiration, the Robinson-designed BRP used much of the technology of the outgoing Lotus 24 but, with its monocoque construction, was very different

simple: the weight (the engine and gearbox were at the rear) and all the front of the car had to do was hold the driver.

As far as Robinson was concerned, he was 'not a pen and paper man, just practical.' The result though was, wrote BRP's number one driver, Innes Ireland, 'a beautiful machine'.

The press described the BRP as 'a well-made car based on the Lotus 25', and indeed its general layout followed the latter closely. There was little in the way of secrecy back then, and Robinson would wind the Team Lotus mechanics up by walking over to their car with a tape measure. Chapman, who would make intricate modifications to the suspension, told Robinson that he was one of the very few people who noticed what he did.

KNOWN FACTOR

A Lotus 25 copy, though, the BRP was not. Robinson had looked at how the Lotus was constructed and realised it would not be too difficult to do the same. However, the 25 was used simply as a known factor, not something to copy slavishly. The one thing he could obviously not see from the pit lane was inside the Lotus' chassis. He could note that it was a riveted piece of aluminium, but he could not see how strong it would be until he started working on such a car himself.

As Robinson points out, the construction was totally different. He made no detailed drawings, just a few sketches. His advantage, he believes, was that the team had the Lotus 24s and he was able to build the BRP around them, using their shape to help with such as the pick-up points for the suspension, the front bulkhead and the driver position, while all the while using monocoque technology.

The 1963 BRP featured four steel bulkheads connected at the lower edges by steel, inverted, v-shaped chassis members, which carried all the water and oil pipes, hydraulic piping and electric wiring. The bulkheads were joined by one inner and two outer skins of aluminium alloy, riveted together, with rubber fuel tanks inserted in the side members. Robinson recalls that such tanks were new technology in 1963, but he had a contact at Marston Excelsior in Wolverhampton that manufactured rubber fuel tanks for the aviation industry. The wheelbase was identical to the 25, because of its wider chassis, the BRP had a track 1.5in (38mm) wider at the front and 1.75in (44.5mm) at the rear. Use was made of the 1962 190bhp V8 BRM P56 engine with Lucas fuel injection, mated to a Colotti-Francis gearbox with a choice of five or six speeds and a gear lever mounted on the right-hand side of the cockpit, instead of the normal position on the floor.

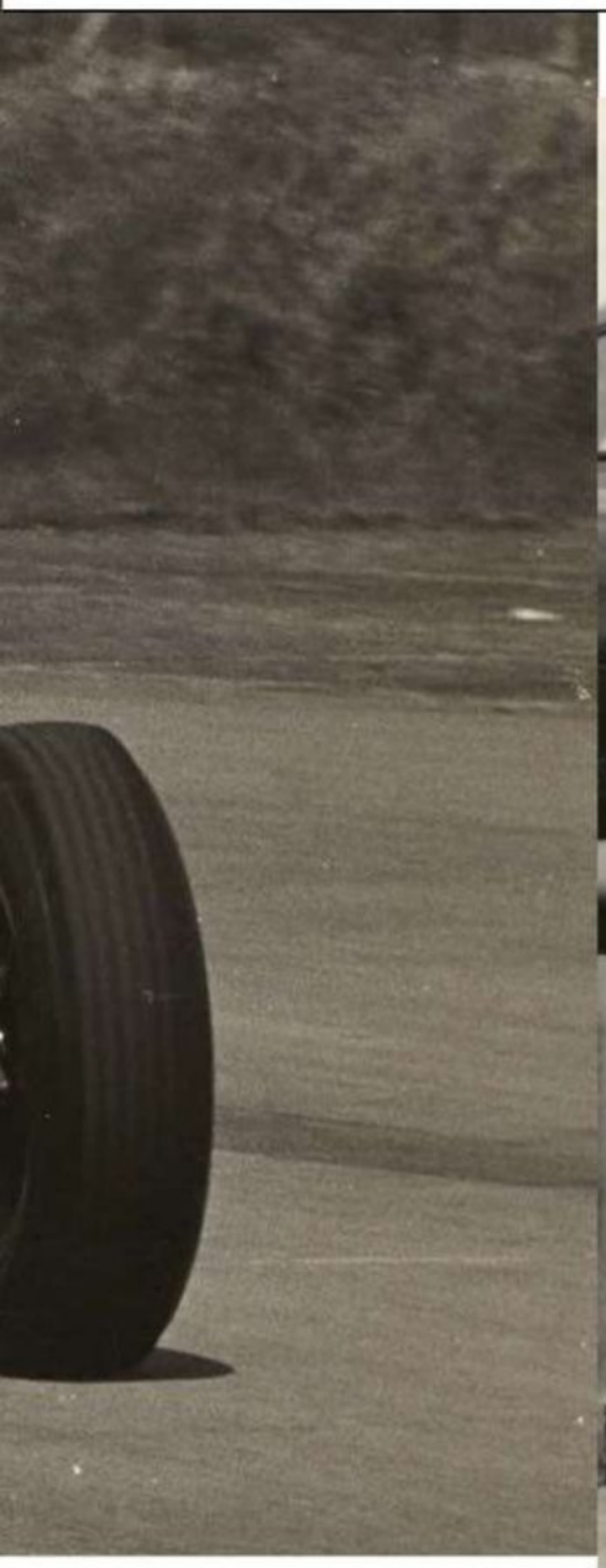
"The BRP was often better made and a better finished product"

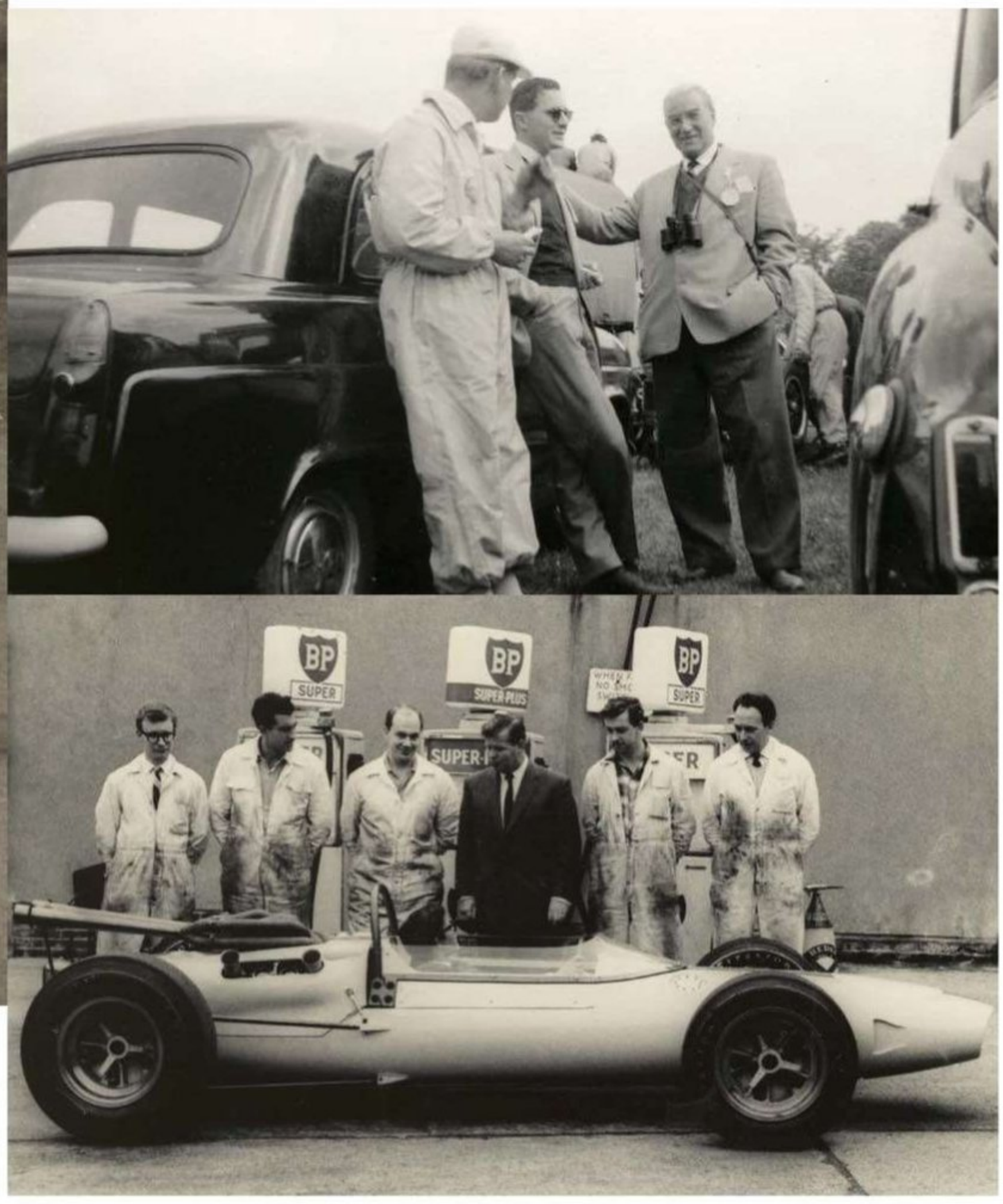
body was designed and built by Williams and Pritchard. Being made from thicker gauge alloy than was necessary, the bare structure weighed 80lb (36kg), the same as the Lotus 24 frame, but was considerably more rigid.

The suspension, steering and brakes were all taken from the Lotus 24 and, while the

The car was tested with vertical stack exhaust pipes but the team later decided upon four short low-mounted pipes.

Ireland was very proud of Robinson's creation. 'I think any observer who would look at any of the five marques of car racing would agree that the workmanship and care that went





into BRP cars was certainly as good as any of the others,' he wrote. 'Every drill hole in the chassis, every weld, was precise, exact and beautifully finished. Everything about them was workmanlike and a precision job – which was more than you could say for some of the other cars racing. If you really went to town, you would find that the BRP was often better made and a better finished product.'

Just one BRP was run during the 1963 season, with a best place of fourth in the Italian Grand Prix. At the beginning of the following season, Ireland drove that car to beat a full international field of Formula 1 cars to win a non-championship event at Snetterton, albeit it in atrocious weather conditions.

Two more chassis were built for 1964 but Robinson had already undertaken a thorough analysis of his creation over the close season and decided upon some modifications. The new cars were made from 18 and 20-gauge alloy, allowing a lighter monocoque with no loss of rigidity. Unlike the first car, the second two had a constant taper from the engine bulkhead to the pedal bulkhead. A BRM six-speed gearbox also replaced the Colotti unit, while the top and bottom joints, wishbones, driveshaft and steering rack were all BRP's own. No longer was Robinson reliant on parts from the Lotus 24. The wheels were now a mixture of Lotus and Brabham, while the cockpit had been redesigned.

BRP/2 made its debut at the 1964 Silverstone International Trophy meeting. Ireland recalled it again as a beautiful machine but one which this time had been tailored for him personally. 'They took my measurements and built the car around them,' he said. Another car was built for Trevor Taylor, but BRP's career as an F1 manufacturer were numbered.

Top: Tony Robinson, Ken Gregory, Robinson's boss at BRP, and Alfred Moss, father of famed racing driver, Stirling Moss
Above: After BRP was effectively blackballed by FOCA, two cars were built for the 1965 Indianaopolis 500. Many feel this was Robinson's greatest achievement, given the timescale involved and the number of unknown variables involved

FOCA YOU

At the beginning of 1964, the Formula One Constructors' Association (FOCA) was established, consisting of BRM, Brabham, Cooper and Lotus (Ferrari declined to join). An arrangement was made known as the Paris Agreement that basically divided start and prize money up amongst its members. BRP was in a different position. It needed its fair share of the start and prize money if it was to continue, but membership of FOCA dictated that a car should be built, in the main, by its entrant and have enjoyed at least one season of competition. Surely BRP qualified?

At Watkins Glen, Robinson told FOCA that cars would be available for inspection in order to prove that BRP was, indeed, a manufacturer in its own right. Nobody turned up. The same happened in Mexico. Hypocritically, the members of FOCA had blackballed the

operation, arguably jealous of Masten Gregory's ability to attract sponsorship. 'If we had been allowed to go on from crawling in 1963 and walking in 1964, we could have created a three-year project,' reflects Robinson.

AND SO TO INDY...

The story, though, was not at an end. Former BRP driver, Masten Gregory, approached the team with a request to build two cars for the 1965 Indianapolis 500. 'We still had the staff and the facilities. I had to go to North America for the end of season US and Mexican Grands Prix, so "nipped over" to Indianapolis and picked up the regulations. I also went to Ford Motor Co in Detroit to see those in charge of the Ford Indy engine project and collate what information we needed. We organised a mock-up engine that was shared between ourselves, Lotus and Lola and also acquired a full-size drawing of the engine.'

Ask Robinson about the design of the car and he will reply that, like the F1s, it was built rather than actually designed. 'We were a team of mechanics and engineers. We weren't designers as such with a pen and paper, we were racecar builders... However, I knew what was required, which I found out through experience. Over the years you get to know what to do without trying anything ambitious. If you have an idea of what not to do and what mistakes you should not make, you can end up with a car that may be as quick as the others, if not a bit quicker, and more reliable.'

Despite the fact that none of the team had any experience of Indianapolis, everything about the chassis other than the obvious like the Girling brakes, Armstrong suspension, Halibrand wheels and Morris rack and pinion steering, was designed or manufactured in house. Even the driveshafts were designed by BRP but made by BRD of Wolverhampton, UK.

The GP cars had given Robinson an idea of the way to go, but he was on new ground when it came to the power and performance of the Ford engine, let alone the speeds that were likely to be reached at Indianapolis. Everything had to be 'beefed up' from the F1 BRPs. The way that team had built the latter was to first make mock-ups and the same process was used for the Indy cars. Using a jig bed that it had from the F1s, the team placed mock-up bulkheads at the front, centre and rear. The mock-up engine and a gearbox casing were put in place and 'we ended up with the physical dimensions. We already knew Masten's size but we did not initially know who the other driver was going to be. Eventually, we were told it would be Johnny Boyd, who was taller than Masten, so we decided on a compromise size for the cockpit. We could not afford to sacrifice too much unused cockpit area as we had to carry so much fuel.'

Robinson was a natural engineer with an ability to translate experience into successful racecar designs. After his stint in IndyCar, he advised Cooper, then went there full time as technical manager in 1967

Initially, it was not known if the car would be fuelled by petrol or methanol. If the latter, it would have to carry 75 gallons to avoid an extra pit stop. It also proved difficult to obtain precise fuel consumption figures on the Ford engine. Consequently, six weeks was spent designing a car capable of incorporating 75 gallons by making use of cowl tanks and pressure refuelling connectors. And then a change in the regulations stated that such tanks and systems were banned. That meant a loss of 10 gallons. Five of these were retrieved by extending the seat tank and making the car a little wider.

"People ask what is the point of KERS. I can see the point if you are getting something for nothing"

'Once we had manufactured the three bulkheads and tied the front and centre by two longitudinal bottom members, from there on in we just had to bend up the internal shape of the cockpit area, clamp it and drill it to the front and centre bulkheads,' recalls Robinson. 'It was all basically straightforward. It looked very much like an F1 car. The suspension was a beefed-up version of what we used on the F1. There was no point in us being too daring.'

The completed cars were shipped to Indianapolis where they were taken over by an organisation established by Masten Gregory's former stepfather, George Bryant. Both cars qualified that year and ran at Indy and elsewhere for three years, one as high as third towards the end of the '67 race.

GREATEST ACCOLADE

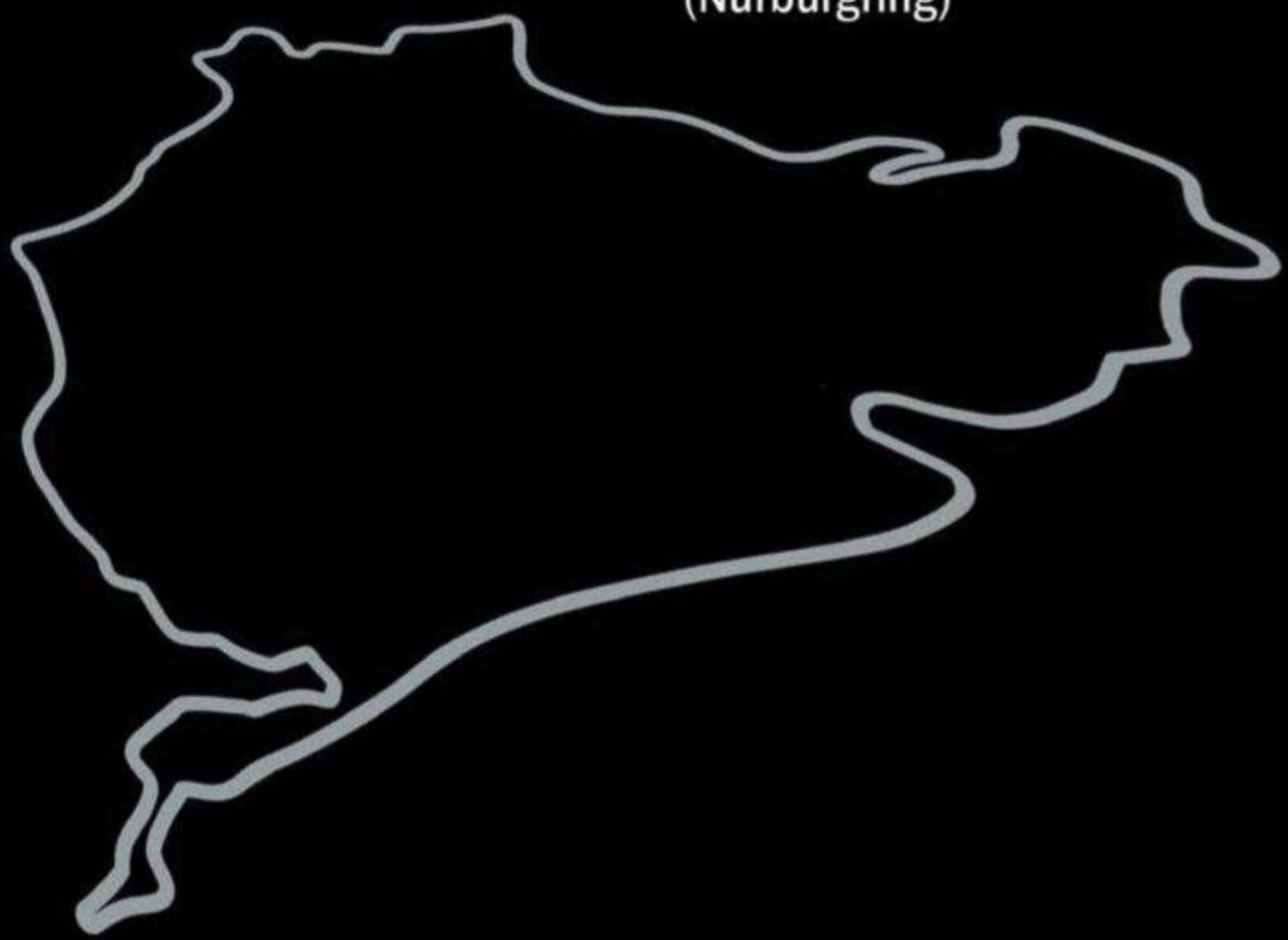
Ken Gregory believes Robinson's greatest accolade should be given for his work on the Indy cars. His small team, which had been told it was not worthy of being considered an F1 manufacturer, had been asked to design and build a car to run in one of the most dangerous races in the world, on a track they had never seen and for an engine they knew nothing about. Yet within five months Robinson had designed, and his team built, a car that was able to run competitively at the Brickyard.

Robinson's experience of monocoque construction led to his advising Cooper designers Derrick White and Bob Marston on the Maserati-engined T81 for the 3.0-litre formula. It also led to his joining Brabham to work on his 1968 Indy car. However, unable to get on with the abrasive Ron Taurenac, his time there was brief. His final involvement with F1 was a return to Cooper as technical manager in 1967, but the former World Championship constructor was already on its last legs and withdrew from grand prix racing at the end of the following year.

Robinson also walked away from the sport but, as an associate member of the BRDC, still maintains an interest. Modern racing represents progress in his opinion and that can only benefit engineering in general and motor manufacturers in particular. 'People ask what is the point of KERS. I can see the point if you are getting something for nothing, and who knows where that will end up on ordinary cars? Once you start making suspension points and gearbox casings from carbon fibre, who knows where that will finish? The drivers can also go quicker [now] because they can run off the road and the car will not fold around them.' Given the accidents he has witnessed, this is a pertinent point, and the monocoque, in which he was so involved during its early days in racing, has been partially responsible for this.

ITS NO SECRET THE GERMANS HAVE SOMETHING WE ENVY...

(Nürburgring)



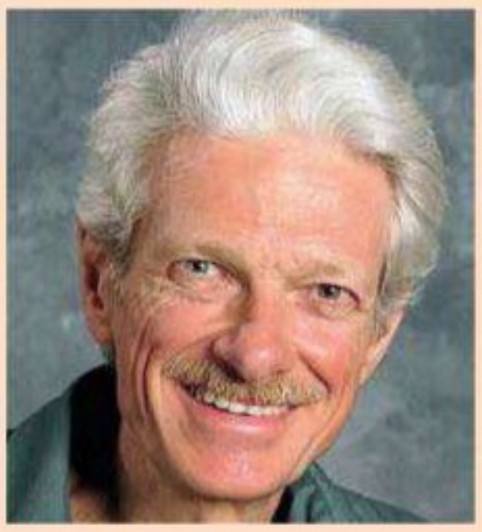
CONSIDER US EVEN.

*Scan code with your smart phone or go to www.performancefriction.com/racecarengQR/Envy

www.performancefriction.com

NEW! Visit our facebook shop!

PERFORMANCE® FRICTION BRAKES



Mark Ortiz Automotive is a chassis consulting service primarily serving oval track and road racers. Here Mark answers your chassis set up and handling queries. If you have a question to put to him
Email: markortizauto@windstream.net
Tel: +1 704-933-8876
Write: Mark Ortiz
155 Wankel Drive , Kannapolis
NC 28083-8200, USA

To anti-squat or what?

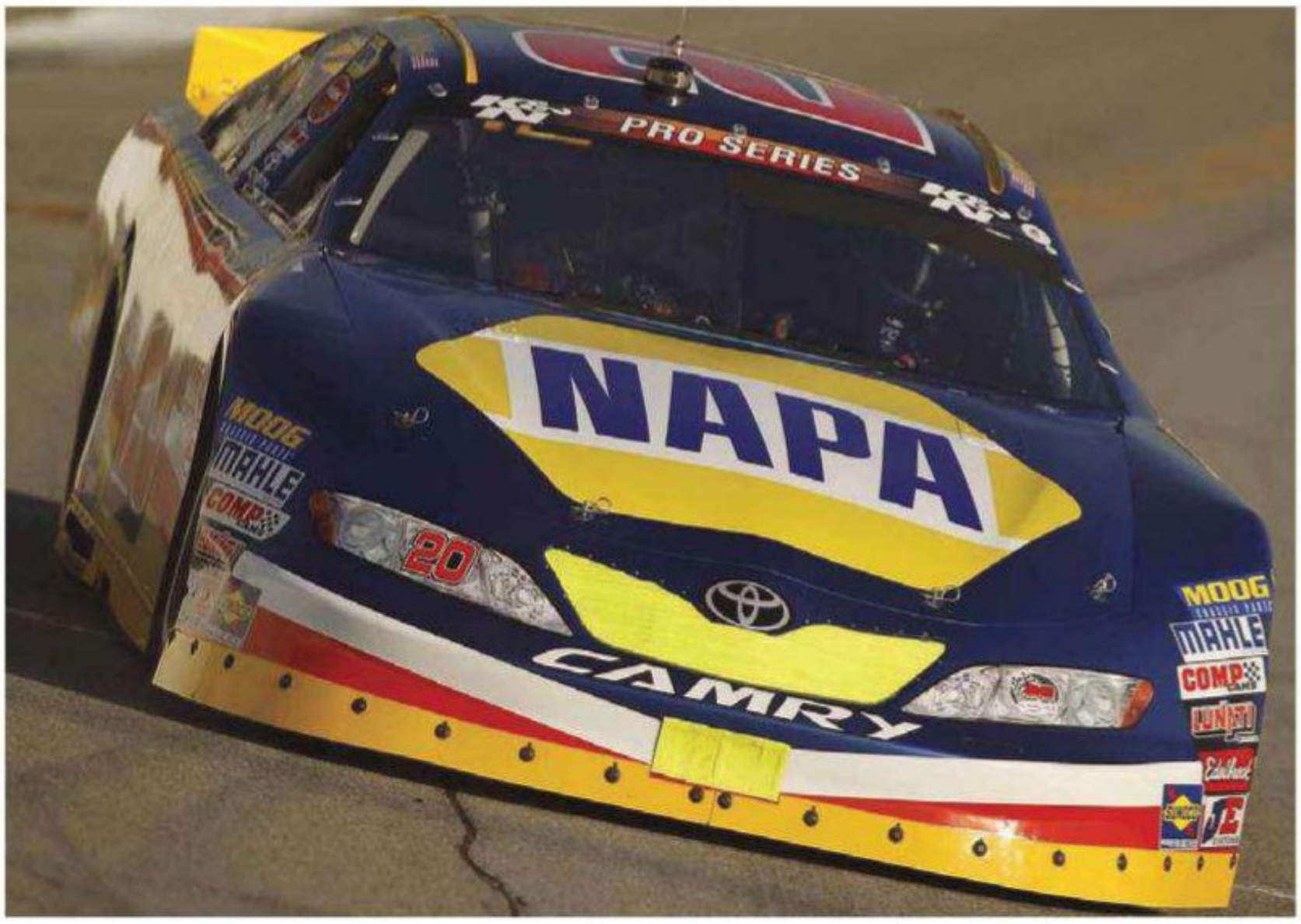
Some thoughts on getting power through the rear rubber

Q I race asphalt Super Late Models. The car is good on the short run, but I'm having a big problem keeping the rear tyres under me during long runs, although it seems decent on re-starts when the tyres cool. When I check the tyres after the race, the rears end up almost 3/4in smaller in circumference than the fronts when they started the race the same size. I'm not sure if I'm burning the tyres up because (a) I'm overloading them (I used to have so much anti-squat that the rear suspension lifted on acceleration, keeping the c of g higher, and transferring more weight... I've since backed off on this so the car squats a little bit) or (b) I'm not loading them enough (because suspension squat drops the c of g and so less weight is transferred) and this lack of load is causing wheelspin in the long run. Here are my thoughts:

To fix (a):
Benefits of less anti-squat (more rear suspension travel) for forward bite:
1. More reverse rake in Panhard bar (more load transferred to LR off the RR)
2. Lower rear roll centre (decreasing rear roll stiffness)
3. More rear steer to the left (based on where I have my trailing arm angles)
4. possibly a longer response time in weight transfer (since the weight must go through the springs rather than be transferred to the tyres through the suspension links, letting the tyres transfer from mostly cornering to mostly accelerating force without going outside the traction circle)

To fix (b):
Benefits of more anti-squat for forward bite:
1. Maintaining or increasing rear chassis height to get higher c of g and more weight transfer to back tyres... usually good for bite.

What do you think? I know trial and error is sometimes best but I'm away at school most of the year so my chance to try things are rare. It may also be helpful to know that I run a spring-loaded third link at about a 10-degree angle (1200lb spring, pre-loaded 12 turns) and the car weighs 2750lb (1247kg), with 51 per cent front weight.



The difference between hardly any anti-squat and a lot is less than a percentage point of dynamic rear per cent

First of all, anti-squat does not have a big effect on rear tyre loading. To see just how small the effect is, let's do some 'back of the napkin' numbers. Suppose we have a 108in (2743mm) wheelbase car where, at 0.8*g* forward acceleration and with 100 per cent anti-squat (no rear suspension ride deflection), the c of g height is 15in (381mm). The rearward load transfer is then 0.8 (15/108) of the car's weight, or 11.1 per cent. If the car had 49 per cent rear statically, it will then have 60.1 per cent rear dynamically.

Now suppose we add enough anti-squat so the rear lifts about one inch (25mm) under the same power application, which will raise the c of g about half an inch (13mm). Rearward load transfer becomes 0.8 (15.5/108) of the car's weight, or 11.5 per cent.

That gives us 60.5 per cent rear dynamically – not much change. Or, if the rear squats one inch (25mm), we have 0.8 (14.5/108), or 10.7 per cent, and 59.7 per cent rear dynamically.

So there is an effect, but the difference between hardly any anti-squat and a really large amount (in pavement car terms) is less than a percentage point of dynamic rear per cent.

Just for grins, let's also consider a dirt Late Model that jacks the rear end up 3in (76mm) under power, has the same 108in (2743mm) wheelbase, 55 per cent rear statically, and a c of g height under power with 100 per cent anti-squat of 17in (432mm). If the dirt is really tacky, maybe this car can also attain 0.8*g* forward acceleration. With no anti-squat, rearward load transfer is 0.8 (17/108), or 12.6 per cent, for a dynamic rear percentage of 67.6 per cent. With 3in (76mm) of jacking, the c of g height is around 18.5in (470mm). Rearward load transfer at 0.8g forward is then 0.8 (18.5/108) of the car's weight, or 13.7 per cent, for a dynamic rear percentage of 68.7 per cent. That's 3in (76mm) of rear jacking, delivering just over one more percentage point of dynamic rear, on unusually tacky dirt. Again, enough difference to be worth a little, but not enough to make a difference between burning up the rear tyres with wheelspin, and not.

"anti-squat does not have a big effect on rear tyre loading"

A CLASS APART

The questioner doesn't mention what kind of Super Late Model this is. I know it's a pavement car because there is no class by that name for dirt cars. However, there are a number of sanctioning bodies that have such classes, and their rules vary. At the nearest short track to me, Concord (NC) Motorsports Park, the rules are NASCAR's. There are three Late Model classes: Limited Late Model, Late Model and Super Late Model. They all look similar, but the engine rules are different, and maybe the tyre rules as well. The Super Late Models are a touring series and don't run there every week. The speed difference between them and the rest is dramatic, and easily visible from the stands. Their events are also much longer – typically, the Limited Late Model feature is 30 or 35 laps, the Late Models 50 or 60 laps and the Super Late Model feature 100 or even 150 laps, on a half-mile tri-oval.

Then there are other sanctioning bodies, mainly in the Mid-west, that have Super Late Model classes with much looser rules, which allow, among other things, three-link rear ends (NASCAR requires truck arms) and bigger rear spoilers. The questioner indicates he is running a three-link, so I know he's not running NASCAR.

TYRE WEAR

Conversation with fellow competitors should quickly reveal whether the amount of rear tyre wear and heating described here is actually abnormal in this class 3/4in (19mm) less circumference at the end of the race translates to about 1/8in (3mm) more tread thickness worn off the rears than the fronts. For a powerful car on a short track, over a fairly long event, that may not be anomalous.

From the standpoint of theory, there are a number of things that may make the rear tyres wear faster than the fronts, even if the car is not loose and even if

The one in the middle wins races

DS1.11® & DS2.11®

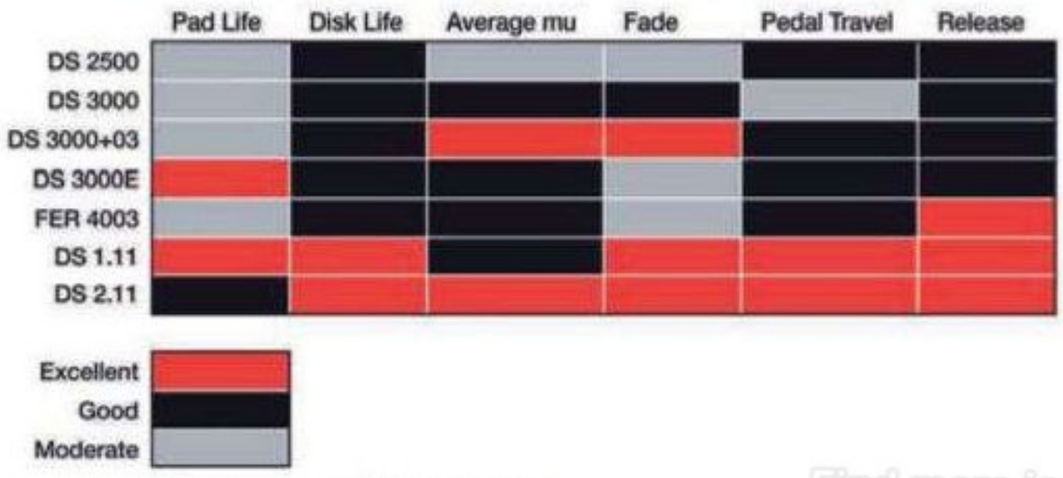
SILOXANE TECHNOLOGY

BRAKE PADS

FERODO™

RACING

Relative Performance Characteristics of Ferodo Racing Range Under Heavy-Duty Conditions



www.federal-mogul.com/ferodoracing

Race Proven

DS1.11 - suffix "W"
- A1GP
- FIA FT
- Touring Cars
- Formula Cars
- Group N
- Stock Cars

DS2.11 - suffix "X"
- WRC
- Rally Group N
- Touring Cars

FEDERAL MOGUL
The best brands in the business

Circuit Supplies (UK) Ltd
Unit 8, Eden Court, Eden Way
Leighton Buzzard, Beds LU7 4FY
Tel: 01525 385 888 Fax: 01525 385 898
info@circuitsupplies.com www.circuitsupplies.com

the static rear percentage is not greater than the front. Wheelspin is one possibility and, if the driver experiences wheelspin, then we know that's a factor. However, suppose the car has considerably more aerodynamic downforce at the rear than at the front. That will tighten it (add understeer) beyond what we would expect from the static weight balance. We can tune the set up to compensate for that, mainly by statically and / or dynamically de-wedging the car, or adding rear tyre stagger. However, when the rear tyres are helped by the aero balance and then loaded more unequally to make up for that, they are working harder than the front tyres, and will heat and wear more, even ignoring the work they have to do propelling the car.

Ideally, in such a situation we'd add front downforce, but the bodywork rules may prevent that. Pavement Late Model rules generally allow only a valance at the front, with varying requirements for front overhang and static ground clearance, but a fairly large spoiler at the rear. It may actually be that in such a case it would be possible to create a set up that would run at its own limit for a longer time without taxing the rear tyres so heavily, by reducing rear downforce and adjusting the set up to re-balance the car.

"it makes more sense to tune for better speed"

However, chances are such a set up would have lower limits ie be slower – so it makes more sense to tune for better speed and accept the fact that the rear tyres will go away more than the fronts on a long run.

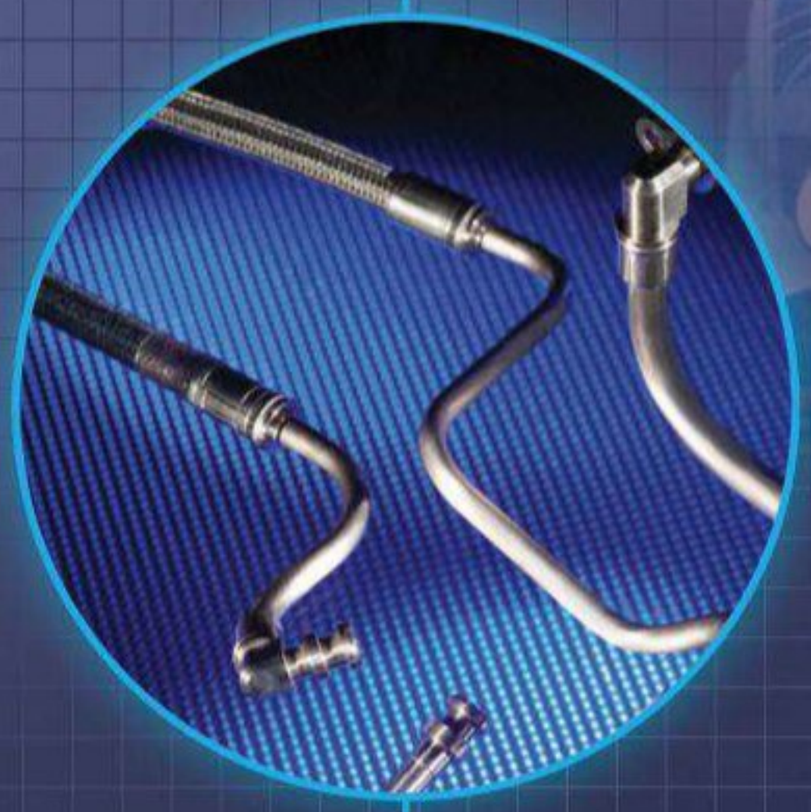
I mentioned stagger. That definitely enters into this, especially when running a spool (NASCAR Late Models use lockers, but spools are common elsewhere). Most spool set ups use more stagger than theoretically necessary for the turn radius. Even the theoretically correct stagger for the turn radius causes the rear tyres to fight each other down the straightaways – the left one drags and the right one has to slip more and provide all the propulsion. That will definitely heat and wear the rear tyres. The front tyres may also have some added work compensating for the yaw moment the stagger induces, but generally stagger will not add as much workload for the fronts as for the rears.

So one way to help rear tyre life, and consistency on long runs, is to minimise rear stagger, especially with a spool. This does have a price, however. A set up with ample stagger is easier to drive because it has more controllable rear breakaway. A set up with minimal rear stagger is twitchier at the point of rear breakaway. So, to some extent, there is a trade off between short-run driveability and consistency over long runs.

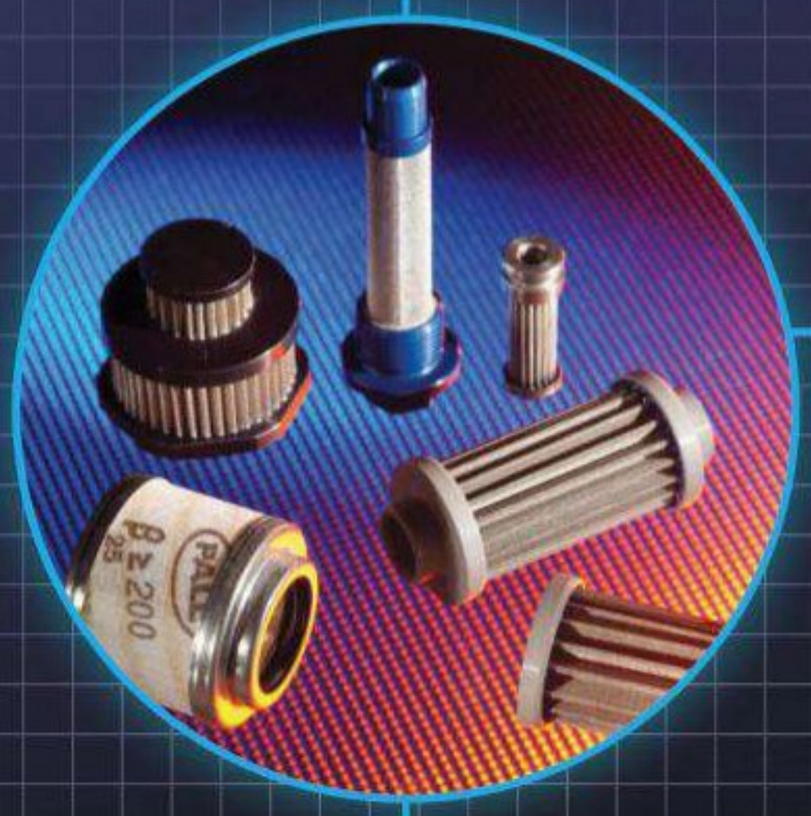
Notwithstanding all of these complexities, one thing jumps out at me from the question. I am wondering why the questioner is running 51 per cent front, if there is a wheelspin problem. Late Models typically have a fair bit of ballast, which makes it possible to get more rear percentage. If the track has tight turns and long straights, the car should be faster with more static rear percentage. If the track is really bowl-shaped, then maybe not. But, if wheelspin is an issue, that suggests putting power down out of turns and down straightaways is an issue. More static rear percentage will help that, much more than anti-squat.

CONNECTING INTELLIGENCE

Flexible Hose and Fittings



Rigid Lines and Swagetite



Filtration

Interpreting the system requirements of top level motorsport designers takes more than simply applying tried and tested formulae, it takes years of experience and intuitive thinking. Blending this with an unrivalled engineering pedigree helps us produce innovative solutions for customers in F1, endurance and WRC – in fact, every form of motorsport.

SERVICES:

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

PRODUCTS:

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

FHS MOTOR RACING

Maintaining system integrity, saving weight and cutting costs. **Make the connection now.**

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

+44 (0) 1753 513080

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

RACEPARTS

NEW PRODUCTS FOR 2012.

WE CAN SUPPLY ALL THE PARTS...

...YOU JUST NEED TO PUT THEM ALL TOGETHER

RACEPARTS HAVE OVER 40 YEARS EXPERIENCE IN SUPPLYING PARTS TO ALL FORMULAE ALL OVER THE WORLD.
WE HAVE HUGE STOCKS AND KNOWLEDGEABLE STAFF.
WHY CALL ANYONE ELSE?

TEL: 0 (44) 1491 822000 EMAIL: SALES@RACEPARTS.CO.UK

NEW CATALOGUE FOR 2012

At last - TPMS without the "dreaded" batteries!!!

Stack's unique Tyre Pressure and Temperature Monitoring System (TPMS) has eliminated the electronics and batteries from the sensors, providing new limits of performance for TPMS, and significantly increasing sensor life to 5 seasons or more! We've reduced the first year cost, and significantly reduced on-going maintenance costs.

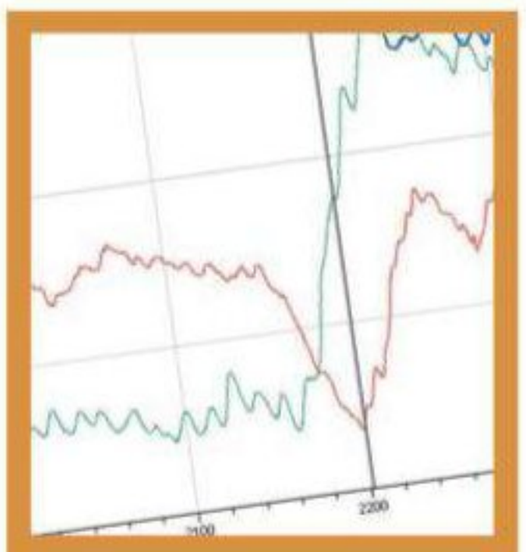
- **Less weight – only 10g (0.35oz).**
- **Sampling rates up to 10Hz without reducing sensor life.**
- **Auto-detect wheel changes without pre-programming.**
- **Maintenance free - longer life, significantly lower running costs.**
- **Higher continuous operating temp – up to 150°C (300°F) or above.**
- **CAN output for connection to existing systems.**
- **Measures both pressures and temperatures.**
- **Specialist high sampling rates – up to 40Hz.**

To find out more call **+44 (0)1869 240404** or visit **www.stackltd.com**

Smart phone users can scan this code for more information from our website.

STACK STACK STACK®

...when only the best will do!



Databytes gives insights to help you improve your data analysis skills each month as Cosworth's electronics engineers share tips and tweaks learned from years of experience with data systems. Plus we test your skills with a teaser each month

To allow you to view the images at a larger size they can now be found at www.racecar-engineering.com/databytes

Look-up tables

Master these and your data analysis will be more thorough

Look-up tables can be a very useful tool for data analysis. Once mastered, they allow engineers to visualise many more aspects of car performance that might otherwise go unnoticed. They also allow data collected off track, or from an external source, to be integrated with the on-track data for direct comparison.

Look-up tables are often used to visualise engine parameters dependant on more than one variable. These parameters can be difficult to express as an equation and require expensive modelling software to calculate. Look-up tables offer an effective way of expressing the channel using numerical methods without the need for advanced surface analysis. The data analysis software uses the raw data points in the table and interpolates between them, generating a full surface. There is also the possibility to extrapolate from, or snap to, the raw data values, depending on requirements.

LOGGED CHANNELS

Any good data analysis package will have the capability to use data from 1D and /or 2D look-up tables from a spreadsheet and generate channels. This channel can then be used in all of the functions and displays, just as any other logged channel.

After the data has been gathered for use in the look-up table, the first step is to format the spreadsheet into a style that can be interpreted by the analysis software. Often the axis points need to be set in ascending order, and for 1D look-up tables, the axes may need to be aligned horizontally instead of vertically. Once the spreadsheet is in the correct format, it normally needs to be saved in a fixed location as if the file is moved, otherwise the analysis software will no longer be able to find it.

Once this is completed, the look-up table can be referenced in the data analysis software. A definition string is then used to define the location and file name of the spreadsheet, the sheet name and the cells that contain the look-up values.

table #name = path\filename\sheet!cellfrom:cellto;
Where:
table = keyword used for defining look-up tables
name = the look-up table's name. It must always start with a '#' symbol
path = the directory path of the Excel file. Relative network paths can also be used (see the examples below)
sheet = the Excel sheet name
Cellfrom = the look-up table's top / top left value cell
Cellto = the look-up table's bottom / bottom left value cell
NB Cellto and Cellfrom arguments can be specified using the Excel Cell syntax eg cell A3 would be A3

Efficiency

Rear Ride Height	Front Ride Height (mm)				
	10	20	30	40	50
10	1.80	1.70	1.60	1.10	0.30
20	2.24	1.85	1.46	1.07	0.68
30	2.48	2.00	1.32	1.04	1.06
40	2.36	2.15	1.18	1.01	1.44
50	2.12	2.30	1.04	0.98	1.82

Cell From

Cell To

Examples
table #local = C:\Lookup Tables\My Tables.xls\Sheet1!B4:B8
table #srv = \\server\c\Lookup Tables\Server Tables.xls\Sheet1!B4:B8
Once the table has been defined, the variables used to calculate the look-up value and the numerical method also need defining. This is done in a secondary line, as below
#name (exp,mode)
#name (exp1, exp2,mode)
where:
name = is the name of the table
exp = the input argument used in 1D look-up tables (IndexColumn)
exp1 and **exp2** = input arguments used in 2D look-up tables. exp1 specifies the IndexColumn and exp2 the IndexRow
mode = optional parameter. It specifies modes of interpolation / extrapolation. If not specified explicitly, the **Snap** value will be assumed. It can have one of the following values:
Interpolate = interpolation is performed
Extrapolate = extrapolation is performed
Both = interpolation and extrapolation is performed
Snap (default value) = neither interpolation or extrapolation is performed and the nearest value is returned
Hold = as Snap mode but will use old value until new value is reached

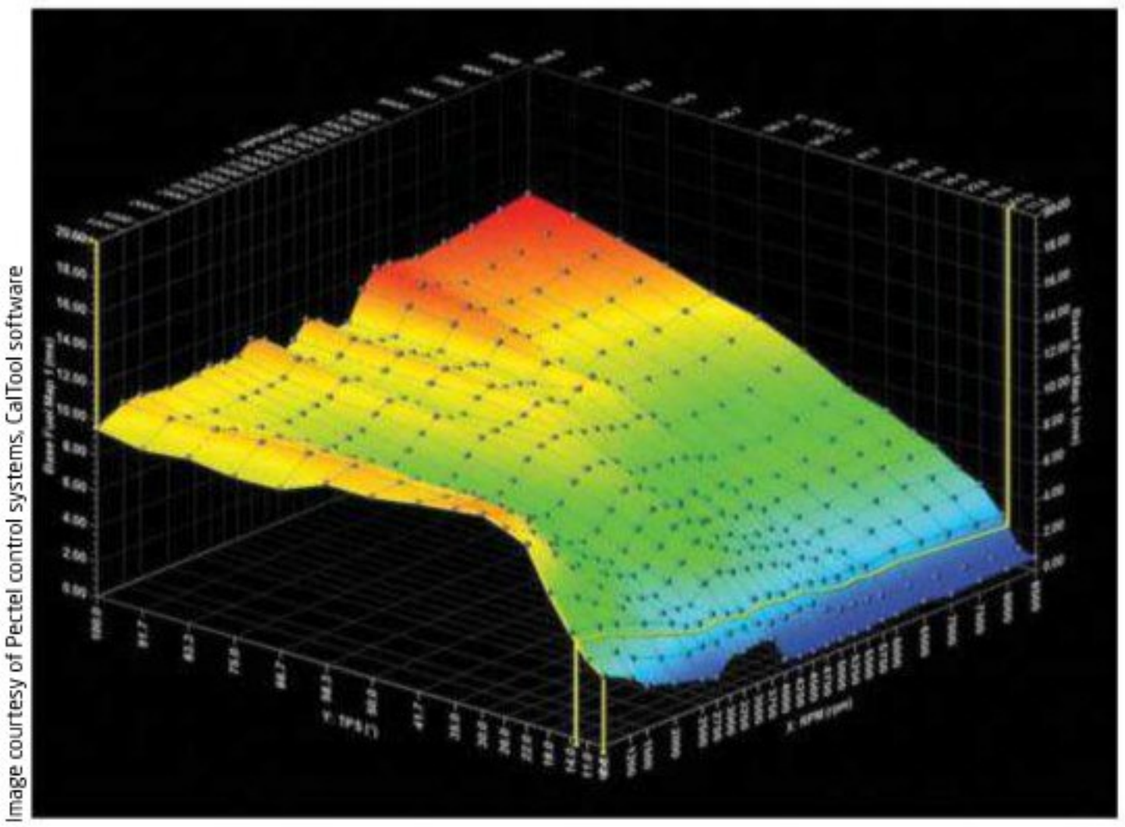
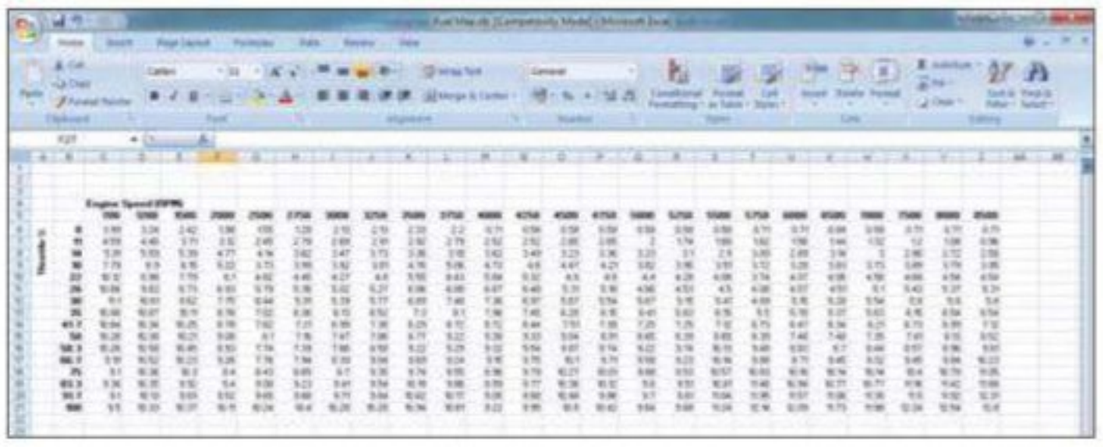
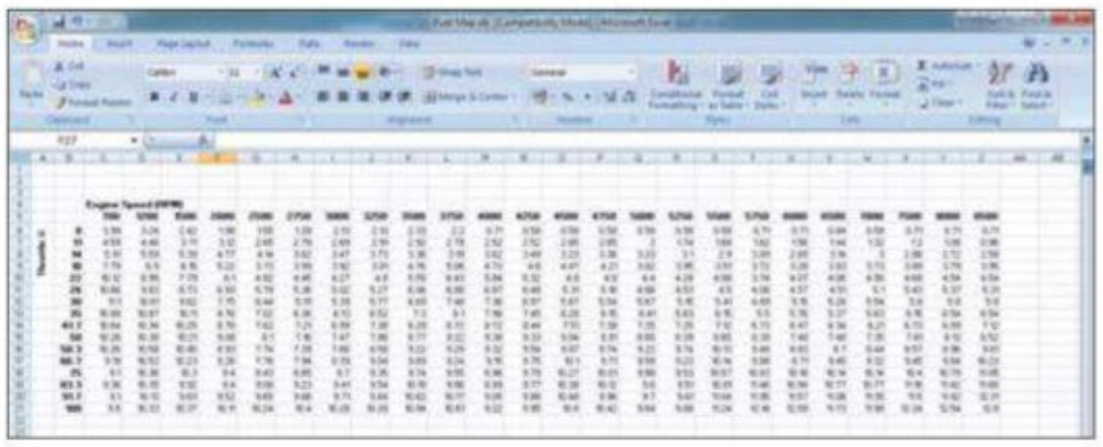


Image courtesy of Pectel control systems, CalTool software

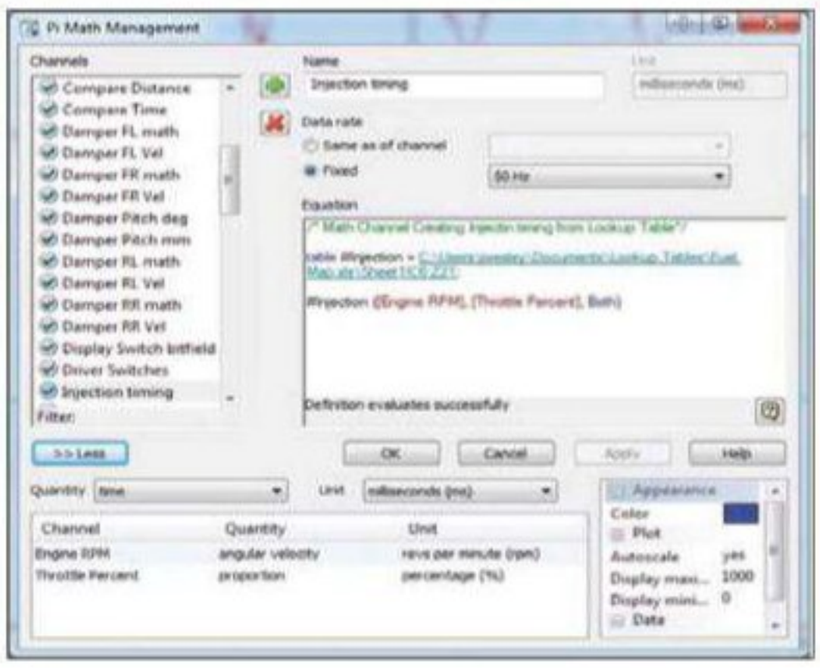
Engine map fuel injection timings vs rpm and throttle position. Just by inspecting the surface shape, it is obvious how difficult it would be to devise an equation to describe this without expensive modelling software



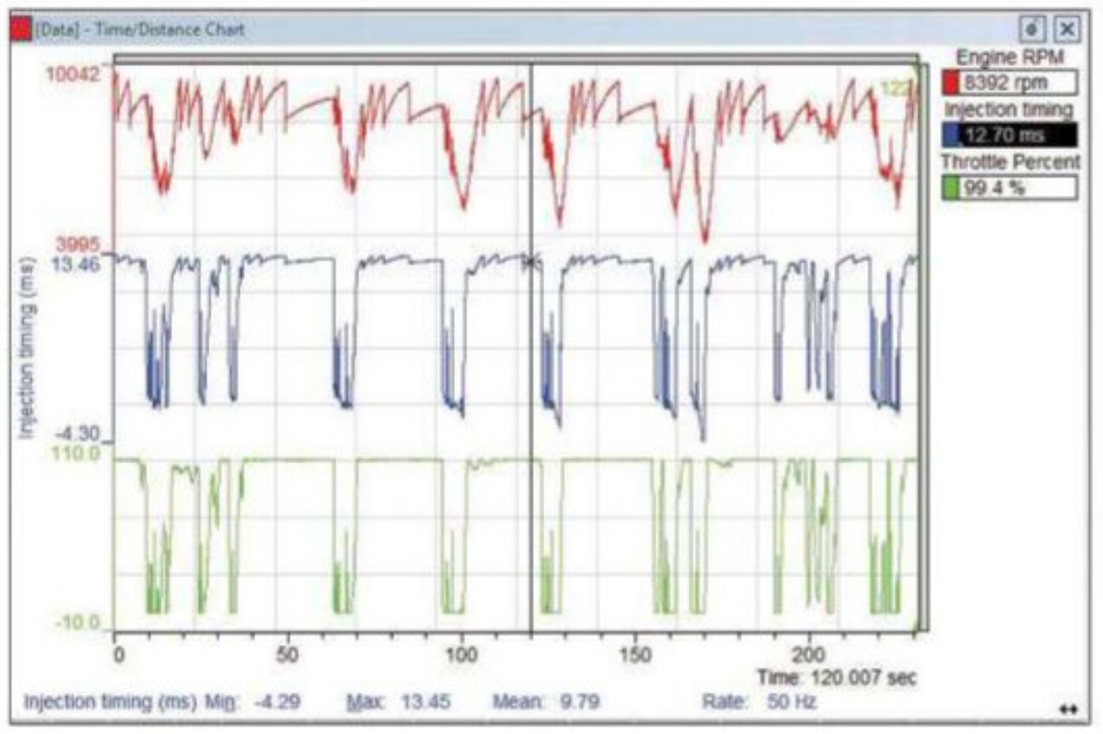
The raw data points used to generate the map are put into a spreadsheet



This is then put into the correct format

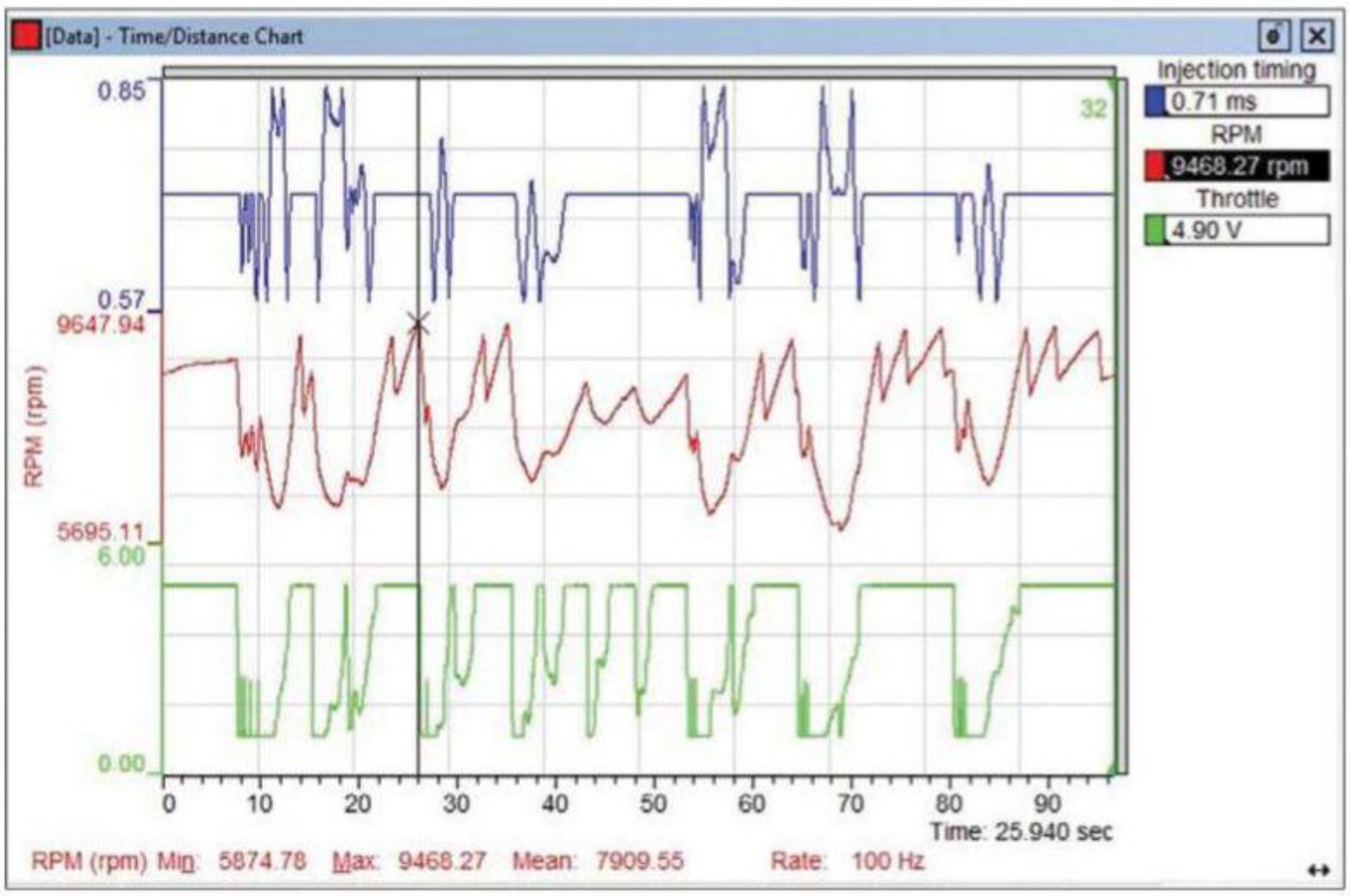


The look-up maths channel is then created, forming the new channel, injection timing



This channel can then be viewed alongside regular data channels

CHALLENGE



An engineer wants to use a look-up table for fuel injection. In this example, the fuel map look-up table is exactly the same as that in the main article, but the trace for the injection timing is wildly different. What has the engineer done wrong?

COSWORTH

Produced in association with Cosworth
Tel: +44 (0)1954 253600
Email: ceenquiries@cosworth.com
Website:
www.cosworth.com/motorsport

Simon McBeath offers aerodynamic advisory services under his own brand of SM Aerotechniques – www.sm-aerotechniques.co.uk. In these pages he uses data from MIRA to discuss common aerodynamic issues faced by racecar engineers

All change please...

A new project, and a comparative look at the initial set up

We commence a new project this month and find ourselves working on the 2011 LMP2 Le Mans 24 Hours-winning and 2011 LMP2 Le Mans Series-winning Zytek Z11 SN-Nissan of Greaves Motorsport.

As usual with a new project, we'll begin with a look at the car and its baseline data, and make comparisons with the nearest racecar we have previously tested. In subsequent issues we'll take a look at the effects of some of the mandatory modifications imposed for 2012, including the engine cover fin, wheelarch top apertures and larger mirrors, with the car straight ahead and at meaningful yaw angles.

In the photos, most of the main aerodynamic appendages are readily visible, with the large, regulation-governed splitter, double dive planes and louvred wheelarches. Not visible, of course, is the curvaceous, broad front diffuser under the front bodywork. Behind the front wheels are apertures in the side panel to allow some of the air to exit from under the front diffuser, and these apertures are fitted with turning vanes just outboard of the apertures and attached to the running boards. At the rear, the wheelarches are again louvred, and the regulation boxes behind the wheels outboard of the controlled but still fairly voluminous diffuser can be seen. The wing is a well cambered dual-element device supported on 'swan neck' mounts. A large Gurney sits on the trailing edge of the rear bodywork.

The car came into the wind tunnel in its 2011 'preferred specification'. By way of comparison, the data for the Eco Racing LMP1 Radical SR10 in its highest downforce, best balanced configuration (as seen in V19N1-3) are also given in table 1.

The coefficients are based on estimated frontal areas, and have been 'normalised' to enable direct comparison, so we can say that the Zytek generated three per cent more drag than the Radical,

Table 1: baseline aerodynamic coefficients of two LMP cars in the MIRA wind tunnel

	CD	-CL	-CLf	-CLr	% front	-L/D
Radical	0.565	1.631	0.607	1.024	37.20	2.89
Zytek	0.582	1.910	0.796	1.112	41.72	3.28
Difference	+3.0%	+17.11%	+31.14%	+8.59%	N/A	+13.49%

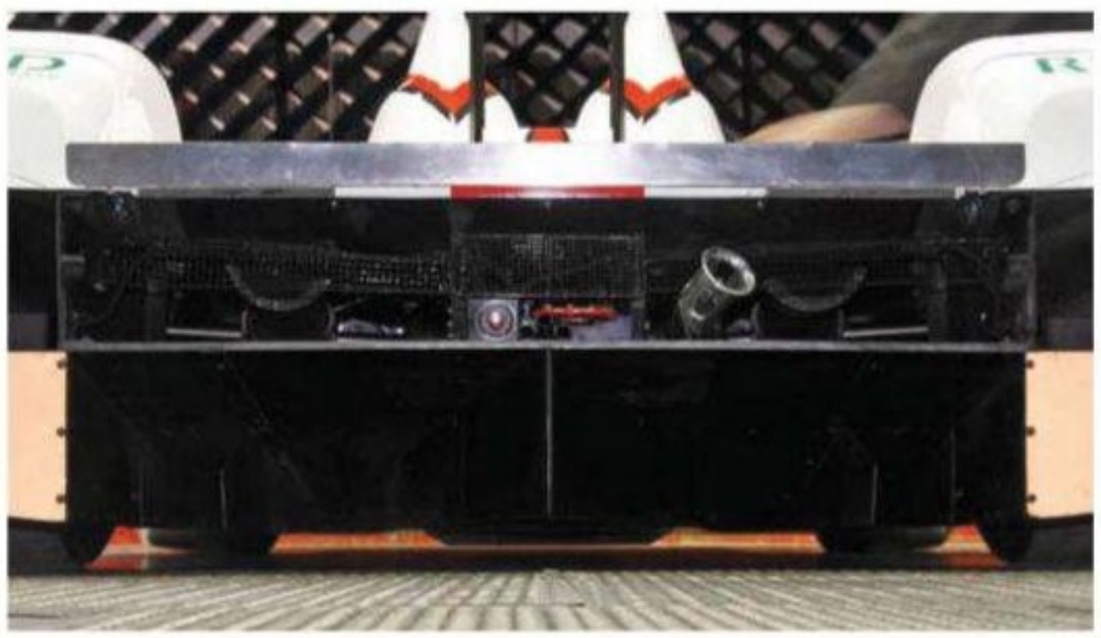
The Le Mans-winning Greaves Motorsport LMP2 Zytek Z11 SN waits for the wind in the MIRA full-scale facility

The potent front end featured the regulated splitter and double dive planes, as well as a curvaceous diffuser below

Side vents were supplemented by turning vanes

While much of the rear end is tightly regulated, the wheelarch flip ups and large rear body Gurney will be adding downforce

The swan neck-supported rear wing was well cambered and obviously fairly potent



The rear diffuser may be strictly defined, but is still reasonably voluminous

For comparison, the lower downforce Radical SR10, as tested in 2008

but it also generated over 17 per cent more total downforce, leading to a 13.5 per cent greater efficiency (-L/D) figure.

One of the most interesting aspects is that despite running with the narrower (1.6m) span, reduced (250mm) chord rear wing mandated from the beginning of 2009, as well as the control floor and diffuser, the Zytek nevertheless achieved over eight per cent more rear downforce than the Radical. Certainly, the Zytek's rear wing was a well-cambered, dual-element device, but, as Mike Fuller explained in last month's issue, it shows that mandating the narrower span wing served predominantly to increase development cost for it clearly did not reduce downforce, at least not for very long. The Zytek's wing mounts were of the 'swan neck' type, which enabled higher downforce to be generated by more heavily cambered wings.

Another key difference between the cars was the level of front-end downforce, the Zytek generating an impressive 30 per cent more than the Radical, giving a more forward bias to the aerodynamic balance. However, these numbers must be viewed in relation to the cars' static front-to-rear weight splits, which were roughly 39 per cent front for the Radical and 45 per cent for the Zytek. So the Radical's aerodynamic balance was actually somewhat closer to its static weight split than the Zytek but, given that the Zytek was in its well-honed 'preferred specification', whereas the Radical was under-developed, we can assume that the Zytek's '%front' value in relation to its static weight split represented a balanced condition out on track. This assertion has two codicils – firstly, with the fixed floor and non-rotating wheels this wind tunnel underestimates the downforce of ground-level devices like front splitters and diffusers. Secondly, a car that has slightly less front aerodynamic percentage than static weight percentage is more likely to have a little understeer at high speed, rather than the inherently less stable alternative. So the '%front' values should be looked at with this in mind and the Zytek provides a useful yardstick in this respect.

One of the things that emerged in the Radical session was how the balance shifted as a range of yaw angles was applied. The Zytek was tested at up to six degrees yaw angle, this maximum being used because it was the slip angle at which the tyres generated maximum grip, according to Greaves Motorsport's race engineer, Alan Mugglestone. The effect on the balance of the two racecars is shown in table 2.

Clearly, the two cars showed quite different responses to increasing yaw angle. The Radical's aerodynamic balance became more front biased as yaw increased, which one would think would be a potentially unstable response. The Zytek showed an initial shift away from the front at two degrees yaw, but the balance then moved more to the front with the remaining yaw increments until, at six degrees yaw, the balance was similar to the straight-ahead position. This seems like an altogether more stable response. It must be remembered though that these numbers were recorded as steady-state readings with data averaged over minute long sampling intervals, and the actual dynamic transient response may not be the same. Nevertheless, the Zytek looks to have more benign characteristics when tested in steady state.

Next month we'll look at the effects of the newly mandated bodywork modifications.

Table 2: the effect of yaw angle on aerodynamic balance, as given by '%front'

'%front' at yaw angle	Radical SR10	Zytek Z11 SN
0°	39.6	41.7
2°	41.3	40.6
4°	42.5	40.9
6°	44.6	41.4

AT THE HEART OF THE WORLD'S MOST POWERFUL ENGINES

www.arrowprecision.com

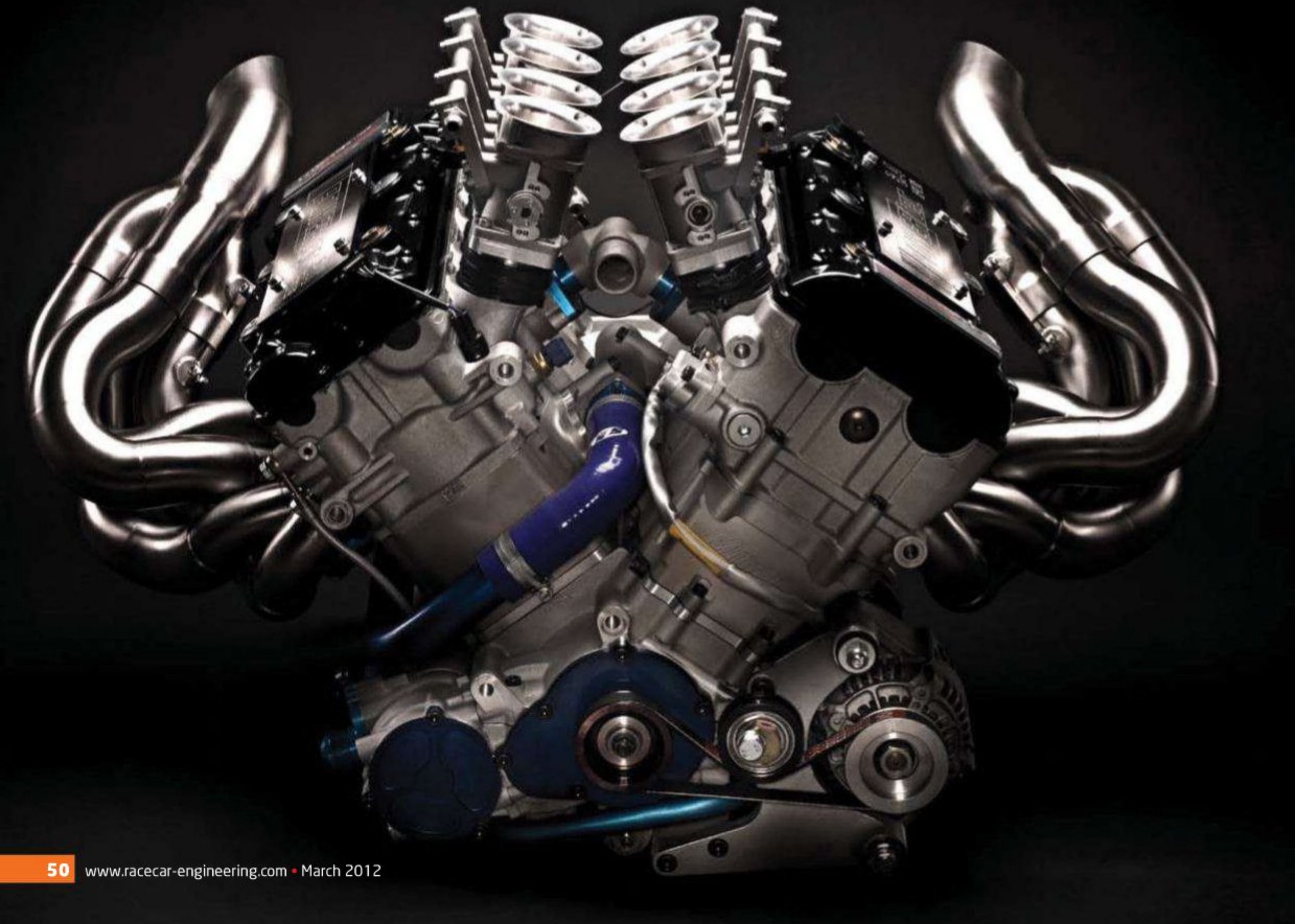
Give us your requirements and we'll find a high-performance solution, no matter how extreme.

Call our sales team: +44 (0) 1455 234200 **Email us:** enquiries@arrowprecision.com

Bikers welcome

As a major Touring Car series adopts the Radical Performance Engine's V8, has the motorcycle-derived racing engine finally come of age?

BY CHARLES ARMSTRONG-WILSON



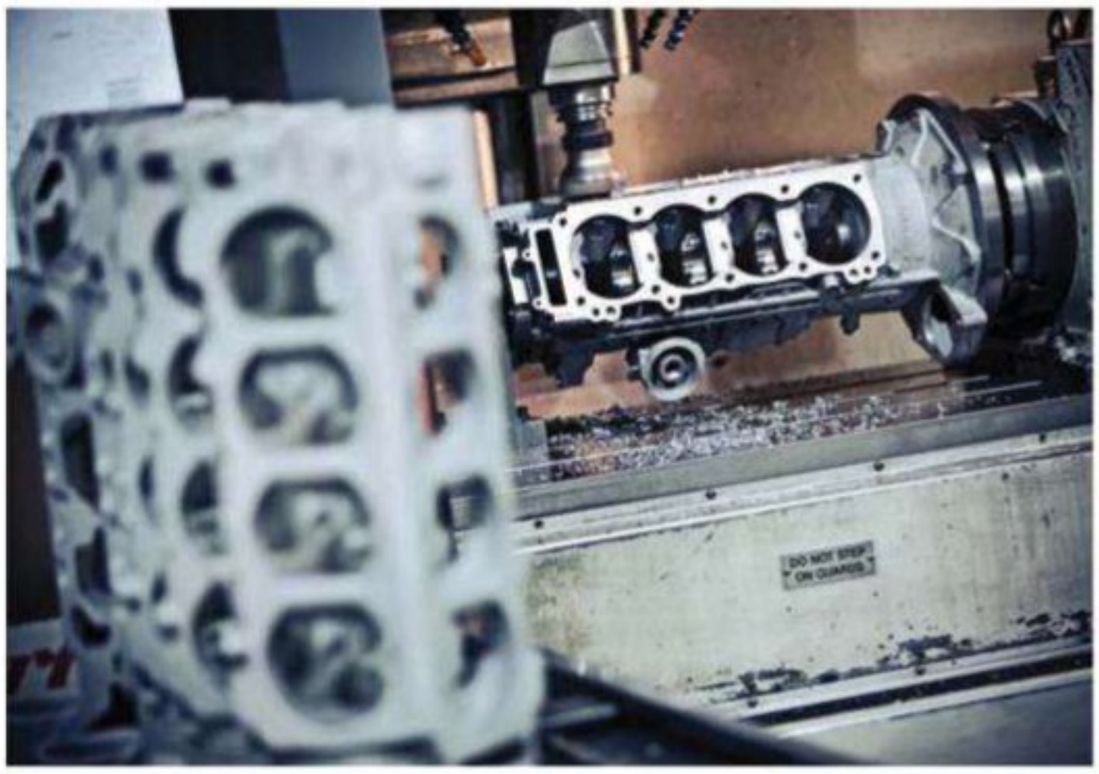
'Some of the die-hard car people were dead against it in the early days of Radical,' recalls Ted Hurrell about the emergence of motorcycle engines in car racing. But, in the opinion of the technical director of Radical Performance Engines (RPE), it was a positive move. 'I remember when we raced with Sports 2000, they hated us. But they only had six people in a race until we turned up, and then they had 20 people in a race.'

Things have moved on a long way since that time. Radical's numerous racing series have become a global phenomenon and motorcycle-derived engines are now widely accepted in racecars. Now with Radical's TCX V8 being mandated the spec engine for Argentina's TC2000 series that surely sees the concept coming of age.

For Hurrell, in 1992 the concept of putting a motorcycle engine into a car was hardly a challenging idea. He was a sidecar racer and his business, Powertech, had grown out of building his own racing engines. For him, the leap from three wheels to four was not a particularly large one. In 1996 he started supplying engines to Radical and, since then, the relationship has kept growing.

Soon he moved his business into Radical's premises and, in 2004, the sports car manufacturer bought into Powertech, enabling more ambitious developments. The biggest was perhaps the RPA V8, basically two Suzuki Hayabusa motorcycle engines on a single, common crankcase. It used the cylinder heads, blocks pistons, con rods and valvetrain from the 1299cc Suzuki engine, together with the company's own flat-plane, billet crank, to make a 2.6-litre V8.

"it was all about what the spectators want to see"

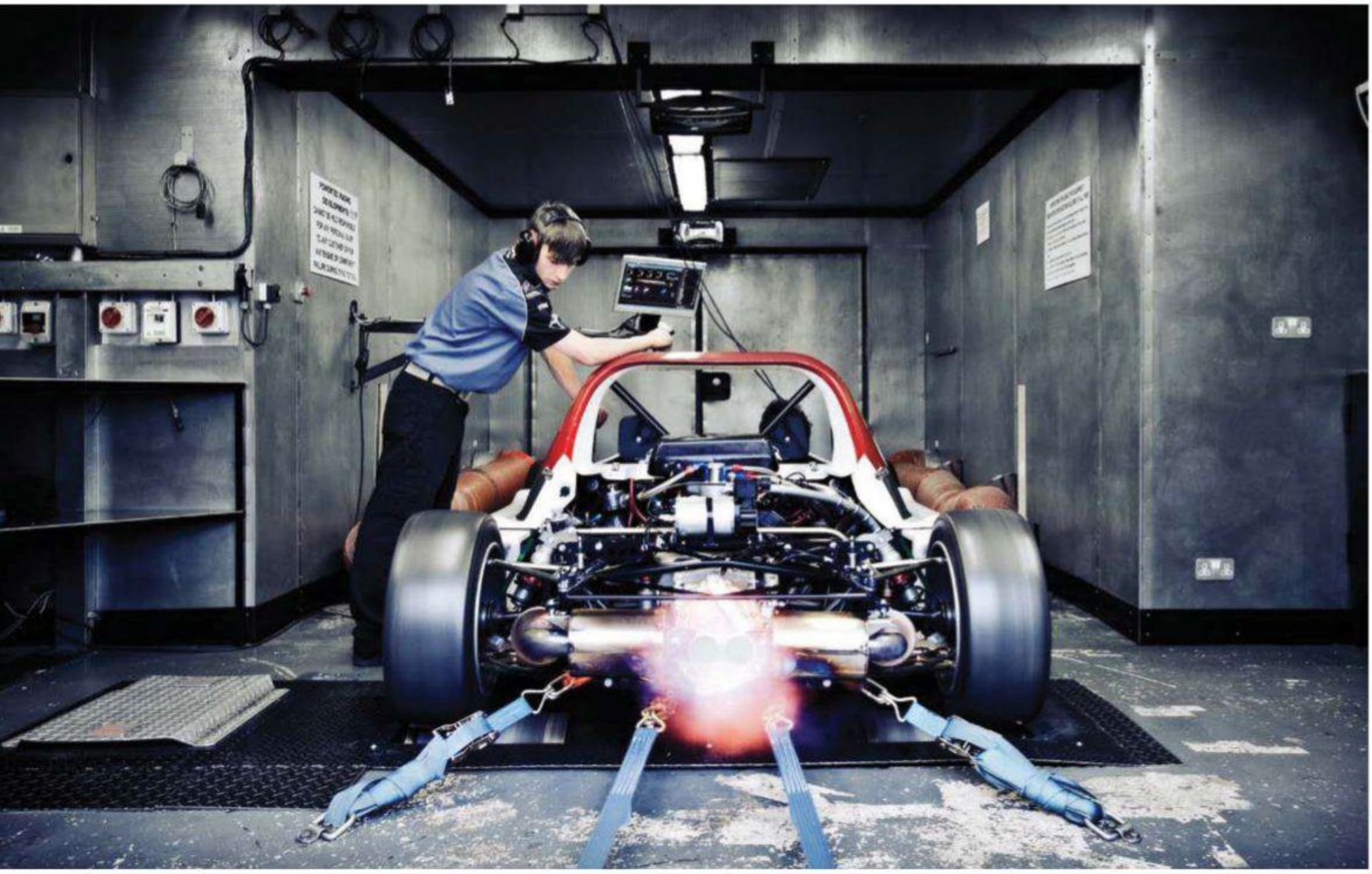


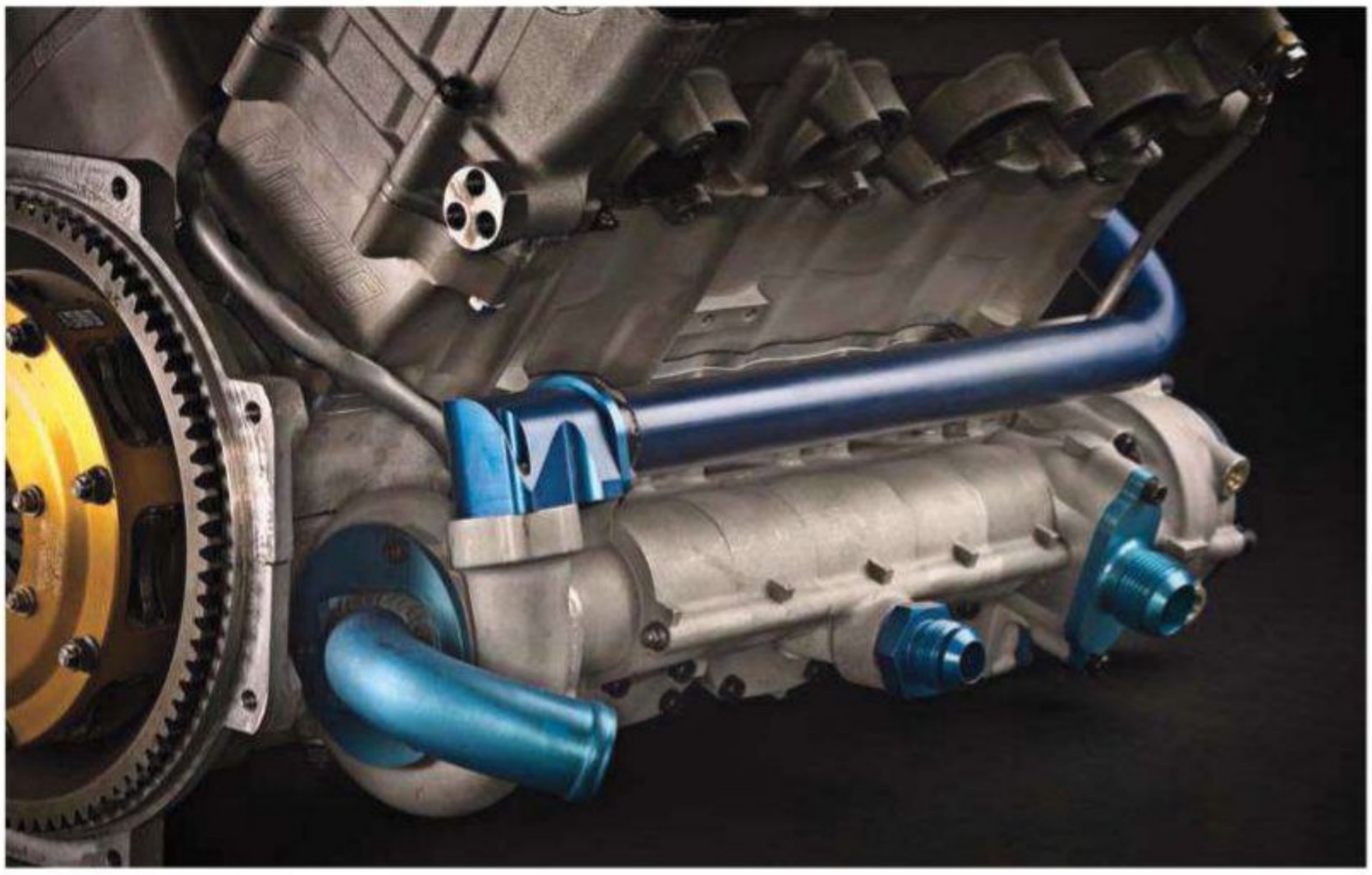
Using the same bore / stroke ratio as the standard Suzuki GSX-R 1340cc engine, the 2.7-litre V8s enabled the use of a vast number of standard Suzuki parts. Boring the blocks to 84mm produces a 3.2-litre version or, using an aftermarket, US-sourced block, 3.4 litres is even possible

'Others tried to do it,' remembers Hurrell, 'but the strength we had was the volume of Radicals. It was a painful process at times, though, because we didn't have just one prototype we were working on due to all the different applications.'

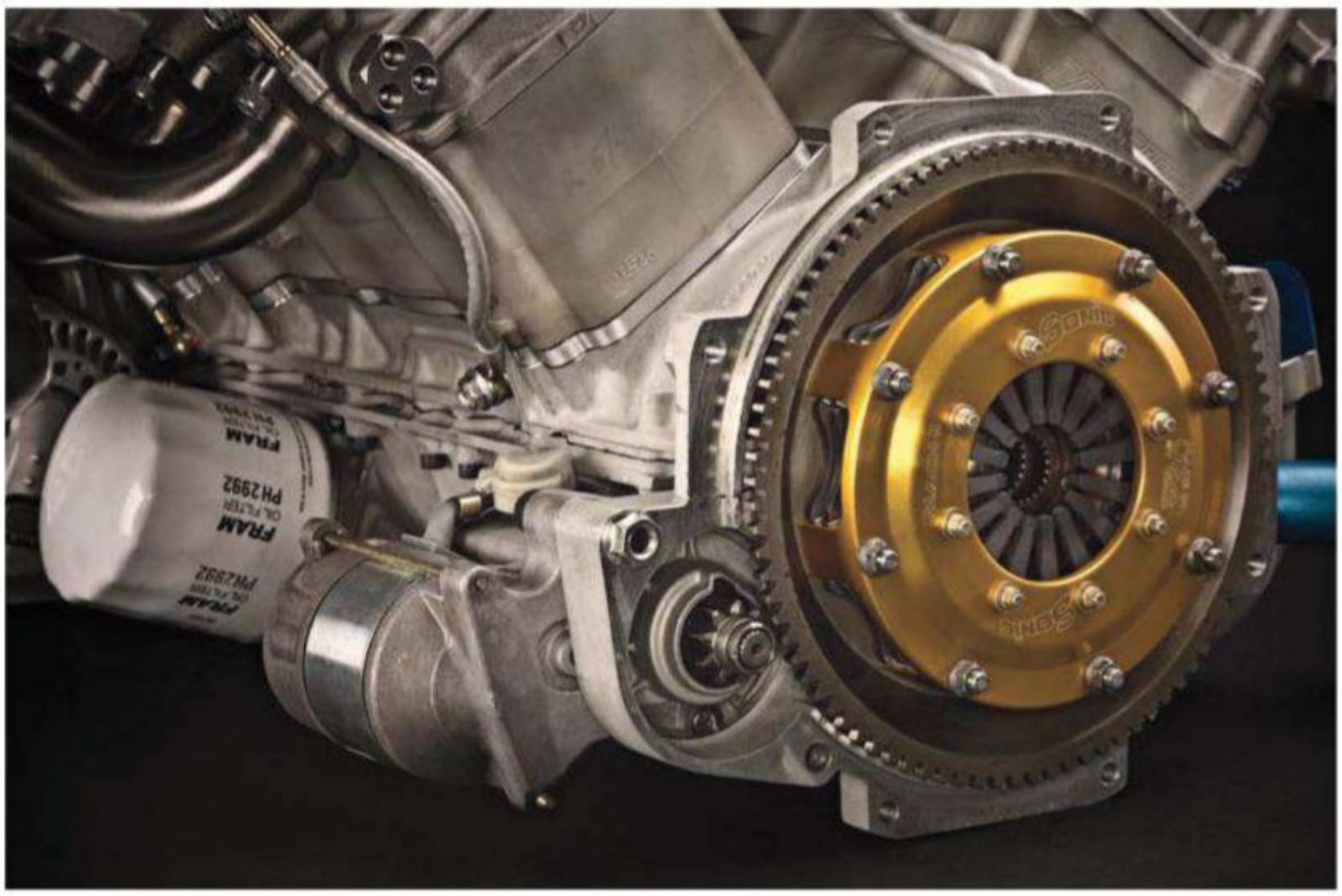
The engine was a watershed for Radical, allowing it to step into a whole new performance arena with its SR8 Sports Prototype. Since then, the engine has found a life in many areas of motorsport. 'We have sold them for hillclimbers, jet skis, autograssers and rally cars,' says James Williams, RPE's production manager. Over that time, more than 250 engines have been built, although most have found their way into Radicals.

Since its launch, there have been developments increasing





Lubrication is taken care of by twin pumps and a four scavenge pump dry sump system



In the Argentinian series the RPE V8 will mate to a Xtrac 1046 Touring Car gearbox, with Radical paddle shift

TC2000 series cars use a bolt-on front subframe, which previously housed a highly tuned Duratec V6. The Radical V8 is therefore a significant departure

the capacity and power of the engine. 'At the end of 2008, Suzuki increased the capacity of its Hayabusa to 1340cc by adding an extra 2mm on stroke,' explains Hurrell. 'We used the 1340cc engine in Radicals for 12 months and it ran very reliably so, at the end of 2010, we adopted the same bore / stroke ratio in the V8 engine.' This 2.7-litre version allowed a high proportion of Suzuki components to be retained, even the con rods.

'We launched the 2.7 at the end of 2010 at Yas Marina with two cars run by the Radical factory team,' says Williams. 'It has a huge increase in power and torque and just worked really well in the Radical car. The result was a lot of interest by Radical owners in the new model, and 14 cars were sold over the next year.'

BIG, BY BORING

Bigger versions still are also available. By boring the standard block out to 84mm and using a 71.4mm crank, the engine can be stretched to 3.2 litres. Or, using an aftermarket, US-made block that takes the bore out to 86mm, the capacity increases to 3.4 litres. However, these engines are only supplied in very small numbers for specialised applications. 'There are maybe five running in America, and over here a couple of guys doing track days,' says Williams.

The Argentinian deal came about after an approach by the series orgainsers, media company Autosports SA. TC2000 is the country's premier Touring Cars series and is based on its own, unique set of rules. Cars are built around steel 'shells from front-wheel drive saloons, with integral rollcages up to the front and rear bulkheads. From here on, they are allowed to use bolt-on spaceframes that carry the suspension and drivetrain.

For three seasons, up until last year, they were using Ford's Duratec V6, uprated to around 300bhp. But, despite the low cost of the base unit, it required significant modifications and regular rebuilds to deliver the power, pushing up the price. With the contract coming to an end, the series organisers were looking for a replacement unit.

TECH SPEC

Radical Performance Engines TCX V8

Suzuki GSX-R 1340cc cylinder head technology
72-degree V8 cylinder,
32-valve quad cam
Eight 45mm throttle body induction system
Steel flat plane crankshaft
Twin pump lubrication system
Four scavenge pump dry sump system
Rotary vane coolant pump
Pre-engaged starter motor
Belt-driven 45-amp alternator

Despite strong grids in Sports 2000, motorcycle-engined racecars have struggled to be accepted, but a move into a major Touring Car series could change that

'We were first investigated by the people from TC2000 two years ago at the Autosport Show,' recalls Williams. 'Then the chief guy running the series contacted us. He had been aware of the Radical brand, and of the V8 engine. They had always dreamed of putting a V8 engine in the TC2000 series. The teams all have a say in the series and they wanted something that would make the cars sound better as well as go faster, high revving and very loud. We even developed the exhaust to give a high-pitched, raspy exhaust note, very different to Radical. It was all about what the spectators want to see.'

The TC2000 cars are front-wheel drive and the Radical engine sits in the same transverse location as the Duratec. It mates up to an Xtrac 1046 Touring Car gearbox [see *RE* V21N10] that operates from a paddle shift on the steering wheel supplied by Radical. The company also supplies much of the braketry and piping necessary to install the engine and ancillaries like the power steering pump. 'It's then down to teams to get their bits on to make a complete car,' says Williams. 'We sent two of our guys there to make sure the engine mounts were correct, the heads were braced in the correct manner and the tanks were all the right size and correct position.'

A feature of the Argentinian TC2000 series is the size range of eligible vehicles from small, three-door hatches like the Peugeot 207 to mid-sized, four-door saloons like Ford's Mondeo. 'Our guys were looking into the different characteristics of the cars. Some have one rad, some have two, and there are some very different air intake designs.' It was important for the Radical technicians to make sure their engines were going to receive sufficient cooling.

An area where Radical was able to provide added value was the engine management. TC2000 has a novel way of equalising performance in its series by limiting practice time at each round. A team running near the bottom of the leader board may have as much as three hour's free practice during a race weekend. In contrast, a front-runner might be limited to just 10 minutes. Its effect on relative performance can be imagined. The leading team might struggle to refine its set up while tail-enders could run through many options in search of the optimum configuration.

This is policed using onboard electronics, making it easy for the organisers to manage the time on track. However, the MoTeC system used on the Duratec was unable to incorporate this function, so it had to be managed by an additional Protec box. For five years Powertech, now re-branded Radical Performance Engines, has been working with LifeRacing to produce its engine management electronics and wiring harnesses. 'It has worked brilliantly,' says Hurrell, 'we have absolute confidence in them.' This relationship meant the practice time limiting function could be incorporated into the engine's ECU.

"extend the engine warranty from 30 to 40 hours"

THREE-YEAR DEAL

'The TC2000 organisers came over, met us and brought their engine specialists,' says Williams. Once they decided they wanted to proceed, an agreement was made for three years starting in 2012. Radical Performance Engines will initially supply 42 examples of the TCX version of the V8 with support and additional units as required over the coming three seasons. One advantage of the change from 2.6 to 2.7 litres is RPE was able to extend the engine warranty from 30 to 40 hours. That means, with the championship lasting 12 rounds, the teams should only need the one rebuild toward the end of the season.

A bonus is the organisers have also become the Radical distributors for South America. So, for now, the relationship seems strong, while competitors and spectators are looking forward to more performance and spectacle in the coming season. Surely the transfer of technology from motorcycles to racecars is complete.

Instant gratification

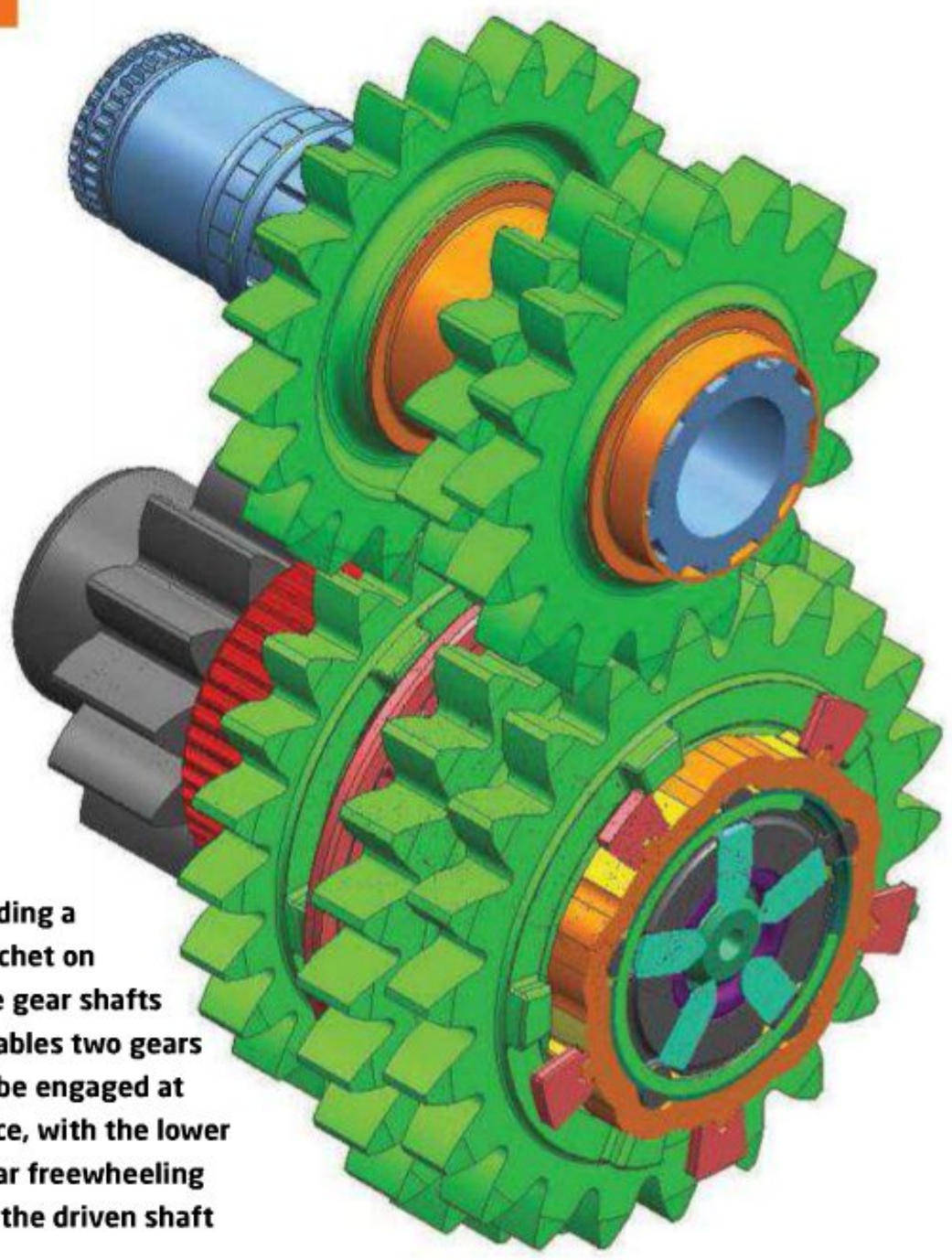
How Xtrac has brought the magic of seamless shift technology from Formula 1 to less expensive race series, and even electric road cars

BY CHARLES ARMSTRONG-WILSON

Seamless shifting. It was a buzz word a few years ago and described something many believed was transmission Nirvana, while others doubted whether it was possible at all. The dream was to have a seamless torque delivery right through the speed range with no breaks due to gear changes. Yes, it can be achieved with a continuously variable transmission, but not within most rules. To achieve it with a set of fixed ratios is a neat trick and there have been many different takes on the problem.

At the heart of the concept is the need to engage the next gear before the previous one has been disengaged. It doesn't take much knowledge of gearboxes to know that if you engage two different ratios, splined onto the same shaft, at once, they are going to want to turn said shaft at different speeds. The consequences range from the transmission locking solid to an explosive failure of the connected components if enough torque is applied. This is why conventional gearboxes cut the torque to the 'box during changes, or disengage one ratio before engaging the next.

Xtrac's technical director, Adrian Moore, reveals it was around 2002 that a passion for solving this particular challenge swept through Formula 1. Continuously variable drives were banned from the series in the 1990s, once people got wind of the fact that Williams F1 was developing a workable system. From then on, the rules specified discrete, fixed ratios. But ever-improving simulation techniques were able to demonstrate the size of the penalty that gear changes were inflicting on lap times. If they could be conducted without interrupting drive to the wheels, quicker laps would result.



Adding a ratchet on the gear shafts enables two gears to be engaged at once, with the lower gear freewheeling on the driven shaft

BIG BRAINS

It transpires that when you put some of Formula 1's best brains onto this seemingly insoluble problem, they come up with not just a solution, but several. For the next few years, different teams pursued their own designs but, over time, one design began to dominate. This is the one employed in Xtrac's own customer F1 transmission used since 2010. The mechanics of the design are disarmingly simple – rather than having a single barrel to move the selector forks, it has two, one operating the odd ratios and the other operating the evens. The clever part is in the control system because, unsurprisingly, the key to success is split-second timing.

With one gear still engaged, the other barrel is rotated to engage the next ratio. As the new gear's dogs meet, they pick up the drive, taking the load off the previous ratio. However, before the unloaded gear's dogs can swing round and engage with their opposite faces, their barrel is rotated to snatch them out of engagement, avoiding disaster by a hair's breadth.

Once perfected, it works very well, and today all F1 cars have unbroken power delivery through the gears, with only the most subtle of engine management interruption to manage the torque spikes at each change.

"no need for sophisticated electronics and management"

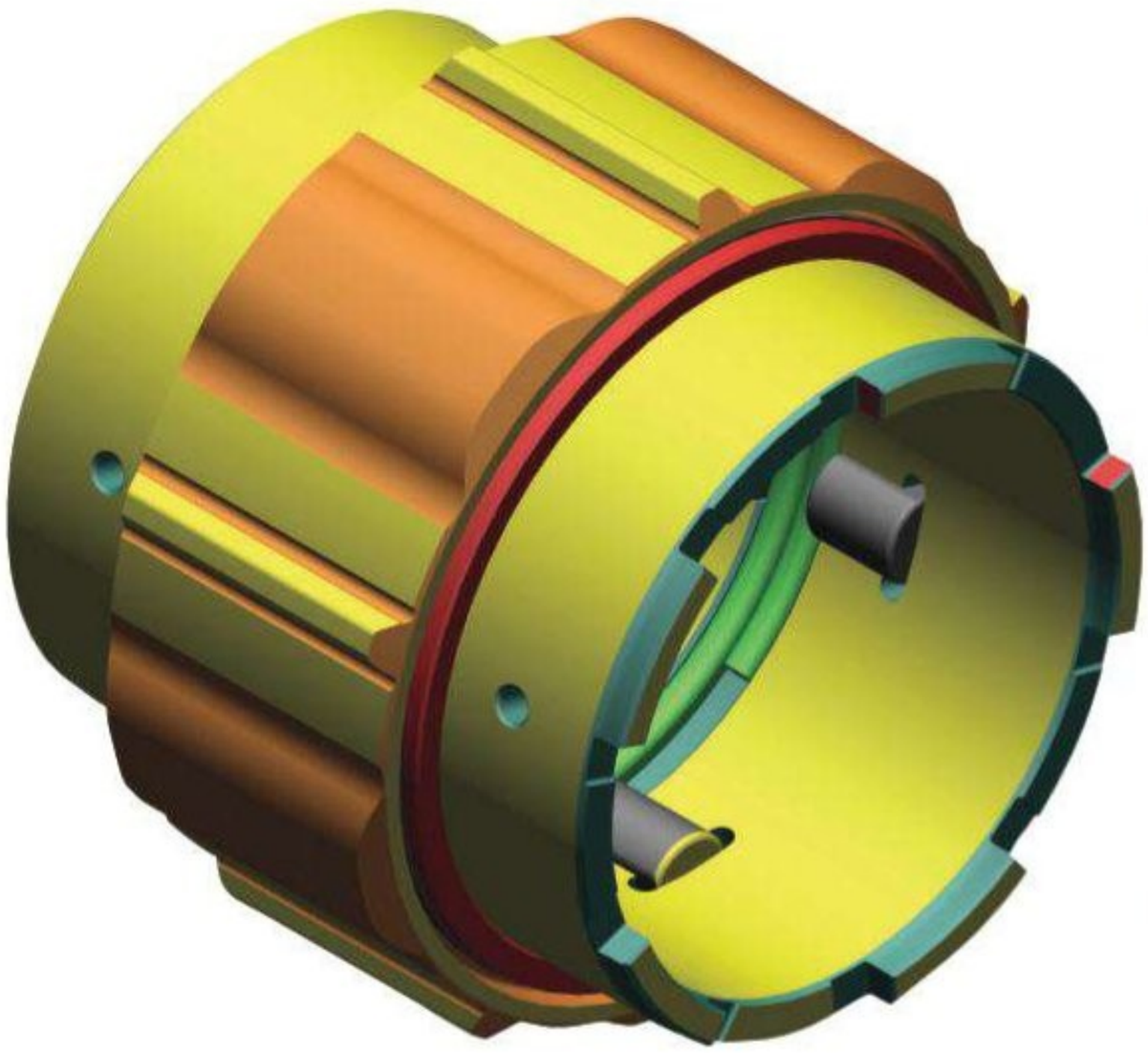
But the development path was littered with expensive errors. Even the production system has redundancy in its position sensors, just in case the harsh environment of an F1 car should cause one of them to decide to take an expensive siesta.

Problem solved it would seem, and the world of racing transmissions will never be the same again. Unfortunately, most race series do not allow the sophisticated electronics and hydraulics required to make the system work. And with good reason, as even Xtrac's customer F1 transmission uses four expensive Moog hydraulic valves.

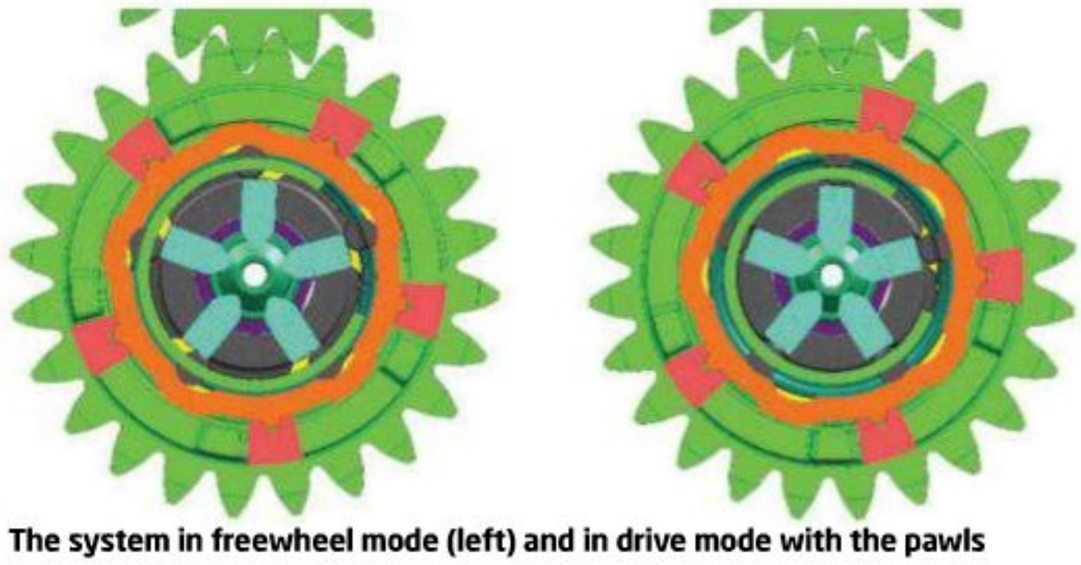
PURELY MECHANICAL

But what if a seamless-shift transmission could be built as a purely mechanical system, with no need for sophisticated electronics and management? Would that be eligible for the broader world of racing? Yes, it would, and Xtrac has developed just such a system. Christened IGS, for Instantaneous Gear Shift, it works entirely mechanically yet achieves seamless shifting with no break in drive during gear changes. It sounds too good to be true, so how does it work?

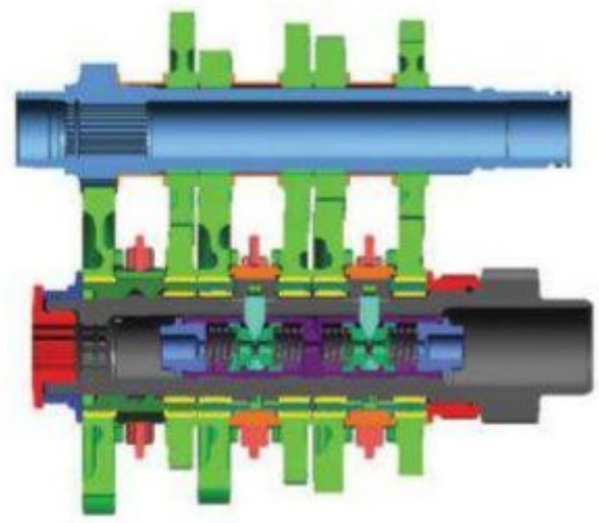
When Xtrac's engineers first tackled the problem, they quickly realised that if they incorporated some kind of ratchet or sprag clutch into the gears then engaging two gears at once would not be a problem. As the higher gear engaged and speeded up the shaft, the lower gear would just freewheel on the driven shaft, preventing lock up. It was a simple solution, but a limited one. Yes, it would achieve seamless shifts up through the 'box, but the car would permanently be in freewheel with no engine braking.



The system's two-part hub, showing the castellated end of the inner sleeve that engages with the adjacent hub's sleeve



The system in freewheel mode (left) and in drive mode with the pawls engaged (right)



Springs inside the shaft load plungers that force the pawls out into the recesses on the inside of the hub

The breakthrough came in 2006 when the problem was run past one of the company's engineers, Andy McDougal. Moore: 'Andy's a creative guy. His track record here is exceptional.' His key to Xtrac's system is a neat mechanism that can control which gear pairs are driving and which ones are in freewheel.

Before explaining how it works, it would probably help to re-cap on how a typical racing transmission works. The driving ratios are fixed to the input shaft and the driven ratios are free to spin on the output shaft. Each pair of driven gears spin on a hub that is splined to both the output shaft and a dog ring. Sliding the dog ring to either of the gears in its pair allows its dogs to engage with the dogs on the face of the gear. Drive is then passed from the input shaft gear to the output shaft gear and then, via the dog ring and the hub, to the output shaft.

THE CLEVER BIT

Where the IGS is different is rather than the drive being transmitted from the hub to the output shaft via splines, it has a set of cylindrical pawls projecting out of the shaft that are sprung loaded by plungers that engage with the hub. On a normal sprag clutch these would be designed so they can only transmit the load in one direction – effectively a freewheel. On the IGS they can transmit drive in both directions, depending on the scenario. Now pay close attention because this is the clever bit.

They only transmit drive when pushed against either side of their slot in the shaft. If they are held in the centre of the slot they do not transmit drive. The next challenge is how do you accurately control which part of the slot the pawl resides in at the right time? Between the shaft and the hub is a sleeve (cage) with rectangular slots that hold the pawls in position.

Each gear pair hub has a separate sleeve with castellated ends that engage with each other rather like dogs but with a small amount of free play. This allows them to turn by a few degrees relative to each other. When one gear pair is driving, its pawls are held up against the side of the slots in the shaft. However, because of the small amount of free play between adjacent sleeves, the neighbouring sleeve is slightly out of alignment, holding its pawls in the centre of the shaft slots and preventing them transmitting any drive. And that is all there is to it.

It works on up and down changes on open or closed throttle. Obviously, to get the seamless shift, successive gears have to alternate between gear pairs as there is only one dog ring per pair and it cannot be in two places at once. But this is normal practice on Xtrac's conventional gear systems as it allows the changes to be timed closer together.

TORQUE SPIKE MATCHING

But what about the problem of matching speeds and the inevitable torque spike when the inertia of a fast-spinning engine is slammed into a set of dogs connected to some sticky racing tyres? Phil Roper, principle engineer, explains that it has not proved to be a problem. Compared to disconnecting the drive altogether, the total variation in torque is actually smaller and can usually be absorbed by the wind up in the drivetrain. 'Only when it's raining do they blend the throttle down to about 85 per cent, but this is to just prevent wheel spin,' he reveals. 'The drivers say it is very smooth and actually unsettles the car less in corners because you are not on / off / on the throttle during a gearchange. The feedback has been very positive.' On a 250m straight it is worth around 3km/h and allows gearchanges to be made 10m earlier. Obviously, the benefit is track and series dependent, but Roper finds it typically worth about three tenths a lap.

"the big cost is not the parts, but the re-calibration of the car"

A big advantage of the design is the compatibility with standard race gearbox architecture. While developing the system, teams did back-to-back testing by simply swapping clusters.

Moore is obliged to respect client confidentiality regarding who is using the system and in which series, but he admits to several customers, all in top-level professional motorsport. Currently, there are no plans to roll it out to standard customer gearboxes. He says the big cost is not the parts, but the re-calibration of the car, which few teams would be able to afford. In fact, the company sees volume sales in road cars, specifically electric vehicles where seamless take up would work well with electric drive. This is why the system has been patented, allowing the company to go public on the design.

So next time you are watching a round of a major international series, listen carefully and see if you can tell who is using it.

SMITHS
HIGH PERFORMANCE

Stockists of high performance metals to the world's most demanding markets

TITANIUM ALLOYS

- 6AL4V
- 6246
- 6242
- CR14
- Bar, Plate & Forgings

Smiths High Performance Unit 0, Stratton Business Park, London Road, Biggleswade, Beds SG18 8QB
Tel: +44 (0) 1767 604 708 **Fax: +44 (0) 1767 312 885**

www.smithshp.com

One giant step

From LMP2 to Group CN, Team WFR proved it is possible to make the step up from engineers to constructors, culminating in the 2011 WF03

BY IAN WAGSTAFF

Such was the domination of the pair of factory WF03s at Paul Ricard for the opening of the SPEED EuroSeries that the championship already seemed foregone. Sure enough, at the end of the season, WF03 drivers, Warren Hughes and Jody Firth, had clinched the title. However, it was not a formality. As other manufacturers steadily improved their products, Ossett-based Team WFR was involved in a development battle with rival chassis manufacturers, and there just was not enough time for conventional performance testing.

It is perhaps outside the remit of this magazine to point out that having arguably the best driver pairing in the series certainly helped, but credit must also go to those who toiled to keep the cars competitive.

It was not the first attempt by Team WFR, or Embassy Racing, as it was previously known, to become a Sportscar manufacturer. In 2008, disillusioned by proprietary manufacturers (although, to be fair to the industry, its Pilbeam MP93 and Radical SR9 were hardly the greatest LMP2 cars), the team decided to build its own Zytek ZG348-engined LMP2s (see *RE* V15N5). It was an ambitious plan, most outsiders said too ambitious, and so it proved to be. The WF01s, designed by Peter Elleray, who had penned the 2003 Le Mans-winning Bentleys, had a troubled season. As Geoff Kingston, who engineered one of the WF01s and subsequently took over the design of the WF03, states, 'It was rather like this year.' The difference was that the WF03 got the results. A similarity may be that both designs have proved to be one-year efforts – the WF01s disappeared at the end of the 2008 season, only for a single car to turn up for a one-off entry at Silverstone the following year. At the time of writing, the fate of the WF03s was still unclear.

"A more affordable route to becoming a manufacturer"

LESS AMBITIOUS

The WF03 (there never was a WF02) was a far less ambitious project. From the ethereal heights of LMP2, WFR moved to the FIA's Group CN category (Appendix J, Article 259), which comprises much simpler Prototypes powered by common, Mugen-supplied, 260bhp, 2.0-litre Honda Civic engines. This provides something increasingly rare these days – multi-chassis racing, and a chance for a variety of manufacturers to be involved. It was also a more affordable route to becoming a manufacturer, certainly if the aluminium honeycomb path, as opposed to the carbon one, is taken (the 2011 season was the first in which composite carbon chassis were allowed).

As with the WF01, Peter Elleray was called upon to design the 03, which tested first at Snetterton in August 2010 and made its public debut at the following January's Autosport International. The show car was said to be one of an initial batch of five. Geoff Kingston rejoined the team to take over development of the car in January. Testing up to this point had been encouraging and the car was running relatively quickly, but proving difficult to drive. A test just before Christmas had been regarded a 'do or die'

PICTURES BY IAN WAGSTAFF AND PETER MAY

effort. In effect, if the car had not achieved a lap time, the project would have been stopped, Hughes and Firth had raced a Bryce Wilson-run Ligier JS49 to victory the previous season in VdV, so there was a reasonable benchmark to work on.

AREAS OF DEVELOPMENT

There were a number of areas to develop. The steering was extremely heavy, which was alright for shorter 'testing' runs but unacceptable for race stints. The car also felt 'nervous', with quick breakaway on the limit and, perhaps the biggest problem for racing, the brake temperatures were out of control.

The steering weight was simply fixed by changing the rack and pinion ratio. Titan Engineering supplied the rack assembly and, says Kingston, were most helpful in meeting the deadlines. Initial work by him on Dynamics' four-post rig at Thetford appeared to indicate insufficient damper travel, particularly at the rear. In effect, the available damper travel limited the ability to achieve a progressive rising rate through using bump rubbers, and, as the travel was limited, the bump rubber had to have quite a high spring rate. This led to an early and major change from Konis to Öhlins TTX dampers. The amount of damper travel, and therefore wheel travel, was increased by about 14mm, which meant the car was no longer as 'edgy'.

In relation to the brake temperature problems, no amount of cooling revisions helped the original F3-spec set up so, after consulting AP Racing, the decision was made to fit 'next size up' calipers and discs. This also meant that new uprights had to be fitted, machined aluminium ones replacing the original cast magnesium items. This resolved the problems, while still enabling the car to use the same cooling systems as the original specification, but resulted in a 7kg weight increase.

Another major change was made just before Kingston arrived. Originally, Elleray designed the car with the airflow going through the front suspension, but the car seemed to suffer from understeer. Large dive planes were being used but they were very 'draggy', so these were removed and up-and-over panels made. This then compromised the cooling, as there was no direct flow to the radiators. In cold ambient they would be running water at 105degC. Holes were therefore made in the front panels at the last minute, only a week before the first race at Paul Ricard. Kingston admits this was an extremely inefficient answer to the problem, but that was how it stayed for the rest of the season. 'You certainly wouldn't do it like that if you were starting from nothing,' he says.

"We were fortunate to be in a position to control all the issues because we were so far ahead"

FIA-regulated CN formula crash box structure is a bolt-on carbon piece, sitting above a very large front diffuser

Despite these early problems, the two cars initially built went to France and were placed first and second in both races. 'It was ridiculous,' recalls Kingston. 'In terms of reliability, we were well away from where we should have been to appear as dominant as we did.' To prove his point, a wing cross brace fell apart in the second race, one of the cars' tail sections was damaged by aero loads and was lifting on the Mistral, while the race-leading car was leaking oil because the swell pot had a hairline crack. Recalls Kingston, 'we were fortunate to be in a position to control all the issues because we were so far ahead.'

Engine is a spec, Mugen-built, 2.0-litre four producing around 238bhp

SETBACK AT SPA

In the week before the third and fourth rounds at Spa-Francorchamps, the team went testing at the Belgian circuit. 'Things were beginning to take shape,' says Kingston, when Joey Foster's car went airborne at Eau Rouge and dramatically leapt the barriers. Typically, in an incident such as this, it has not been possible to say with 100 per cent certainty what caused the accident. What was evident from the data was that the car had lost a significant amount of rear downforce and shed some drag just prior to the Bus Stop on the preceding lap. Driving into the hill at Eau Rouge the vertical wheel loads were naturally quite high, due to mechanical downforce, and at the top of the hill, when the aero is needed, in this case it was not there. Had this happened before a normal corner there would probably have been a minor moment but Eau Rouge was probably the worst place it could occur. As a result, both factory cars and a private entry were scratched from the weekend's races.

Team WFR withdrew from the SPEED EuroSeries championship to concentrate on manufacturing. Dave Beechcroft's Warrington-based Xero Competition, which had been due to run the first customer car at Spa, ran the WF03s and, at Donington Park, they were again dominant.

REDUCING WEIGHT

The WF03 was over 50kg over the minimum weight of 570kg, a handicap difficult to quantify here in terms of lap time but, with their rivals on or close to the limit, that could mean up to a second and a half slower on any lap.

" There just was not enough time for conventional performance testing "

The chassis was, by Elleray's own admission, over-engineered, a fact that probably saved Foster's life. To help overcome this, the team were continually looking for ways to reduce weight, so ran lithium batteries at Donington, but one of these failed on Ben Clucas' car. Such batteries are not as straightforward as standard ones and the team never really got to the bottom of the problem, so standard Red Top batteries were reinstated for the rest of the season, and the 5-6kg that had been saved were put back on.

A new floor replaced the original, 22kg, wooden one. Kingston decided to split the floor, with a wooden part with Jabroc skids for the first third of the floor and glass fibre composite for the rest. This saved about 10kg. A further 3kg were saved when the engine frames were lightened by reducing tube diameter and gauge. A spherical bearing was introduced on one of the attachment points, which seemed to give the frames a longer life than before, but there was still a problem with cracking – a problem on most of the SPEED EuroSeries cars due to the vibration harmonics of the in-line four Honda engine

Another problem arose in qualifying at Imola. The WF03 uses pull-rod suspension and the gearbox had been designed for a push-rod system, so a bracket had to be bolted onto the side of the gearbox to mount the rocker. One of the two studs broke on Firth's car and the afternoon was spent fixing it, only for this to fail again in the first race. In the second race, a bolt holding one of the hubs together on one of the cars broke.

At Silverstone, the importance of the floor leading edge height was illustrated. Personnel new to the WF03 fitted the floor on Hughes and Firth's car, but it didn't fit properly as the underside of the chassis had been damaged at Paul Ricard and shim spacers had to be used to regain the flatness to the road. Unfortunately, a lack of communication resulted in a 15mm left to right lateral rake of the floor, and led to a consequent reduction in performance.

Despite this, the team, as Kingston admits, 'lucked into' second and third places and the WF03s were still in contention for the championship when it came to the final rounds at Estoril. Hughes was on top form that weekend and the title was secured, despite the fact that rival manufacturers appeared to have caught and passed WFR.

Now Even Lighter.

New ultra lightweight compact 3 & 5 way connectors.

AS Micro Xtra lite HE

A STEP AHEAD

Visit **www.deutsch.net** for more information, a list of our worldwide distributors or to download a technical datasheet. Alternatively call **+44 (0) 1424 852722** or email **autosport@deutsch.net**

DEUTSCH

AUTOSPORT

KRONTEC

Fitting & Hose Systems

...one step ahead

High quality hose assemblies

- All race series F1,ALMS, WTCC, WRC
- 100% pressure tested
- flushed to NAS on request

Airjack system - quick lift

- Most lightweight – only 962g at 230mm stroke
- fastest actuation – by 40bar pneumatic pressure
- Highest safety – by integrated pressure relief valve

Steering wheel quick release

- Only 272g
- Conical seat - free from play
- Easy to connect by ingenious mechanism

Bespoke parts

- CNC turning and 5-axis milling machines
- short delivery times
- full traceability

NEW online shop

- delivery from stock
- easy order system
- worldwide delivery service

New facility in the UK

KRONTEC Design Ltd., Phone: +44(0)17 93-42 20 00

www.krontec.com

So, what was good about the car? At Paul Ricard it appeared to have a top speed advantage. Up to fourth gear, speeds seemed similar to the Wolf – at that stage the quickest of the rest – then, in fifth and sixth, the WF03 crept away. That advantage evaporated as the season progressed, but it did seem to be more reliable than the competition. Kingston also adds, 'One of the major things about our car was that it conformed to the regs!'

One of the problems encountered was using non-specific parts. The WF03 has pull-rod suspension but used a Hewland FTR gearbox designed for push-rod applications, meaning a conversion bracket had to be made. It broke

Changes made to the original Peter Elleray-designed aerodynamics led to problems with airflow to the sidepod-housed radiators

TECH SPEC

WF03

Chassis: aluminium honeycomb, 20mm panel section, 0.7mm skins

Bodywork: GRP, wet lay up

Aerodynamics: To FIA CN Prototype regulations, other than addition of rear diffuser (allowed in SPEED EuroSeries)

Suspension: twin wishbone, unequal length with pullrod-activated dampers through rockers

Steering: Titan rack and pinion

Brakes: AP Racing CP5219 four-piston radial mounting calipers; AP Racing CP3580 280 x 25mm discs

Wheels: Speedline aluminium alloy, front 8.25 x 13, rear 10 x 13

Tyres: Cooper (series spec tyre)

Transmission: Hewland FTR 200

Data acquisition: MoTeC

Control system: In Control

Fuel tank: ATL 80 litre

Dimensions:
Wheelbase: 2705mm
Front track: 1524mm
Rear track: 1484mm
Overall length: 4800mm

Engine:
Type: Honda Mugen
Configuration: in-line four cylinder
Displacement: 2.0-litre
Standard, other than the addition of: dry sump oil system; MoTeC ECU; airbox system, including a restrictor and K&N filtration; racing exhaust
Max torque: 158ft.lbs
Max power: 238bhp

TRADITIONAL TECHNIQUES

The car is simply described. The main chassis structure is made from aluminium honeycomb with steel reinforcement of the front, the dashboard bulkhead and the rear roll over structure. There is a cast magnesium front bulkhead to which the aluminium panels are riveted and bonded.

The aluminium honeycomb follows traditional manufacturing techniques of routing the inner skins out, and then bending them round a former to construct from the floor to the side, with a riveted angle section to regain skin continuity. Inserts are cold bonded to take the suspension, which uses pull rods at the front and dampers mounted very low in the chassis. The anti-roll bar is a blade type. At the back, an alternative 'sprung link' was designed and manufactured but only tested briefly at race meetings, while the suspension is pull rod with the dampers mounted on the side of the gearbox. The FIA-regulated carbon nose box is as dictated for the CN formula.

Aerodynamically, the WF03 was pretty competitive, even though it never went into a wind tunnel, indicating Elleray's strength in this area. The front diffuser is a shaped panel from the front of the car to just ahead of the front suspension. It is a very large surface area at quite a shallow angle. The exhaust exits at the rear, this being possible because the diffuser design was to the letter of the regulations.

In 2011 the regulations stated that the diffuser had to be a single, continuous flat plane. Obviously, this would not work unless a bulge was included for the gearbox, which meant there was a natural limit to where the wishbones were and that produced an angle of around eight degrees. When the team arrived at Paul Ricard it found a number of its competitors had curved diffusers. Nothing was said at the time, but Kingston admits that when the leading Wolf had an obvious power advantage, 'we became twitchy'.

The WF03's dry-sump engine is completely reliable as it comes from Mugen. Dyno tested, it was found to have 235-238bhp but, with Wolf claiming 250-253bhp for its engines, Kingston is convinced the WF03s were giving away some 15bhp through airbox and exhaust design.

'We started the year with a car that was obviously competitive, but with areas that needed improving,' reflects Kingston. 'When a car fails during a race, rather than when testing, you spend your next period of time resolving the problem instead of performance testing. I believe the car is pretty solid now.'

THE FUTURE

Believing the CN regulations offer designers a real opportunity to be individual, Kingston penned a concept for a WF04. The proposed Tatuus PY 012 CN featured a 'Coke bottle' rear-end bodywork with a cover over the suspension like a formula car and single-seater sidepods. To commit to such a different concept it would have to be 'checked' by aero testing in the design stage, but the team were confident they could produce a racecar to rival the best available. Sadly, though, there will be no WF04. One of the reasons is that, to be competitive, any new car would have to use a full carbon chassis and, says Kingston, the cost of getting the first one to the grid is similar to an LMP2 car.

" CN regulations offer designers a real opportunity to be individual "

The project seems, therefore, to have come to an end although, at the time of writing, there was still a possibility that either Xero Racing or Bryce Wilson's If Motorsport might race the cars in 2012, while Team WFR will now go British GT racing with a pair of Ginettas. 'I still think there is more in the car than we got out of it,' muses Kingston. But even if it is about to be retired, the WF03 will be in the record books as having won a championship in its only season.

THE NEW LEADER IN POWER MANAGEMENT

THE PM1 & PM2 FROM GEMS

- > CAN multiplexed power control system
- > Up to 64 outputs in a network
- > Fully programmable logic
- > Interface to keypads or switches
- > Fully customisable system

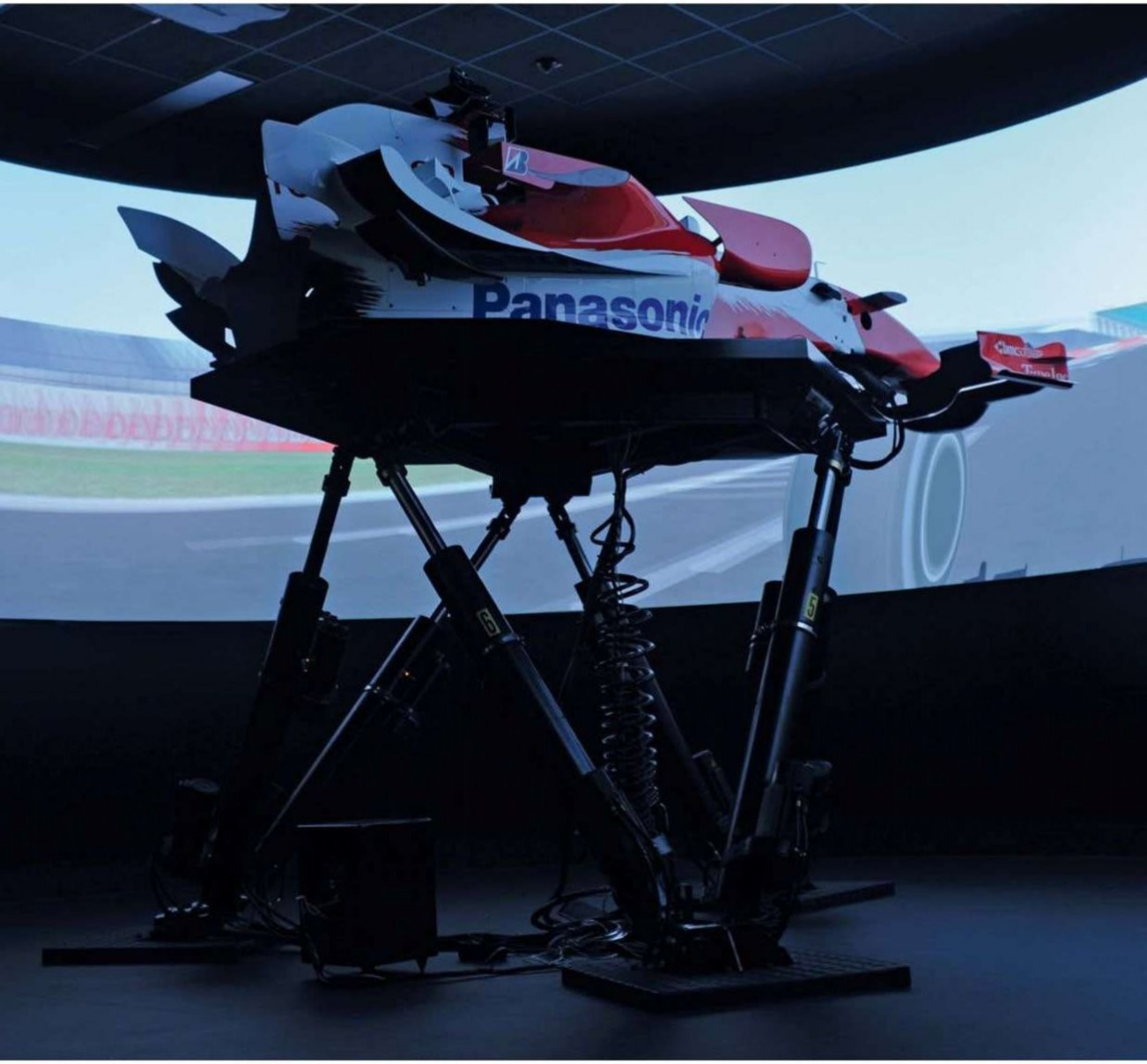
GEMS
PERFORMANCE ELECTRONIC SYSTEMS

www.gems.co.uk

Alternative reality

More than just a driver training aid, TMG's advanced motorsport simulator is a hughly tuned car development tool

BY SAM COLLINS



Long before the TS030 was announced, there were rumours about Toyota returning to Le Mans. When TMG announced that it had uploaded the Le Mans circuit to its human-in-the-loop simulator, they only intensified. The rumours were, of course, correct and the installation of the Circuit de le Sarthe on the simulator was to allow for the development of the new car.

One of the first to try the TS030 on the simulator was Nicolas Lapierre. 'I think I did four days in the simulator before getting in the car, and we always ran on the Le Mans track because that is what we are working towards,' he explains enthusiastically. 'It was useful because it was good to get a first feeling of this car, and what the balance of it is, as it is a bit different to the Peugeot 908 HDI FAP I drove last year. It's good to get used to the hybrid system, which is very sophisticated, and it's good to see where and how it works. I can look at the data and look at how the energy is recovered and how it is deployed. When I sat in the car for the first time, I was very confident and I felt that I had already driven it.

'The hybrid system gives us a lot of power and we, as drivers, need to know how to use it. This is the biggest challenge, but on the simulator the hybrid and its effect on the handling of the car was spot on.'

With just one test car available, and very limited testing time, the team will be reliant on the simulator to get at least seven drivers up to speed (three for each car and one reserve) in good time for Le Mans.

TECH SPEC

TMG simulator
Screen: 220-degree fixed
Projectors: five
Refresh rate: 100Hz
Resolution: 1400 × 1050dpi
Latency: ~40milliseconds
Platform: lateral travel: ±0.6m
Longitudinal travel: ±0.6m
Vertical travel: ±0.4m
Yaw: ±38 degrees
Roll: ±27 degrees
Pitch: ±27 degrees
Latency: ~50milliseconds

"repeatability is critical for car development"

FULL FLEXIBILITY

However, the simulator is not just a driver training aid, it is a highly tuned car development tool. Built in collaboration with Rexroth (a division of Bosch), it offers a six-degrees-of-freedom electric motion platform that simulates driving sensations while an electric feedback motor creates realistic steering torque. TMG's vehicle model translates wind tunnel and kinematic data to simulate the effect of aerodynamic or mechanical changes. An accurate tyre model includes thermal effects, as well as a choice of weather, to cover all scenarios and provide full flexibility for repeated tests in identical conditions.

That repeatability is critical for car development as Mathieu Le Nail, who runs the facility at TMG and is also a race engineer on the TS030, explains: 'The grip and temperature we keep constant, we can adjust it corner to corner, but it is too unpredictable and unrealistic for what we want to achieve here for car development and car concept work. We are really just doing repetitive testing. We would typically look at doing something like a wing scan – Monza is a good example of that – where you have a fairly flat wing but there is still a choice between different wing levels. You run each wing to decide what is best and it saves on track time.'

When it comes to a new driver, 'feel' is something that is notoriously hard to quantify, but the TMG engineers claim to be able to do just that. 'This is not something you can really get with quasi-static simulation, and it takes up valuable time at the track. So, in the F1 days we would do that on the simulator, some time before the event.'

The data that goes into the simulator is critical to the output, as is so often the case with computer technology, but at TMG that does not present a problem. 'The car model we use is the same as we use for any other simulation so, if we are looking at a new suspension geometry, we get the points from the design, put it in the model and try it with the driver, then feed back to the design team. We use this for things that are hard to quantify in other simulations – something like a different caster angle for example. It is hard to quantify the feel using other tools. You can see what it does mathematically, but you cannot see what it does to the feel of the car.'

But to get good driver feedback on that all-important 'feel', and to be able to judge if one design is better than another, the driver must feel that the simulator feels like a real car.

'We have two real cockpit set ups. We can run the sequential shift with a standard GT steering wheel and GT car chassis or the 2007 F1 tub with the full F1 steering wheel. The braking is very important too, so we run a full hydraulic circuit with master cylinders and everything. It does not really matter too much what balance you have because this is handled by the software. At the front there is one brake disc with two calipers on it. In the F1 era we also had a disc at the rear.'

REAL WORLD CORRELATION

As well as making drivers feel at home in the car, the TMG engineers have also spent a lot of time making sure that the data correlates with the real world. The Formula 1 programme (and budget) made that possible.

'The first part of the work with calibrating the simulator to a new car is to try the car on the track, then come back to the simulator with the data and run it to try and make it more accurate,' explains Le Nail. 'After any grand prix or test we would try to get the driver in the simulator and get them to run the set up from the track that they had just run and see if you could get correlation on the data. We would also get their feeling of the variance between the simulator and car.'

Not all drivers are comfortable with modern simulators. Michael Schumacher famously felt seasick when he first tried the Mercedes GP system, which apparently is quite common. Others cannot get the input they need from the feedback.

'On the simulator you get a bit more understeer than in reality, but we always find that it is harder to control a car right on the edge than it is in reality, and that is why there is a little more push. Some drivers – Timo Glock and Kamui Kobayashi for example – were very similar and really keen on using the simulator because of the way they feel the car. But other drivers like Jarno Trulli, who was very sensitive, were not so keen on it because he feels the car in other ways. He reacts to things that the simulator cannot really reproduce,' Le Nail continues. 'It is quite different to get the motion cue right, for example, to differentiate between the rear end breaking away and the car just rotating through a corner. It's a fine difference and we have been tuning for a long time!'

Seven speed ahead

Renowned British gearbox manufacturer releases a new seven-speed unit to meet demands of specialist sports car customers

BY SAM COLLINS

Quaife Engineering is a relatively small, family-run transmission company based in Kent, England, but their products are known and respected around the world. At the 2012 Autosport Engineering show, the firm took a step forward and introduced its first ever seven-speed gearbox.

The new unit, carrying provisional part number QBE89G, is an in-line unit, Quaife opting to add the extra ratio after requests from specialist sports car manufacturers and racing teams who wanted a transmission with ultra-close ratios. 'The trends in production car gearbox design these days is for transmissions with seven or eight ratios,' says Michael Quaife, the firm's technical director. 'Look at the Porsche automatic gearboxes, for example, and that has been an influence on our designers.

'In addition, we have a strong customer base of clients with lightweight, front-engined cars using small, high-revving engines who sometime struggle with optimising the correct overall gearing using existing available crown wheel and pinion ratios. The seven-speed 'box offers a larger choice of ratios for users to ensure customers will always be in the correct gear in a wider variety of circuit conditions.'

Designed from the outset with lightweight construction and user adaptability in mind, Quaife Engineering's QBE89G offers a number of innovative technological features, including a lightweight alloy, two-piece casing that reduces overall weight. For easy installation into a wide variety of front-engined, rear-wheel drive machinery, it uses a quill-type input shaft.

'The design of the seven-speed unit is based on the successful six-speed sequential QBE60G, which was designed for heavier, real-wheel drive cars, so the technology, such as the modular gear design and the shift mechanism, is already proven,' Quaife continues. 'Crucially, the QBE89G retains the same overall external dimensions as the popular Ford Type 9 gearbox, making it an easy installation prospect for customers in the specialist sports car market. It weighs just 34kg dry and we're rating it as suitable for power outputs of up to 250bhp in heavier cars and 350bhp in sub-600kg machines.'

QBE89G gear ratios (prototype)

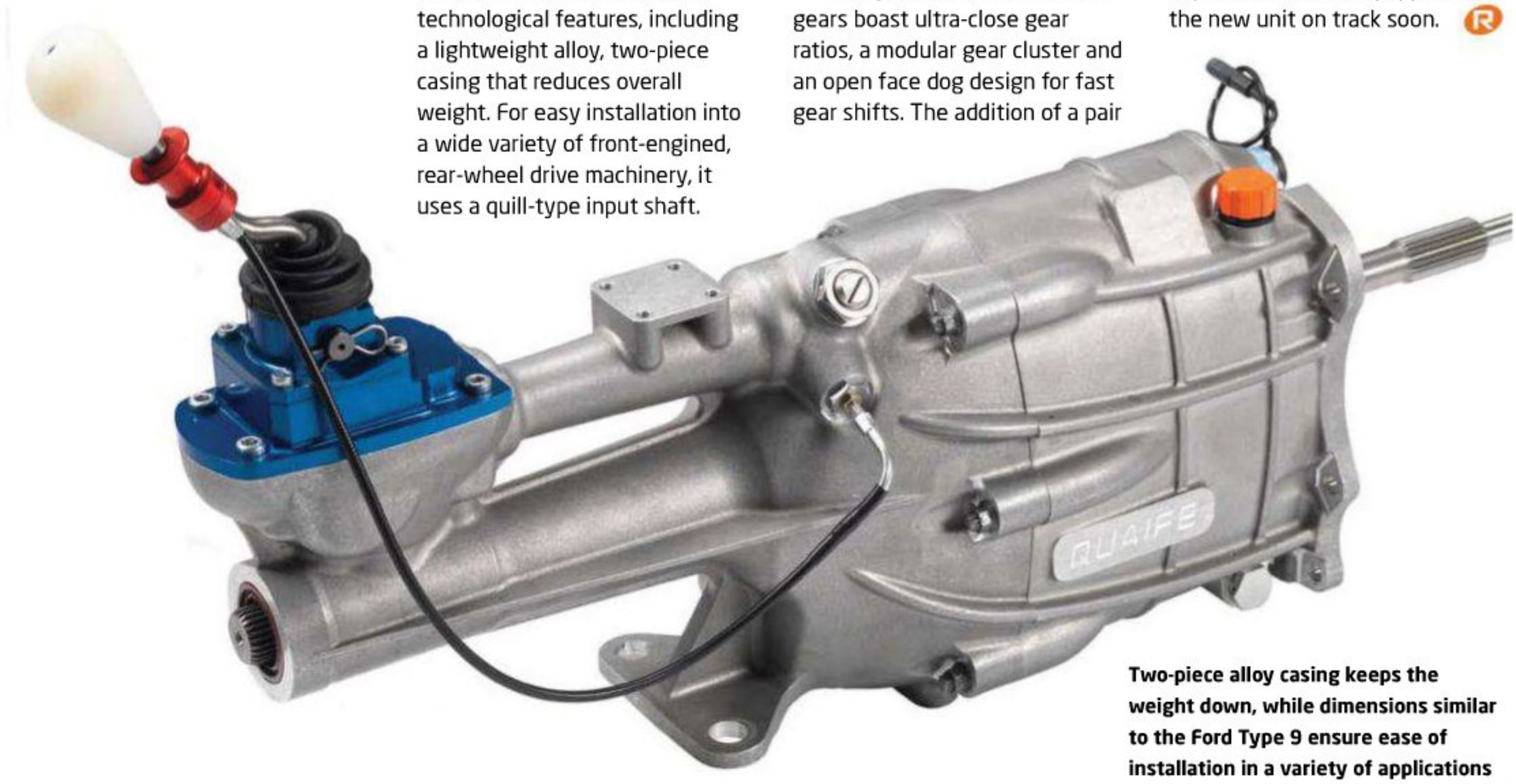
1st	2nd	3rd	4th	5th	6th	7th
2.750	2.214	1.800	1.471	1.238	1.043	0.920

The QBE89G's seven forward gears boast ultra-close gear ratios, a modular gear cluster and an open face dog design for fast gear shifts. The addition of a pair of interchangeable drop gears within the casing will allow end users to easily tailor the unit to suit their needs – for example, fine tuning between racing circuits to optimise top speed.

From the outset, Quaife's engineers have designed the QBE89G to run with an optional semi-automatic paddle gearchange system to maximise the transmission's potential. Gear ratios for the prototype QBE89G are shown in the table to the left, while the prototype's drop gear ratio is 1.045:1

As with much of Quaife's product range, the pricing has been kept relatively low – another thing the firm's customer base demands. It will set back buyers around £9000, which is only about £350 more than the firm's curent six-speed unit.

The QBE89G is already available in the marketplace, so expect to see cars equipped with the new unit on track soon.



Two-piece alloy casing keeps the weight down, while dimensions similar to the Ford Type 9 ensure ease of installation in a variety of applications

Tuning for sensitivity

How to use transient simulation tools in NASCAR

BY DANNY NOWLAN

Of all the racing series out there, NASCAR is without a doubt unique. It has the resources and budget to rival Formula 1, yet the form of the racecar is a time capsule of cars from 60 years ago. Add to that the fact that the tyre compounds are changed regularly and tools such as data acquisition are banned in the race events, and you have all the ingredients for a very demanding racing challenge.

The purpose of this article is to illustrate how transient simulation tools can be used to help you through this mess. At first you might be thinking such simulation tools might be useless in this environment, but the banning of data acquisition actually makes simulation even more vital because it gives you a very good picture of what is going on with the car. Using simulation you can quantify parameters on the car that would otherwise be impossible.

"if you don't have data to fall back on...tune the model for sensitivity to changes"

Also, let me highlight the fact that the whole point of simulation is to establish a representative environment of the car. One of the biggest traps I see people fall into with racecar simulation is to become so obsessed with accuracy they forget about set up sensitivity. Forget perfection – if you are looking for it in this business, OPB (other professions beckon). If you don't have data to fall back on, which is the situation you have in NASCAR, tune the model for sensitivity to changes. Remember, you win races by making the right calls on the car, not by predicting qualifying times to the nearest 0.01m/h. And in my experience, if you get the trends right, the correlation has a funny habit of looking after itself.

First thing's first though. Any transient simulation is equivalent to running the car through a seven-post shaker rig. It is one of the many reasons I rejected pseudo-static simulation in putting together ChassisSim over 15 years ago. To illustrate what you get out of a transient lap time simulation, consider the rudimentary NASCAR model on an oval, as shown in **figure 1**.

Please note, what I have done with the model is taken a V8 Supercar base model and adapted it for an oval. Consequently, I don't pretend this will be the world's most accurate model. However, it is presented as an

illustration about what simulation is capable of.

Let's walk through the data traces quickly. The first trace is speed, the second is throttle, the third is front dampers, the fourth is rear dampers, the fifth is steering and the final trace is lateral and longitudinal acceleration. By measuring up the car, employing damper and spring dynos, and without having to install a single sensor in the car we already have a good idea of what the car is doing. This is the power that is resonant within every simulation run you do.

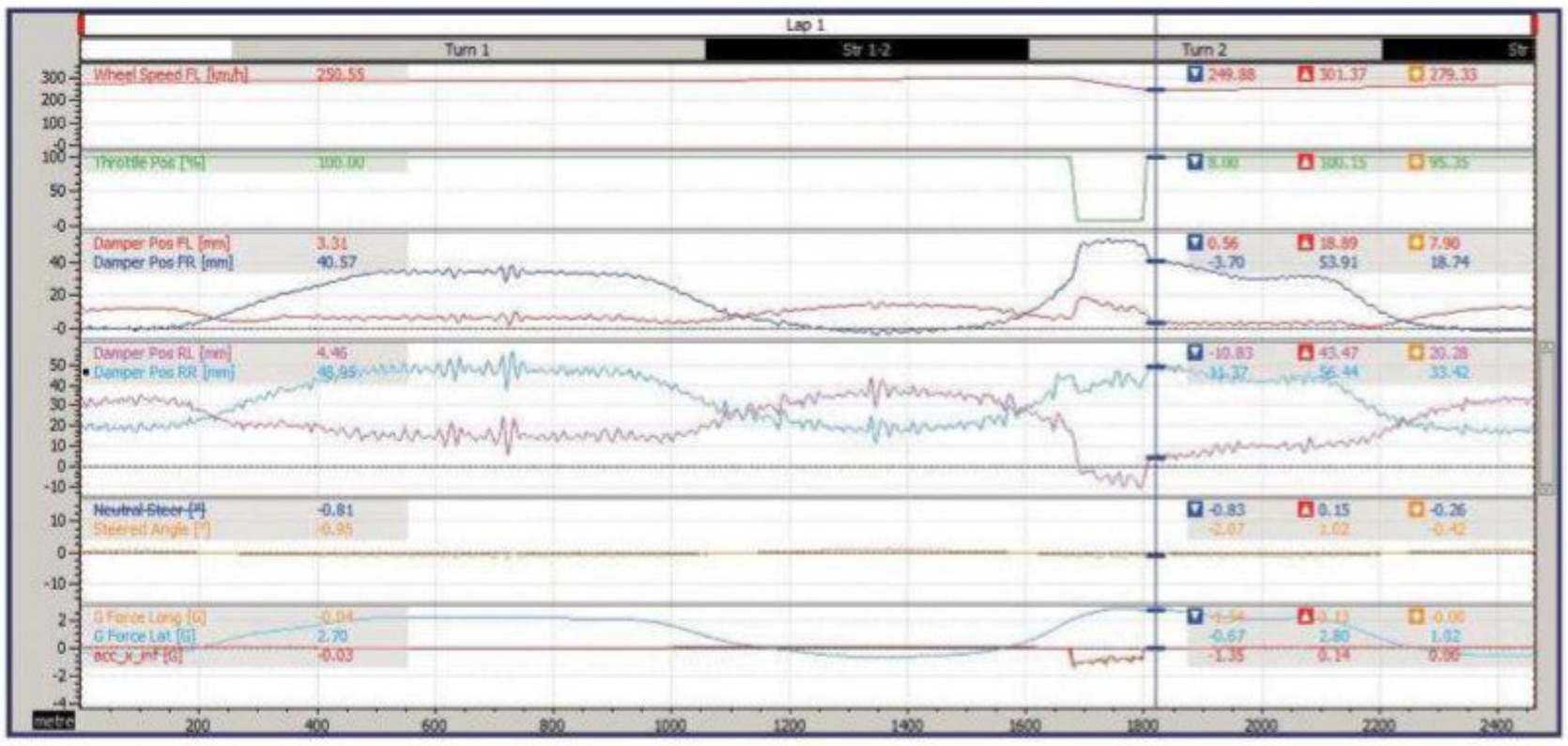


Figure 1: ChassisSim simulation of a NASCAR on an oval

DAMPER ADJUSTMENTS

One of the biggest benefits of transient simulation is it provides a valuable window on damper adjustments, and any crew chief / race engineer knows just how powerful these adjustments can be. An example of a damper histogram from simulated data is shown in **figure 2**.

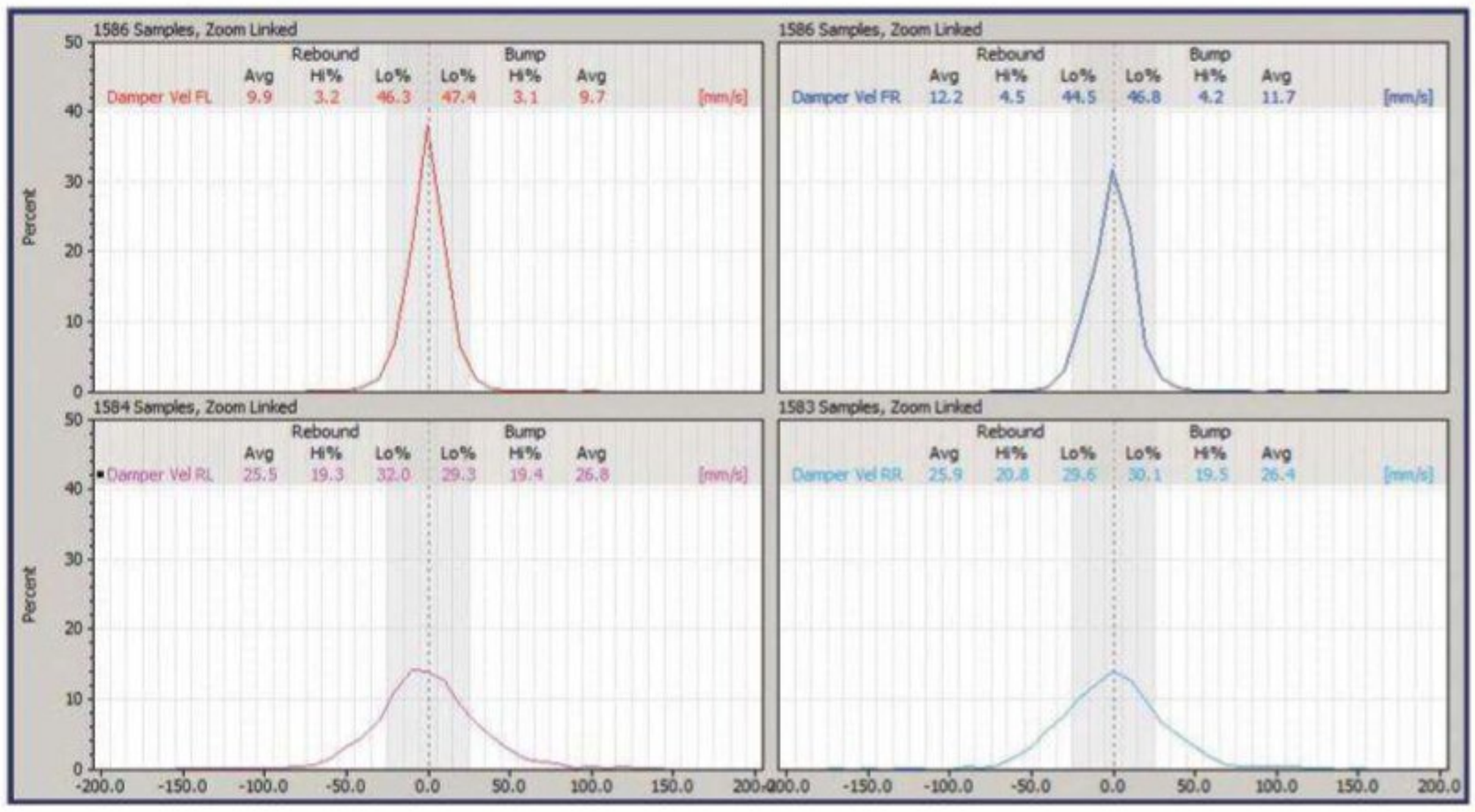


Figure 2: damper histogram of NASCAR model at a Super Speedway

Damper histograms are the bread and butter of anyone looking at damper adjustments, and this is what transient simulation provides in spades. Also, the great thing about this is that once you have a few track models, you can look through your running notes and see what worked and what didn't. What you then do is run the set ups that did work through the simulation package and you have an accurate picture of not just why it worked, but what to aim for as you change set ups. This knowledge is invaluable.

The other bit of useful information you obtain from any simulation run is tyre loads and surface tyre temperature. This is invaluable as you start to play with wedge, roll centre changes and tyre pressure adjustments. To illustrate this, consider **figure 3**, which illustrates tyre loads and surface temperatures.

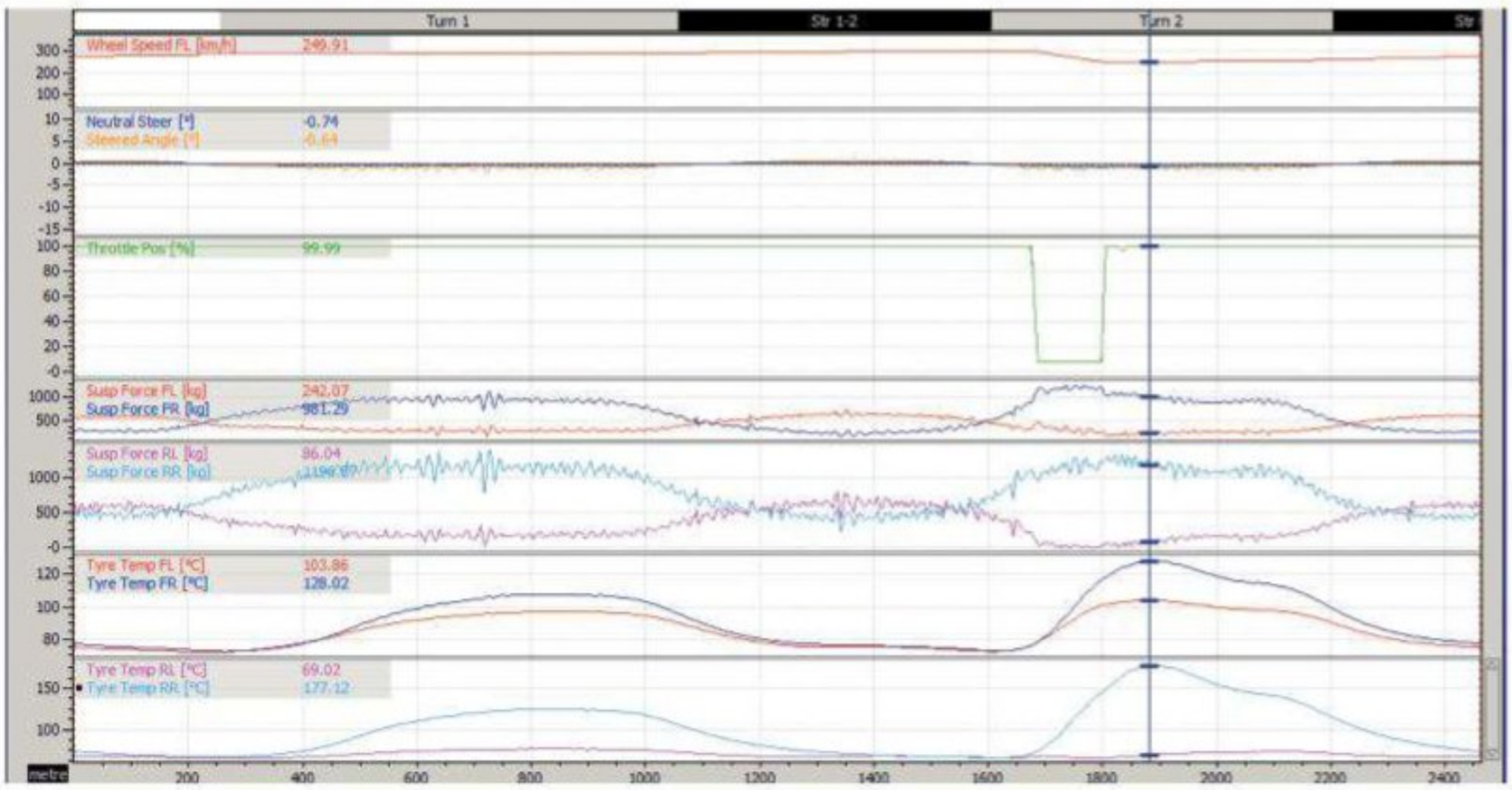


Figure 3: tyre loads and temperatures for a NASCAR model on a super speedway

QUANTIFYING THE EFFECT

This information is gold because for every change you do you can see what it does to work the tyre, and the ensuing effect it has on tyre temperature. What this allows you to do is to quantify the effects as you change wedge, tyre pressures, roll centres and springs. This is invaluable because, as you stand on the pit wall, you have an accurate picture of what adjustments to go to to obtain the desired results.

Another tool that comes as a by product of transient simulation is the ability to do swept sine tests. This is something that has been used in Indy Lights and is starting to be used extensively in the GT and V8 Supercar elements of the ChassisSim community. The results of a swept sine test is illustrated in **figure 4**.

What this test gives you are outputs over inputs plotted against frequency. In this particular case we have shown heave (body position) and pitch angle. The other very useful parameter is the CPL numbers,

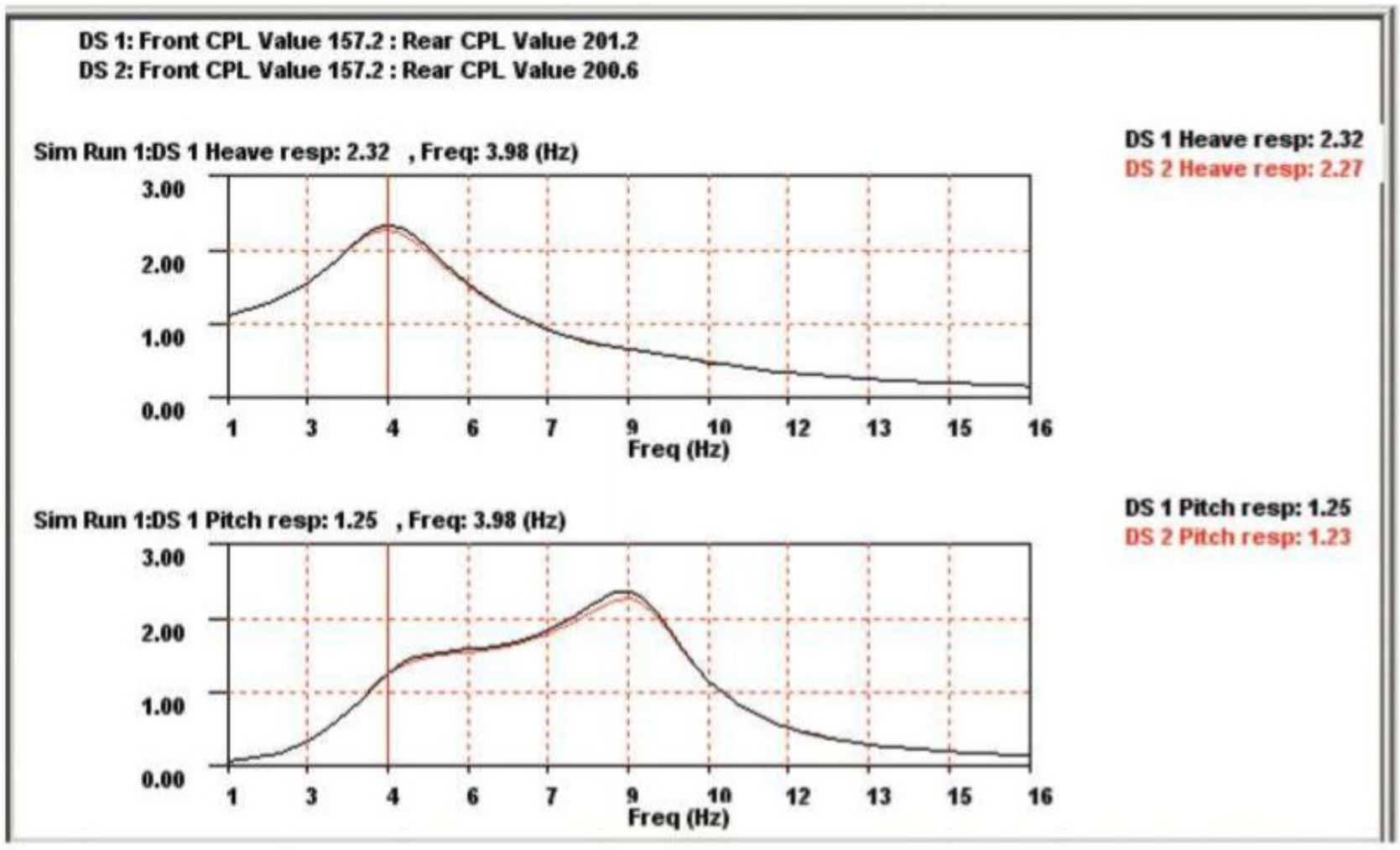


Figure 4: results of a swept sine test

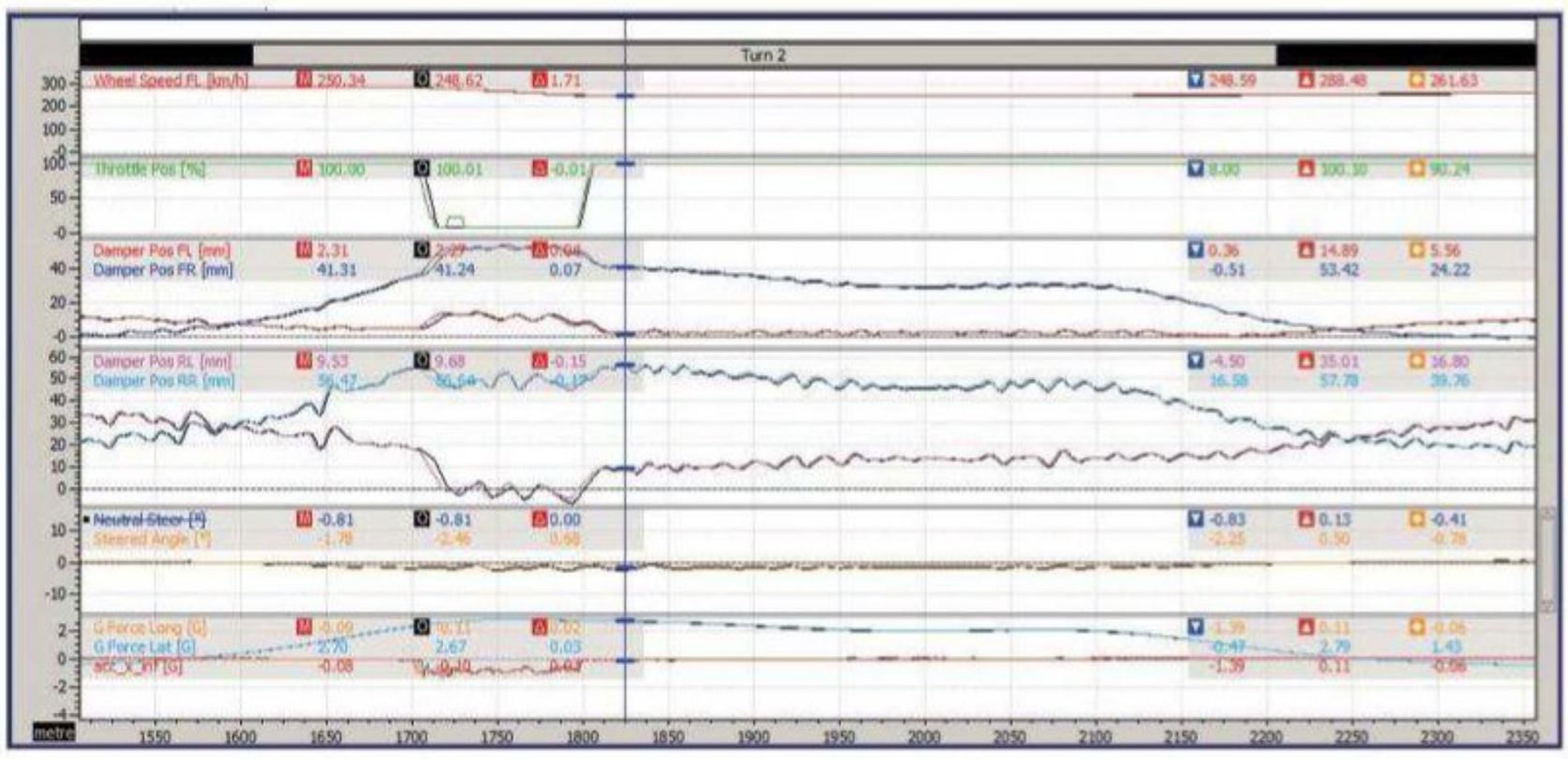


Figure 5: comparison of increasing the front slip angle of the NASCAR model by one degree

or contact patch load variation. This is a measure of the load deltas from static weight at the particular vehicle speed you happen to be at. Where the gains come are from studying the trade offs between CPL and heave and pitch response. Again, this is a very powerful tool.

Typically though, another question I am frequently asked is how do we use transient simulation to prepare for a circuit we have never been to before? This is of particular relevance for the NASCAR community since data is so scarce and, believe it or not, there are some easy ways to do it. These are as follows:

- **Ask you ChassisSim dealer nicely for one. I can tell you for a fact they are very susceptible to flattery and good quality wine and beer.**
- **Using the circuit centreline model, use the ChassisSim auto track generation feature, which is currently in beta development.**
- **Create it from actual data from an equivalent race car.**
- **Source it using rFactorCentral and the video game rFactor.**

"it forces you to understand the car in ways you never thought possible"

The first three methods are pretty self-explanatory. Methods one and three are battle proven and method four, while it may sound rather colourful, is actually brutally effective. Let me give you an actual example. In preparing for the A1 round at Kyalami in South Africa we had no reliable data to draw on. So, I simply got on the rFactorCentral website, downloaded the Kyalami circuit, ran it through rFactor using the self-drive feature then, using the MoTeC data acquisition plug-in, I exported the data to MoTeC Interpreter and extracted what I needed from there. As rough as this was, it was also extremely effective.

If I had the time, I would have generated a bump profile for it as well. However, the biggest pay off of using simulation is it forces you to understand the car in ways you never thought possible. A big reflection of this is tyre modelling. When simulation doesn't deliver the results you expect, most people tend to throw their hands up in the air and say 'this is rubbish!'.

I have said on a number of occasions that when something in the simulation doesn't make sense, it's the simulation's way of telling you something isn't right with the model. Knowing where that is in the tyre model is a sure fire way of coming to grips with a tyre compound change. To finish off, let's illustrate this with a simulated example by increasing the front slip angle on the front tyres by one degree. The results of this are shown in **figure 5**.

The baseline is coloured and the increase of one degree is shown in black. I would draw your attention to the steering trace. In the mid-corner, the steering angle has increased by approximately 0.80 degrees. Consequently, if you have a situation where you have a set up that worked well and the tyre compound is changed, you can change parameters in the tyre model to reflect the current behaviour of the car and then you are good to go. While this is a simple example, it illustrates what a powerful motorsport calculator transient simulation is.

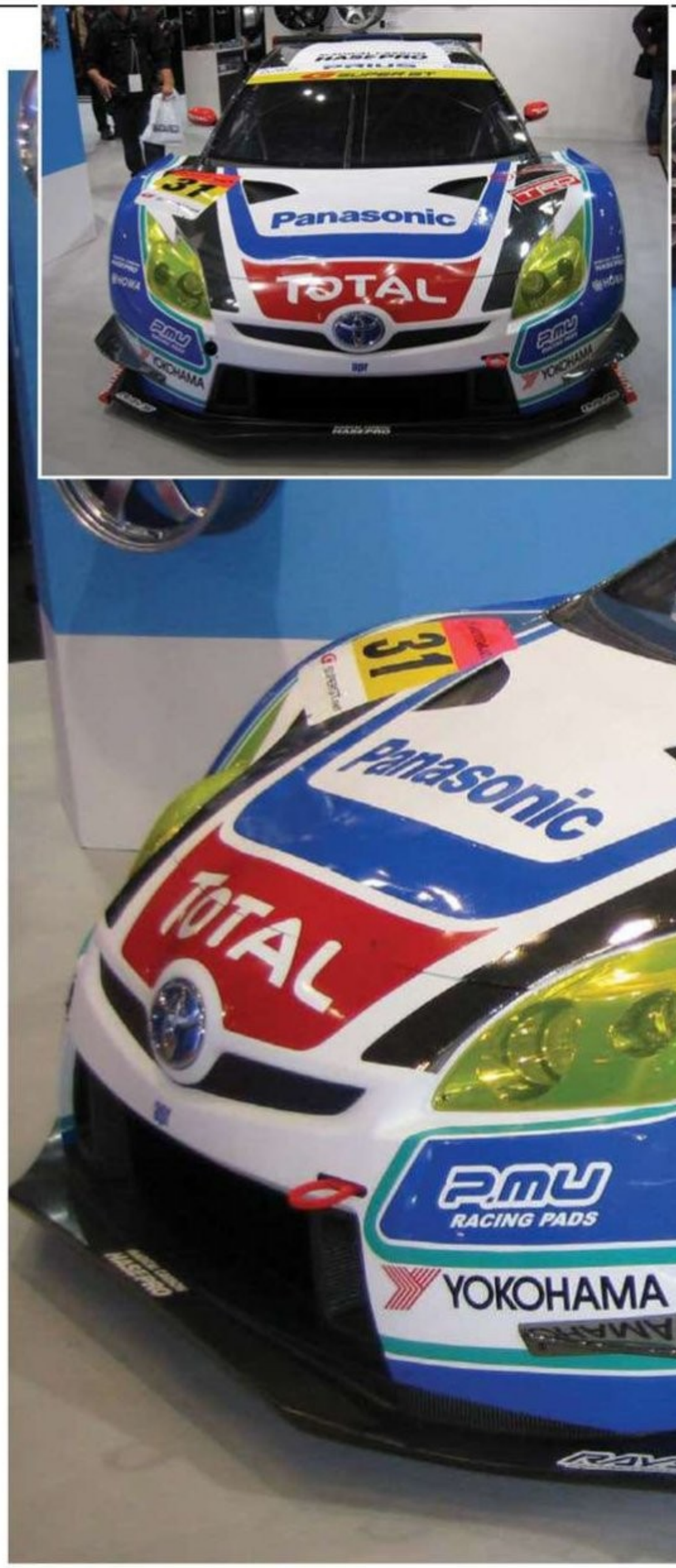
CONCLUSION

In closing, transient simulation is a very powerful tool to use, particularly in the NASCAR formula. The principal benefit it gives is the ability to create a representative environment of the car and to show you information you wouldn't normally have access to. More importantly, it can shed light on things such as tyre loads, tyre temperatures and dampers that ordinarily you would only have access to using empirical data. Furthermore, if you backtrack and run the simulations on the set ups that have or haven't worked, it will start to shed light on what does what. It can also be used as an estimation tool to quantify things such as tyre compound changes.

Setting the pace

Japanese Super GT unveils the first hybrid in international GT competition

BY SAM COLLINS



The unveiling of the APR Racing Toyota Prius at the Tokyo AutoSalon heralded the arrival of hybrids in Super GT. It is the first international level GT championship to allow such technology as part of the mainstream class structure (Porsche's electro-mechanical flywheel hybrid, for example, only runs in an invitational class).

APR has, surprisingly, not opted for a standard motorsport KERS, such as the readily-available Zytek system already being tested in Formula Nippon. Instead, the GT300 Prius utilises series production components. The control system, MGU, battery and inverter are all taken directly from the road car. This means that car also has to use the Prius regenerative braking system, which creates a unique situation on the rear of the car where the rear discs are each fitted with two calipers, one from Project Mu and the other from AP Racing. The former is smaller and forms part of the regenerative system, whilst the other mounted at the front of the disc is used when the car is in non-regenerative mode.

The car is powered by a 3.5-litre Toyota 2GR-FSE V6 engine, exploiting the GT300 regulations that allow the use of any engine made by the relevant manufacturer, including purpose-designed racing units like Toyota's RV8K (as used in LMP1, Formula Nippon and GT500), which the Prius may be fitted with later this year.

RULE CHANGES

The GT300 category has undergone something of a transformation during the winter months, which goes far beyond the introduction of hybrids. GTA, the organiser of Super GT, has decided to give the class a substantial performance boost by increasing restrictor size and boosting power outputs up to between 400 and 450bhp (surely it should be re-named GT450?).

New bodywork regulations will see the cars look slightly different too, as LMP-style dive planes can now be fitted to the front of the cars, while the front splitter can now only sit 40mm above the flat floor (in 2010 this was 130mm). The cars will also run 5mm lower at 45mm. It seems this is something of a trade off to allow the teams to have dive planes, and certainly one engineer in the class believes this to be the case: '40mm is all we have. This is a headache and a big topic for all the JAF GT300 teams. Because everyone was making noise and shouting, GTA allowed the dive planes, but this adds drag, big time.' Some in the GT300 paddock would clearly have preferred to keep the larger splitter as a way of generating downforce. The regulations governing the rear floor, which allows for a diffuser with a maximum of four strakes, remains unchanged, which could see some teams struggling for balance.

The single-plane rear wing was planned to have been reduced in section by 70mm and restricted to a maximum width of 1900mm, but the reduction in section was dropped after consultation with the teams.

Another change that will increase cornering speed and influence the aerodynamic package are wider, GT500-style 14in wheels. They must be made of aluminium, with a minimum weight of 10kg.

Up against the purpose-built GT300 cars will be a fleet of FIA GT3-spec cars, including the Audi R8 LMS Ultra, Ferrari F458 and BMW Z4. This has lead to the JAF GT rules cars being allowed more advanced electronics, with both traction control and paddle

shifting now permitted.

Alongside the new Toyota, Subaru have signed up with a thinly veiled works team (full factory efforts are only allowed in GT500) running its new BRZ. Honda is also rumoured to be bringing an extreme version of its CRZ hybrid and Proton will join the class in 2013. So once again, the Japanese series proves its willingness to push boundaries and set standards for other GT series to follow.

Diffuser and single-plane rear wing remain unchanged, but the addition of small dive planes, a significant reduction in front splitter height and 5mm reduction in ride height could cause problems with overall balance

DTM AND GT500

The ongoing saga surrounding the use of DTM cars in GT500 seems to have finally been resolved, with agreement between the two championships. Super GT teams will continue to construct their own carbon fibre chassis locally, albeit to the same dimensions as the Dallara DTM tub.

HEAT EXCHANGER SERVICES

Our ISO graded '**clean room**' is available for complete core cleaning and particle cleanliness assessment on radiators, oil coolers and chargecoolers.

Core Cleaning
Ultrasonic, Power Flush, Pulsation, Agitation & Flow Bench

Particle Assessment
ISO 16232, Microscopic & Optical Analysis, Size & Count

Calorimetric, Flow & Pressure Testing
Radiators, Oil, Gearbox, KERs & Chargecoolers

Core Race Preparation
Cleaning, Filtration, Drying
Oil Conditioning and Sealing

www.youngcalibration.co.uk
+44 (0)1273 455572
Unit 4, Ham Business Centre, Brighton Road, Shoreham by Sea, BN43 6RE

ECU/Exchange Loom/Throttle Body Packages available

Complex modern engine? We can manage it.

ECU solutions for:
Honda S2000 and K20A
Ford ST170 and Duratec
Toyota 2ZZ
BMW Single / Twin VANOS
Audi 1.8T and 5 cylinder
Chevrolet LS7.

DTA fast

Our ECU's are capable of dealing with the most complex of modern engines without the need to change sensors or sacrifice key features such as variable camshafts.

S series

Get the very best from any engine and from only £495.00 + VAT.

DTAfast, 10 Boston Court, Kansas Ave, Salford M50 2GN
Tel: +44 (0)161 877 1419 Fax: +44 (0)161 877 7086
Email: office@dtafast.co.uk Website: www.dtafast.co.uk

OvaX

STEELS FOR THE RACING INDUSTRY

OvaX 200
Case hardening steel

OvaX 300
Quench and tempering steel

OvaX 500
Quench and tempering steel

OvaX 600
Through hardening steel

OvaX 800
Through hardening steel

OVAKO

Ovako Hofors AB
SE-712 80 Hällefors,
Sweden
Phone: + 46 591 60 138
Fax: + 46 591 60 606

Ovako North America, Inc.
1096 Assembly Drive, Suite 312
Fort Mill, SC 29708, USA
Phone: + 1 803 802 1500
Fax: + 1 803 802 1501

www.ovako.com

In defence of Delta...

John Travis' and Karl Nikas' technical evaluation of Delta Wing in V21N10 overlooks the experience of All American Racers. AAR designed and campaigned Toyota-powered GTP cars that were innovative in their approach to front axle diffusers and were dominant for several years.

This sort of know-how is exactly what is needed to make the narrow front track Delta Wing work.

Gurney also pioneered the Delta Wing shape with a USAC Indy car that used a conventional width front track and triangle platform aft body. It's performance at Indianapolis was lacklustre, but it won on the Riverside road course later that year.

An exaggerated version of the Delta Wing layout that confirms the concept's efficiency and stability is Al Teague's Bonneville Streamliner – the front wheels are set in tandem for minimum frontal area, and it had the traction and stability to run 409mph on the salt with just one blown Chrysler engine.

...using lessons learnt from the experience of All American Racers

Roger Kessinger
Riverside, California

Coffee cup set up lessons

The consultant, V21N9. Toe-out? Yes, but for more reasons than just turn in. My good friend, Glenn Taylor, has been setting up his Formula Fords and his Formula Atlantic with toe out for almost three decades. When he first told me that it improved his lap times by a great deal I decided to investigate it.

A quick way to illustrate an additional advantage of toe out is to lay a disposable fast food coffee cup on its side. Now roll it either way, the open side represents a cambered tyre and it can be seen that it will roll to one side. So, basically the left tyre rolls to the right and the right tyre rolls to the left. Toe out will mitigate most of the drag.

As a corner is approached, brakes are applied and the nose dips, so the tyres bump up relative to the chassis. Camber is gained (with unequal length wishbones) and bump steer is normally set up with toe in on bump. In this way, drag is induced with slip angle increase on both counts.

As the wheels are turned, weight shift begins a roll (the degree of which depends on shocks, springs, weight etc). Roll and weight shift loads the outside wheel, increasing camber gain, so much of the toe out is cancelled out. On the inside, the spring damper unit tries to push the tyre down into droop but the anti-roll bar tries to keep it up. Additionally, the bump steer curve will apply a toe out force, and Ackermann will yield its power. Ackermann in this situation can be used to pivot for the outside wheel, similar in a way to brake steer used by McLaren in F1 in 1998 and on its MP4-12C road car.

Richard H 'Yag' Yagami
Connecticut, USA

Poor car sales lead to Peugeot pulling plug on LMP programme

Disastrous car sales figures in its core European market in 2011 seem to be at the heart of Peugeot's decision to pull the plug on its Le Mans and World Endurance Championship (WEC) programme.

Peugeot's shock withdrawal was announced in late January, leaving Audi as the only manufacturer contesting a full season of WEC events in LMP1 in 2012, as Toyota will compete in only selected races and Le Mans with its new LMP1 hybrid, while Porsche's new challenger is not expected until 2014. Peugeot has run variants of its diesel 908 Prototype in the Le Mans 24 Hours and its associated racing series since 2007.

However, while the news took the racing world by surprise – it was announced on the day the company was expected to sign up for the WEC – the writing has been on the wall for some time, with parent company, PSA Peugeot Citroën, struggling in the ongoing financial crisis.

PSA, which is Europe's second largest automotive group, issued a profit warning in the autumn when it also outlined an austerity plan aimed at cutting some €800m in costs and entailed the loss of 6000 jobs across Europe.

On top of this, and just a few days before the deadline for entries for the WEC, the company's car sales figures for 2011, as supplied by the European Automobile Manufacturer's Association, showed that it had had a very bad year on the forecourts. Peugeot's car sales in 2011 were 9.4 per cent down on 2010, with 911,703 cars sold. Meanwhile, sister PSA company, Citroën, suffered a similar eight per cent fall, selling some 770,726 units. Incidentally, Citroën was quick to quell rumours that its WRC effort might also be dropped.

The decision to axe the LMP programme was made at the highest level and based on a number of factors: 'This decision has been taken against the backdrop of the challenging economic environment in Europe, coupled with a particularly busy year for the brand in terms of new vehicle launches,' Peugeot said.

Audi would not be drawn on how the news might affect its LMP programme – including rumours that it might run four cars in 2012 – but it's worth noting that the company's parent organisation, VAG, continues to thrive in the marketplace, with Volkswagen topping the European sales charts with an impressive 1,684,150 cars sold in 2011, that's a nine per cent increase on 2010. Audi was also up nine per cent, with 680,262 units sold.

The now familiar Peugeot 908 diesel will be missed in World Endurance competition, the car having been a stalwart of the series since 2007

US military turns to motorsport to aid vehicle design programme

A wide-ranging new initiative to engage America's motorsports industry in the design of vehicles for the US Army has been launched by the Institute for Defense and Business (IDB), the North Carolina Department of Commerce, and the North Carolina Military Foundation.

Called the Military Vehicle High Performance Capabilities project (MVHPC), it has been developed by Kay R Hagan, the Democrat senator for North Carolina, and will be managed for the IDB by IMSolutions.

Senator Hagan's idea with MVHPC is to use capabilities developed by the motorsports industry to address specific problems with the military's wheeled-vehicle fleets. The military is currently devoting significant funds to re-capitalisation and modernisation programmes, in response to operational requirements in Iraq and elsewhere, and an aging Department of Defence vehicle fleet. MVHPC will evaluate a range of motorsport technologies for possible integration into these programmes.

'This project provides a valuable link between two of North Carolina's biggest industries,' said Senator Hagan. 'The motorsports industry is developing cutting-edge technology that can significantly improve the mobility and safety of our military vehicles. MVHPC will provide critical support for our military, linking military vehicles to motorsport's best practices, engineering expertise and technology, while boosting job growth in North Carolina. The project is a win-win for North Carolina. I am committed to ensuring our state's motorsports industry can meet the emerging requirements of our nation's defence sector.'

The project partners, who have already hosted several capability demonstrations linking military commands with motorsport companies, arranged a North Carolina Motorsports Technology Tour in Mooresville between January 18/19. Participants will include: the Marine Corps System Command; the US Army Tank and Automotive Command; the US Army Tank Automotive Research, Development and Engineering Center; the Army Research Office; the US Army Special Operations Command and the Marine Corps Special Operations Command.

Lacklustre sales points to thin Formula 3 fields in 2012

Sales of Dallara's new F312 chassis, the only car currently available that complies with the new-for-2012 Formula 3 regulations, seem to suggest that some F3 grids could be on the sparse side this season.

Dallara's Jos Claes, the engineer responsible for the company's F3 programme, told *Racecar Engineering* that around 30 of the new chassis had been sold, with a further 10 sales expected before the start of the season: 'We hope to achieve 40 sales before the season starts,' said Claes. 'Of these, 20 cars are between the British and Euro series. The rest is Japan and Spain.

'In all honesty, it's nothing compared to 2008 [the last time it marketed a brand new car]. But then nobody expected it to be. At the moment all the teams are just fighting to get the deals done. There is definitely a deep crisis hitting motorsport.'

When asked if he was pleased with the rate of sales, Claes said: 'Pleased is a big word. We cannot be pleased about it, but it is not worse than our expectations. We tried to be realistic. We had a good idea of what was coming and the sales are according to our expectations.'

The car is priced at €94,800 (£78,850 / $122,850), which is around €2000 more than the price of its predecessor, but Claes says Dallara has done everything it can to keep the cost of its chassis down. 'It is not a bad price, if we only applied the inflation we would have charged more. Also, just the addition of the Zylon panels in the monocoque [required for the new FIA regulations] represents far more than this price increase. But we made an effort to reduce costs, like everyone needs to do these days.'

Dallara remains the only company manufacturing cars to the new regulations – Mygale has confirmed that it will not be building a new F3 anytime soon – so its sales are a good barometer as to the current state of Formula 3. And while it is too early to put a figure on the number of new cars out in each championship across the world, with just 40 F312s sold, there's sure to be a dearth of top-level cars in at least one of the championships.

It is already known, however, that at the very least, nine F312s are set for action in the UK, with Carlin buying five and Fortec four. The British Championship will also be allowing F308s, albeit with spec Mugen engines and downgraded aerodynamics, into its National class.

With Mygale now out of the picture, the Italian racecar constructor is currently the only company building chassis to 2012 F3 regulations

BRIEFLY

Argentina breaks out

The ground has been broken at Zárate, 50 miles outside the city of Buenos Aires, to mark the start of a major new FIA Grade 1 race circuit project, licensed for Formula 1 and aimed at reviving the Argentine Grand Prix. The racing facility will be part of Velociudad, an extensive, $100 million complex whose CEO, Eddie Freedman, presented the project to the media. The design contract has been won by Populous, the British specialist behind the recent and ongoing re-development of Silverstone.

Over and out

NASCAR has banned car-to-car radio communications as part of its campaign to eradicate tandem drafting at superspeedways. Until this move, drivers were able to arrange drafting formations via the radio, something that only ever occurred at Daytona and Talladega, where tandem drafting has been a feature recently. Pit-to-car, and car-to-pit, communications will not be affected.

Changes have also been made to the cars' restrictor plates and radiator openings this year in a bid to counter the practice.

Caterham F1 team to move to Leafield

The Caterham Formula 1 Team is to move from its current factory in Hingham, Norfolk, to the Leafield facility that was once the base for the Arrows and then the Super Aguri F1 teams.

Caterham's GP2 team will also move to the Leafield Technical Centre, both outfits set to up sticks in August, while the company also plans to build a new factory on the Leafield site for the Caterham road car business.

Team principal, Tony Fernandes, explained the decision: 'We propose moving the F1 and GP2 teams to the new site in or around August 2012, giving us ample time to build up the infrastructure required to house all the critical elements of both teams, and we propose moving Caterham Cars into a new, bespoke development and production facility on the same site in due course. We are able to build the new home for Caterham Cars from the ground up on the Leafield site, giving us a permanent home in the perfect location for two of the primary arms of the Caterham Group.'

From August, all Caterham car construction will be centred in Oxfordshire, with only the composite facility remaining at the old site in Norfolk, UK

However, there will still be a Caterham presence at the original Norfolk facility, says Fernandes: 'We will continue to develop that site into the new permanent home for Caterham Composites. We have cutting edge technical and production facilities already in operation in the factory, now focused on the F1 and GP2 teams, and we will be expanding those facilities to help meet the future demands of Caterham Composites clients.'

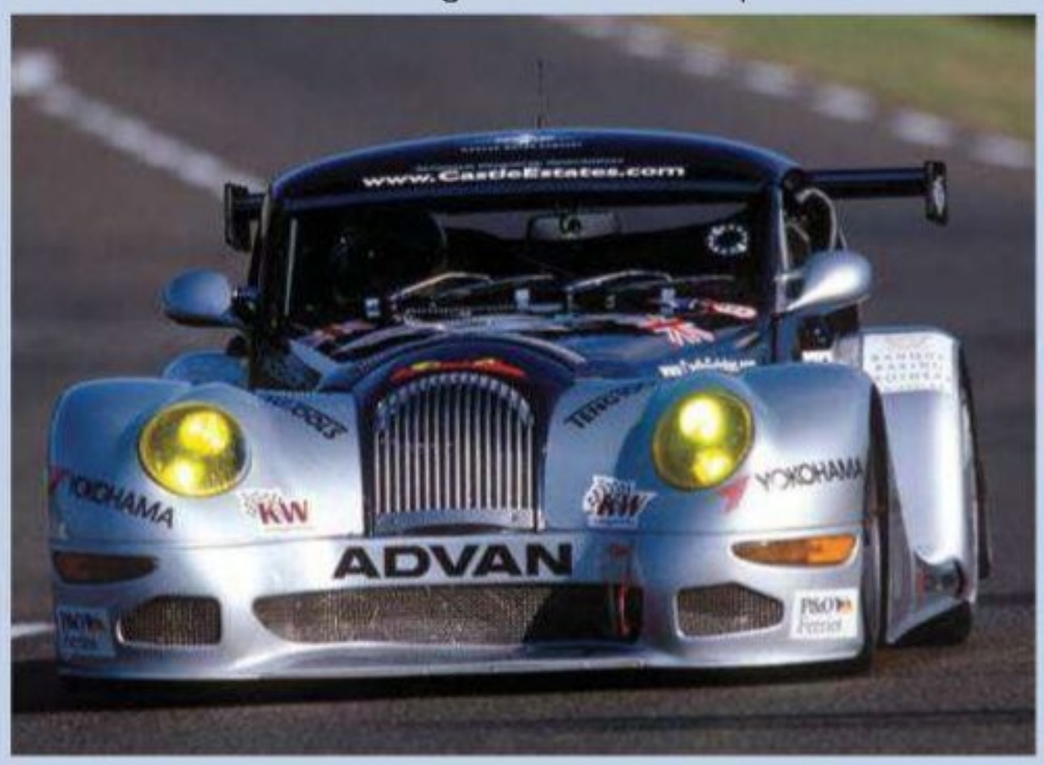
BRIEFLY

Williams sponsor search

The Williams F1 team is believed to be courting a number of telecoms companies as it seeks to replace the AT&T backing it lost after the conclusion of its sponsorship deal with the American multinational at the end of 2011. There has been some talk that Brazilian company, Embratel, a long-time backer of recent Williams' signing, Bruno Senna, might be in the frame, but the more likely candidate now seems to be Qatari telecoms company, Qtel, which is currently investing heavily in sport sponsorship. AT&T is believed to have forked out around €7m a year to have its name on the Williams' cars, but now it's thought that the team, which has not won a grand prix since 2004, is looking for around €10m a year.

Morgan's heart of OAK

British car manufacturer, Morgan, is to make a return to the Le Mans 24 Hours this year after agreeing a deal with French outfit, OAK Racing. In what amounts to a badging deal, OAK's Pescarolo-based LMP2 will be known as a Morgan LMP2. The tie-up follows news that



a Morgan dealership has recently been opened in China (the country will host a round of the WEC this year). Morgan hopes to sell 50 cars in China in 2012, which is a fair proportion of the 1500 units it aims to sell worldwide. Morgan is celebrating the 50th anniversary of its 1962 class win at Le Mans with the Plus 4 Supersport this year, and the OAK Racing deal means it will return to Le Sarthe for the first time since the factory ran a GT2 class Aero 8R in 2004.

GP threedom

Cash-strapped GP3 teams will be pleased to hear that the organiser of the series has relaxed its rules on the number of cars each outfit must run for the 2012 season. Previously, each team was contractually obliged to run three cars at every race, leading to a situation where some drives were given for free or at a very low price last year, which financially hit some teams. Under new rules, the minimum team size at a race will be two cars, although teams that wish to field three cars will still be allowed to do so.

Status go

Single-seater outfit, Status Grand Prix, a team that excelled in A1GP and, more recently, has been a frontrunner in the GP3 championship, is set to race in LMP2. The Silverstone-based organisation is soon to take delivery of a 2012-spec Lola B12/80 and, while the team has yet to finalise its test and race programme for this year, it is looking at a full campaign in the World Endurance Championship in 2013. Status GP, which has worked in LMP and GT in the past as a technical partner to existing teams, says the move will not affect its existing GP3 commitments.

Manufacturers likely to invest in hybrid technology

Car manufacturers could be even more likely to sink their motorsport budgets into series that are seen to embrace hybrid technologies in the future, according to a report from a top global research company.

The KPMG Global Automotive Executive Survey 2012, which was the result of interviews with over 200 top automotive executives around the world, found that over half of those questioned (53 per cent) believed that hybrids will be the technology that will attract the most investment in coming years.

John Leech, head of automotive for KPMG in the UK, told *Racecar Engineering*: 'The interesting thing to us when we spoke to all the automotive executives was their view that you would see hybrid being the major alternative powertrain that we will see for the next 15 years. They still see it as a niche product but, in a world of long term high oil prices, it's going to be increasingly important that in their range of vehicles there needs to be hybrid over pure electric or fuel cell cars. We complete this survey annually, and this is the greatest acceptance yet of hybrid over the other forms of [alternative] power we've seen.'

Leech also said that manufacturers were likely to be drawn to the prospect of developing their hybrid technology within motorsport, due to the added promotional benefits: 'Because hybrid technology is environmentally friendly, there's a slight concern among the car makers that it's not seen as exciting or sexy, and manufacturers do still want to have some excitement for the public in their range. Seeing cars like the Porsche 911 GT3R and the Toyota LMP1 on the race track is certainly going to get the public's interest.'

Because you're Wirth it...

It has emerged that the Virgin F1 team's infamous all-CFD aerodynamic tie up with Wirth Research has cost the outfit a whopping £17.6m.

The figure, which is listed in the recently filed accounts for Virgin's holding company, Manor Hold Co, is part of a £35m loss for the company in the period up to December 31 2010. The amount of that loss that is apportioned to Wirth – and this does not include money paid up to its spilt with Wirth in 2011 – is all the more remarkable as the attempt to design the aerodynamics of the car entirely on CFD was largely seen as a failure. Virgin finished last in both the 2010 and 2011 championships, and part way through last season signed a deal with McLaren to use its wind tunnel facilities.

Other figures to note in the accounts are revenues of £30.1m, mainly from sponsorship and prize money.

Despite the company's debt, it is still operating because of the involvement of Marussia, the Russian sports car firm which has also become the new name for the team. Marussia has provided funding to keep the outfit afloat this year. The accounts also reveal that the team has a stated objective of finishing on the podium at the first Russian Grand Prix, set to take place in 2014.

Meanwhile, at the time of writing, fellow F1 struggler, HRT, was believed to be asking wannabe F1 drivers for a staggering €6m for the privilege of joining Pedro de la Rosa in one of the Spanish team's cars. Dutchman Giedo van der Garde, who was third in GP2 last year, was thought to be favourite for the seat as *Racecar Engineering* went to press.

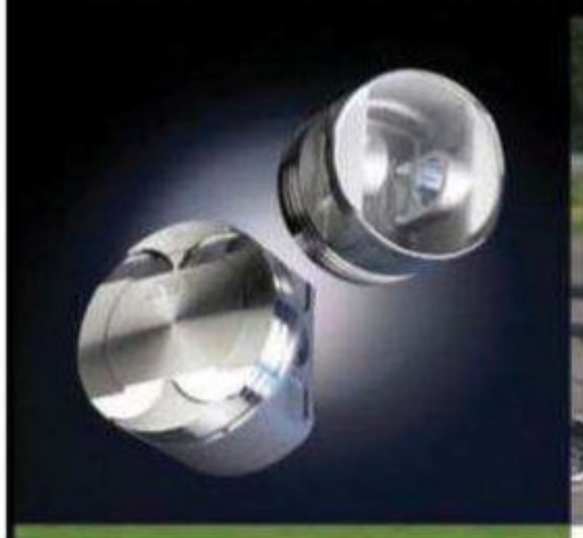
ACCRALITE
performance forged pistons

A DIVISION OF

OMEGA PISTONS

ENGINEERED TO PERFORM
world leaders in high performance pistons

MANUFACTURERS OF WORLD CHAMPIONSHIP WINNING PISTONS FOR MOTOGP, WORLD SUPERBIKE & SPEEDWAY. WE POWER WINNERS IN THE AMA, LE MANS, BTCC AND MANY MORE...



Omega Pistons
Oak Barn Road, Halesowen
West Midlands B62 9DW

Tel: 0121 559 6778
Fax: 0121 559 6779
info@omegapistons.com
www.omegapistons.com

"Our objective:

to consistently satisfy motorsport's demand for the best connection system, bar none."

- The lightest hose and fitting combination available
- Crimp and reusable hose end options
- Excellent bend radius - less hose used
- All one piece 'billet' fittings, no brazing
- Four exterior braid options
- Custom CNC tube bending service
- Engineering design service - part of your team

BMRS 2010 Champions in:

NASCAR Sprint Cup • NASCAR Nationwide • NASCAR Truck • NASCAR K&N East
IndyCar • ALMS LMP • ALMS GT • Grand Am Prototype • Grand Am GT
World of Outlaw Sprint Car • ARCA • USAR • USAC Midget • ASCS Sprint Car
Formula Drift • Lucas Oil Dirt Late Model • Knoxville Track • Daytona 24hr
Daytona 500 • Brickyard 400

Brown & Miller Racing Solutions
BMRS
Professional Race Hose & Fittings

www.bmrs.net

USA: BMRS Concord +1 (704) 793 4319
UK: BMRS Slough +44 (0)1753 545554

Euro crisis threatens Formula 1 in Spain

The crisis in the Eurozone has begun to impact on Formula 1 in Spain, with the country's two grand prix venues now unsure they can afford to continue being involved in the sport.

Both the Catalunya government (responsible for the Barcelona race) and the Valencia government say they feel they might not be able to afford to host the races at the current price. Both are believed to be seeking to re-negotiate their deals with F1 management.

Valencia is especially keen to get a better deal. The details of the current contract are not public, but it's known that it has agreed to host the race until 2014. However, it is now the most indebted of all Spain's regions. It is also widely believed the race has been making a loss, though again the figures are not in the public domain. The region has a total debt of €20.5bn, according to the Bank of Spain.

Catalunya's government also says it may need to re-think the hosting of its Barcelona-based Formula 1 race, given the economic situation: 'We could reconsider the hosting of Formula 1 or motorcycle grands prix,' Andreu Mas-Colell, Catalunya's minister for economy, said. 'It is not clear to us that we can afford them in the current situation.'

However, the problem both venues face is the cost of breaking the contract with F1, and Mas-Colell has said the situation must be looked at carefully in order to make sure breaking a contract does not cost more than hosting the race. Barcelona has a deal to host the Spanish GP until 2016.

"It is not clear to us that we can afford them in the current economic situation"

Meanwhile, McLaren's primary sponsor, Vodafone, has been having a rough ride on the markets as the turmoil in the Eurozone, and subsequent downgrading of European countries by the credit rating organisations, has led to its value tumbling by 2.5 per cent to 175p, at the time of writing.

MEANWHILE, IN FRANCE...

Conversely, the French GP could be restored to the Formula 1 calendar as early as September next year, according to Gilles Dufeigneux, the government appointee responsible for reviving the most historic event in Grand Prix racing. The plan is for the race to return to the Paul Ricard circuit at Le Castellet, which is owned by Bernie Ecclestone, and to share a date in alternate years with the financially beleaguered Belgian GP at Spa-Francorchamps.

The French Grand Prix had been regarded as part of the DNA of Formula 1, the very first motor race bearing the 'Grand Prix' title having been held in the nation in 1906, at Le Mans.

Dufeigneux says negotiations with Ecclestone and the Formula One Group have reached final stages and that a decision will be announced imminently. 'All the indicators are green now, or soon will be,' he told *Nice-Matin* newspaper. 'My current mood is summarised with three words: optimism, prudence, humility. We have entered the stage of completion and we can say that final decisions will be made in January or early February.'

According to *Le Figaro*, the proposals are now on Fillon's desk, and it only remains for the prime minister to say yes to the nation's minister of sport, David Douillet, and FFSA president, Nicolas Deschaux. In view of the proposed French government funding, Ecclestone is understood to have agreed to increase the spectator capacity of the venue to 50,000, but this would still make it one of the smallest crowds of the championship.

Van Diemen stays out of all-new Formula Ford

The Van Diemen name will not be appearing in top-line Formula Ford for the first time since 1973, with the news that the owner of the marque has decided not to make a chassis for the new Ecoboost formula.

Van Diemen, which in the late 1980s was the world's biggest racecar producer, has been a mainstay of top-level Formula Ford for nearly 40 years, but the present owner of the brand, Elan Motorsports Technologies, has decided not to commit to building a car to the new regulations.

A mainstay of the series since 1973, many are surprised by Van Diemen's decision not to build a car to 2012 regs

In place of the works Van Diemens, Fluid Motorsport, the team that has run the works cars since 2009, will build and field a totally new car called a Sinter (see SEEN), which it will race under the Southern International banner.

Lyndsay Allen, head of Southern International and a veteran of Formula Ford competition, said he was disappointed by Van Diemen's decision, but added that this does not necessarily mean the end of the road for Van Diemen in Formula Ford.

'I am sad about it,' Allen told *Racecar Engineering*. 'but you can't really say it's the end of the name, because the Duratec will still be racing [in a secondary class]. It is a shame they didn't want to come in with a new car, but I'm saying they're not coming in at this point. They've got other commitments in the States, they're still building other formula cars in the US and, when the market steadies, they might come back.'

The new Formula Ford regulations, introduced for this season for the Dunlop MSA Formula Ford Championship of Great Britain and the Formula Ford EuroCup, are based on the 1.6-litre Ford EcoBoost direct injection, turbocharged engine.

In its time in Formula Ford Van Diemen has racked up an impressive series of titles in that time, including some 33 UK national championships and 21 victories in the prestigious Formula Ford Festival.

INTERVIEW - TERRY GRAHAM, managing director, Zircotec

Q. How did you come to be involved with Zircotec
Zircotec was part of the nuclear programme – much of the technology comes from the nuclear industry. But it has carried out motorsport work from the early '90s, and I became involved about six years ago. Then, about three years ago, two other directors and I did a management buyout.

Terry Graham (51) is a chartered engineer who has worked in the nuclear industry and also in chemical weapons destruction. He has managed a variety of mostly hi-tech and start-up businesses and is currently MD at Zircotec.

Q. What work is carried out at your Abingdon factory?
It's coatings in metals for exhaust systems, primarily, but also coatings on carbon composite, which is the bit that's growing within motorsport. People are using more and more lightweight materials and they don't stand up to heat particularly well.

The coating material is our own propriety product. It's a ceramic-based material with a high content of Zirconia, but with a number of rare earths in there as well.

Q. How difficult is the process?
Our ceramic-based material is sprayed at 10,000degC, so we have a substation on the side of our building because we use a lot of electricity to generate plasma. We're also firing the material at the metal components at about twice the speed of sound, so the operator needs to wear protective clothing, and work in a booth that is sound proofed.

Q. How much of your business is motorsport related?
A lot of high performance car manufacturers use our coatings. Motorsport is actually a smaller and smaller percentage of the business, even though it is still growing – it's now around 20 per cent of our work.

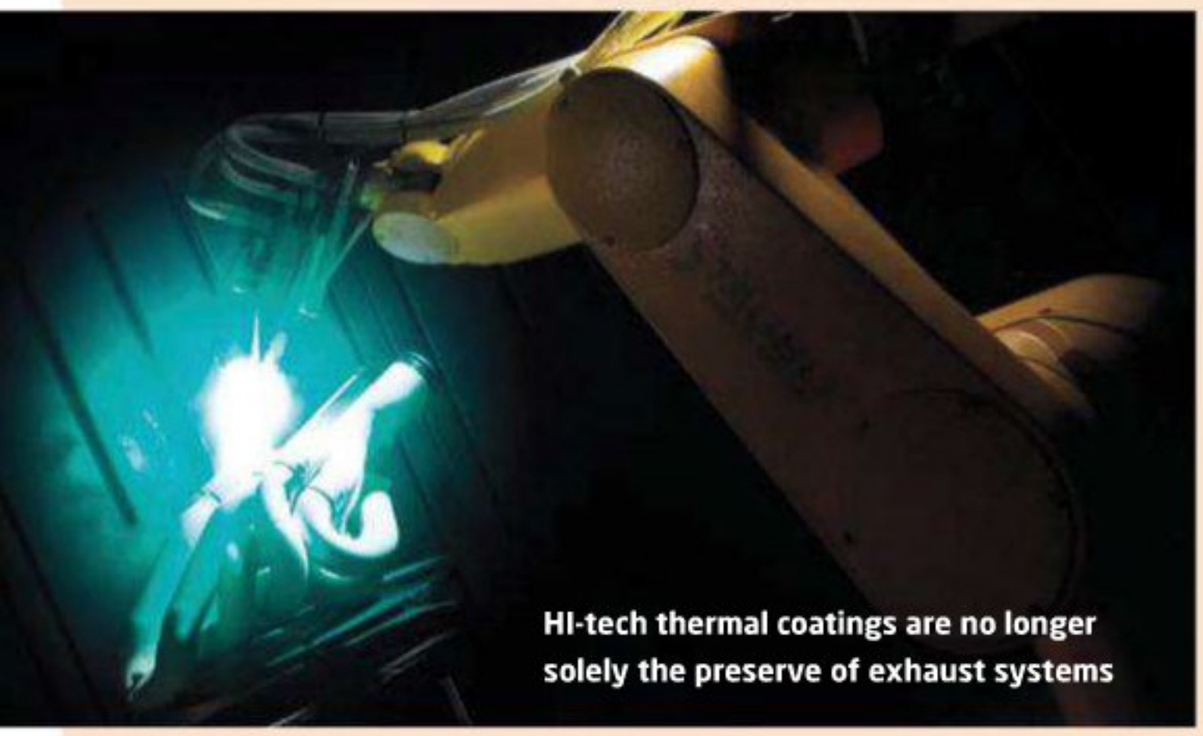
F1 has grown over the last three or four years, and we had a very good year last year with the blown diffusers, when we worked with all but one of the Formula 1 teams. We are expecting Formula 1 to grow less quickly for us this year, but other motorsport is growing in the UK, and we are signing distributors across the world.

Q. What other products do you offer?
There's Zircoflex, which is a general purpose heat shield material. Rather than the service, it's a product. You buy it in a roll or a sheet, and a Formula 1 team would typically carry some Zircoflex in their race truck. Some of the teams are actually building Zircoflex into the car when they manufacture it. They will also use it as a fix for heat problems at the track. It has a metallic backing with a flexible ceramic mesh built into it. The ceramic gives it its thermal barrier properties, while the metal backing provides a reflector for radiant heat.

Q. How has the nature of your work with motorsport teams changed over the years?
These days we work much more closely with professional teams to provide solutions rather than products. Teams will now come to us with a problem and we will use our coatings to solve that problem.

It's not just heat, either, there are aero issues that coatings can solve. For instance, controlling surface texture with an aerofoil section – quite often you want something that's very smooth so you're not spoiling the airflow across the surface. Historically, our coatings were quite rough in texture but, over the last few years, we've developed a smooth version that's proved to be very popular. Also, with F1 there was an issue with tyre rubber sticking to aerofoil sections, so we developed a form of our coating that was more resistant to this. That's what we like to do.

Now we're at the stage where it's all about engineering our product into the car, rather than the teams running the car, finding that they've got a heat management problem, and then coming to us as a bit of a last-minute fix.



HI-tech thermal coatings are no longer solely the preserve of exhaust systems

Q. What does the future hold for Zircotec?
We've got a number of products coming along, and building on the Zircoflex range is an exciting prospect for us. As carbon composite becomes even more widely used, we expect to be coating even more of it with the performance car manufacturers, but also with aerospace. Carbon composite is used more and more in the aircraft industry too, and I can see us getting quite a lot of interest from that sector.

Ferrari sign up Bridgestone tyre wizard

After a 2011 season in which Ferrari struggled to get the best out of its tyres, the team has signed up Hirohide Hamashima, the former director of tyre development at Bridgestone.

Hamashima, known as Hammy in the F1 paddock, will head up the department at the Scuderia, which deals with the interaction between the car and the tyres. He will report to technical director, Pat Fry.

Commenting on the arrival of Hamashima, Ferrari team principal, Stefano Domenicali, admitted that the team had struggled with the new Pirelli tyres last year: 'He will give his contribution to the development of the car and the issue of tyres. As this was an issue where last year we suffered in some conditions,' he said.

Hamashima (59) is a graduate of Tokyo's University of Agriculture and Technology, where he studied macro-molecules. He previously worked with Ferrari during the Michael Schumacher years, when it was Formula 1's dominant team.

Ferrari suffered from temperature-generating issues with the Pirellis last year, which was particularly highlighted at Barcelona where Fernando Alonso led the grand prix on the soft tyre, only to end up being lapped after the hard tyre was fitted later in the race.

Hirohide Hamashima

SEEN SINTER FORMULA FORD

QUICK SPEC

Engine: 1.6-litre, direct injection, turbocharged Ford EcoBoost, limited to around 165bhp

Transmission: six-speed sequential with mechanical shift mechanism

Chassis: increased safety levels to the latest FIA standards, which demand front and rear carbon crash structures and side intrusion panels

Bodywork: design input from Caterham F1 Team

Computer images of the new Sinter Formula Ford have been released. Sinter is only the second manufacturer, after Mygale, to commit to the new turbocharged formula.

The Sinter, said to be a 100 per cent new design, has been penned by Sam Owen and will be developed and built by Southern International / Fluid Motorsport, while the bodywork has been designed by Caterham F1.

First impressions suggest a car that is very similar to the Mygale, but Fluid Motorsport boss, Lindsay Allen, says there will be key detail differences. 'The pictures we have released are just computer images and have no real detail to them, so the car that will come out will look slightly different from that,' Allen told *Racecar Engineering*. 'But the problem is that you have the cockpit opening, which is a mandatory part, and the top part of the engine cover, also a mandatory part, and they're fundamental areas of the car... so you're ending up with cars that are going to look fairly similar.'

The car should be testing by the time this issue is published and Allen is hopeful of selling three of them (at a cost of around £34,000 ($53,000) per rolling chassis), although he admits he may have to run the Sinter with a proven driver to show its potential first.

Sam Roach of RacingLine, the Dunlop MSA Formula Ford Championship of Great Britain promoter, said he was pleased a second chassis would be joining Mygale on the grid: 'Freedom of chassis design has driven Formula Ford since the inception of the category in 1967. Only Formula 3 and Formula 1 offer the same levels of freedom, which help drive technical standards to exceptionally high levels. The different implications of car set up and individual chassis variation create a steep learning curve for drivers, helping to accelerate the development of their abilities.'

New premises for Primary Designs

UK-based Formula 1 and supercar exhaust manufacturer, Primary Designs, has moved into a purpose-built new factory as it looks to expand its business into other markets.

The company, which was founded and is run by ex-Williams engineer, Pat Barrett, has taken up residence in a 6500sq.ft factory in Thame, Oxfordshire, and is now looking at supplying other sectors beyond Formula 1 and supercars, including defence and marine applications.

Barrett believes the new factory at the Thame Park Business Centre and an enlarged workforce – up by 25 per cent in the last 12 months – will help offset the seasonal demands associated with working in the professional motorsport industry.

Barrett also hopes to find more work in the aerospace sector where Primary Designs' ability to weld specialised alloys is already leading to business enquiries and development projects. 'The factory is designed to be flexible. Anything from a one-off system to significantly higher volumes can be accommodated,' Barrett said.

Specialised welding is just one of many areas of expertise at Primary Designs

In addition to the exhaust manufacturing side of the business, Primary Designs will also offer other sub-contract services such as surface finishing processes and measuring technologies that enable companies from any industry to use F1-grade equipment on an *ad hoc* basis. 'We had to invest in the highest standards of equipment for Formula 1,' says Barrett. 'We plan to offer such services in the coming months.'

BRIEFLY

Delta ambitions

Former Grand Prix Masters single-seater builder, Delta Motorsports, is to enter this year's all-new FIA World Endurance Championship with the aim of proving itself in the heat of competition, and ultimately landing an LMP1 manufacturer deal.

The company will campaign at least one ORECA-Nissan LMP2 in this year's championship and has joined forces with Alan Docking Racing, which will help run the operation. Delta aims to win the LMP2 championship this year and then move into LMP1 with a hybrid-equipped car in 2013. In preparation for this, the company is already involved with hybrid projects elsewhere in this burgeoning automotive sector.

RACE MOVES

Yves Matton has replaced Olivier Quesnel as team principal at the Citroën World Rally Championship team, a post he had originally been tipped to take in 2007. **Xavier Mestelan Pinion** has been appointed Matton's deputy principal and technical director.

Gianpiero Moretti, founder of the Momo steering wheel company and a successful Sports Prototype racer, has died at the age of 71 after a long illness. Moretti will perhaps be best remembered for helping to persuade Ferrari to build the 333SP in the 1990s.

Beaux Barfield

LAT

Beaux Barfield is IndyCar's new race director, taking on the role vacated by Brian Barnhart towards the end of 2011. Barfield had been the race director of the American Le Mans Series since 2008 and, before that, was a ChampCar steward and has also been chief steward for the USF2000 championship. **Paul Walter** will replace Barfield at the ALMS.

Red Bull Racing chief technical officer, **Adrian Newe**y, has been made an Officer of the Order of the British Empire in the New Year's Honours List. The award had been made in recognition of Newey's services to motorsport.

Dieter Gass has joined Audi Sport as its head of racing commitments. Gass was an engineer at Audi before switching to Toyota to start his F1 career in 2001. He had moved to Lotus, where he was the sporting director, before the Japanese company pulled out of F1 at the end of 2009.

The F1 world was shocked to hear Toro Rosso trainer, **Raniero Gianotti**, has died at the age of 46. Gianotti had been involved in motorsport for more than 20 years, working with a number of drivers and teams. He was cycling in the Urbino area of Italy when he suffered the heart attack.

Former F1 driver, **Luis Perez-Sala**, has taken the place of Colin Kolles as team principal at the HRT Formula 1 team. The Spaniard raced for Minardi in 1988-'89, scoring one point from 26 starts. HRT has now severed all ties with Kolles.

Max Jones has been named team manager of the Earnhardt Ganassi Racing with Felix Sabates NASCAR operation. Jones was previously president and general manager at Richard Petty Motorsports and has NASCAR experience dating back to 1991, the year he quit race driving. He spent 2002 to 2004 as general manager of Red Bull Cheever Racing in the IndyCar Series.

Ultra-successful NASCAR crew chief, **Greg Zipadelli**, has left Joe Gibbs Racing to join Stewart-Haas Racing as its competition director. Zipadelli has won two Sprint Cup Series championship and 34 races during his 13-year spell with JGR.

Jason Ratcliff has replaced Greg Zipadelli as crew chief on the no 20 Sprint Cup racer at Joe Gibbs Racing. Ratcliff has spent the past seven years as crew chief for the organisation's no 18 Nationwide Series entries, which have won owners' championship honours in 2009 and 2010 and narrowly missed out on completing a hat trick of titles last season.

Todd Gordon is now the crew chief on the Penske Racing-run no 22 Dodge in the NASCAR Cup Series. Gordon has been moved from Penske's Nationwide operation, where he led the team's car to six wins and six poles. He joined the Penske organisation at the start of last year.

Penske Racing has appointed **Jeremy Bullins** as the crew chief of its no 22 Dodge in the NASCAR Nationwide Series, replacing Todd Gordon in the position (see above). Bullins makes the move from Richard Childress Racing, where he served as race engineer for the no 29 car in the Sprint Cup Series.

Luis Perez-Sala

LAT

Jerry Baxter has joined Eddie Sharp Racing as its crew chief on the no 33 Chevrolet in the NASCAR Camping World Truck series. Baxter was most recently at Michael Waltrip Racing, where he worked with up-and-coming drivers before they reached the Sprint Cup Series ranks. These included David Reutimann, Scott Speed and Trevor Bayne.

Foxy business for Lifeline

Well-known UK motorsport business, Lifeline Fire and Safety Systems, has announced it will be supplying fire suppression systems for the British Army's forthcoming Foxhound Light Protected Patrol Vehicle.

The Coventry-based company has been working with Force Protection Europe – which is building the new Foxhound for the Ministry of Defence – and it has designed two systems to protect the occupants and engine bay of the vehicle in the event of fire. A two unit, 2.25kg Zero 360 extinguisher system protects the engine bay and a 2.25kg Zero 360 unit ensures protection for the crew area. This gaseous compression discharge system, adapted from an off-the-shelf Lifeline motorsport version, deploys automatically in less than 60 milliseconds from the first detection of fire, using UV and IR linear heat detection techniques, the company tells us.

Jim Morris, managing director of Lifeline, has acknowledged the part played by the Motorsport Industry Association (MIA) in securing the deal: 'As members of the MIA, we are in no doubt that the Association's Motorsport to Defence initiative set up in 2007 has been a major factor in our securing this contract. By exposing MOD contractors to the techniques and products being developed in the motorsport arena, a number of MIA members have secured ongoing MOD contracts.'

The Foxhound, Britain's new Light Protected Patrol Vehicle will use Lifeline extinguishers

Lola competition to encourage female engineering talent

UK-based racecar producer and engineering company, Lola, has founded a national competition aimed at encouraging young women to pursue further education and careers in science, design and engineering.

The competition was launched at the end of January and will run throughout Spring 2012 and will be open to all women under the age of 25. Entrants will be required to produce an original, revolutionary design for a product that is compatible across Lola's diverse portfolio of technologies in motorsport, aerospace, defence, communications, renewables and automotive industries. A panel of expert judges will assess every entry and narrow the field down to a shortlist of 10.

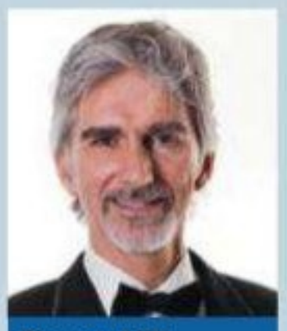
Lola says the competition will culminate with a celebration of young female engineering talent at a prestigious award's ceremony where shortlisted candidates and the winner will be announced. The top prize will be awarded to a woman who demonstrates ability, imagination and passion for engineering. The winner will receive a cheque, a trophy and the opportunity to further enhance and test their winning design at Lola's state-of-the-art facilities in Huntingdon.

Lola says it has launched this competition due to the lack of female engineers in the UK, where only 13 per cent of engineering graduates are women, falling to nine per cent when entering the workforce.

Martin Birrane, owner of Lola Group, said: 'Lola is determined to support the discovery of Britain's brightest female engineering talent and inspire young people to pursue their passion in science, design and engineering. The under-representation of women in these sectors provides a threat to the UK's global competitiveness.'

RACE MOVES

Former Jordan Grand Prix technical director, **Gary Anderson**, is to join the BBC's commentary team for this season. Anderson will act as technical analyst for the network's F1 coverage, enlightening viewers on the latest technical developments and race strategies. Meanwhile, 1996 world champion, **Damon Hill**, is to join Sky TV's commentary team.



Damon Hill LAT

Legendary Stock Car crew chief, **Dale Inman**, has been admitted into the NASCAR hall of fame. Inman made his name working alongside his cousin, **Richard Petty**, who has said Inman invented the position of crew chief. Inman (75) scored 193 victories and 129 poles in a career that stretched from 1958 until 1992.

NASCAR Nationwide team, Turner Motorsports, has snapped up veteran crew chief, **Mike Shiplett**, to oversee its no 38 car. Shiplett, a former driver, has over 20 years of racing experience and has worked in all three of NASCAR's top series. He began the 2011 season as the crew chief for the no 43 Cup car at Richard Petty Motorsports, but was replaced mid-July last year.

Michelle Mouton LAT

Nadia Morini has stepped down from her position as team manager at Draco, the well-known Italian single-seater squad. **Simone Giglio** will take her position at the team, which is a former Formula Renault 3.5 championship-winning outfit.

The New Jersey Grand Prix organisers have appointed **Tom Cotter**, formerly the head of successful motorsport marketing firm, The Cotter Group, as president of the company that will promote the new US F1 race. Cotter will work alongside new chief operations officer, **Dennis Robinson**, formerly the New Jersey Sports and Exposition Authority CEO. The inaugural New Jersey race is set for June 2013.

Prodrive boss, **David Richards**, has stepped down from the position of team principal of the Mini World Rally team, which Prodrive runs. In his place, **Dave Wilcock** will now combine his role as technical director with that of team principal. Richards will still be involved with the team, and will continue to attend some rounds of the championship.

Yukio Yoshida is the new corporate planning director at Japanese tyre manufacturer, Falken's, European headquarters in Offenbach, Germany, replacing **Satoru Ushida** in the position. Yoshida began his career at Falken's parent company, Simitomo Group, in 1990.

Former rally star, **Michele Mouton,** who is now manager of the FIA World Rally Championship and president of the FIA Women in Motorsport Commission, has been awarded the rank of *Chevalier of the Legion d'Honneur* by the French President, Nicolas Sarkozy.

Former racer and accomplished engineer and team owner, **Tony Shaw sr**, has died. Shaw, father of Manor Competition team boss, Tony jr, was well known for his exploits at the wheel of a Modsports Jaguar E-Type, and also peddled a Camaro in the 1975 British Saloon Car championship. He also co-founded the Comet Delltune team, which was based at Thruxton.

Motorsport insurance expert, Ellis Clowes and Company, has announced a number of promotions and appointments. **Karen Ellis** is now chief executive officer of the specialist Lloyd's Insurance broker, with **Tim Nagle** taking her former position as managing director. Former F1 driver and TV pundit, **Mark Blundell**, has also joined the company as a non-executive director.

Michael Wentworth is the new licensing manager at the MSA, the UK's governing body for motorsport. Wentworth has served as the deputy manager for the past year, and joined the licensing department in 2006.

■ **Moving to a great new job in motorsport and want the world to know about it? Or has your motorsport company recently taken on an exciting new prospect? Then send an email with all the relevant information to Mike Breslin at bresmedia@hotmail.com**

Williams F1's athletic support

The sports training company founded by Olympic legend, Michael Johnson, has entered into a sponsorship agreement with the Williams F1 Team.

Johnson's Performance Inc concern (MJP) will be providing an intensive training regime for the team's pit crew personnel, in order to cut down on the time it takes to turn around the cars at pit stops. Williams personnel, including the drivers, will wear the MJP logo on overalls and kit in return for the training.

Williams' pit stops were ranked seventh quickest over the course of 2011, an average of 1.1 seconds behind the fastest wheel changers at Red Bull Racing.

Team principal, Sir Frank Williams, said: 'I had the privilege of first meeting Michael at the Belgian Grand Prix in the late 1990s. I have always admired the dedication required to be an Olympic champion. The attention to detail and the commitment required is what sets these extraordinary individuals apart from the rest of us.

'When Michael and I met again recently, he explained how he had established a company that specialised in improving athletic performance. I was extremely keen to learn how he could help our team as there seemed to be a lot of areas of common interest. We all know how crucial the brief time the car spends in the pits can be, and so it will be exciting to see how Michael and his team can help give us the edge in this respect.'

Johnson, who scored a famous 200m / 400m double gold at the 1996 Olympics, said he was sure his expertise would help speed up the team's pit stops. 'I am confident that the experience and biomechanics expertise of the MJP staff can benefit the Williams F1 Team pit crew in their goal to cut tenths and even hundredths of a second from their pit stop times,' he said. The results will be interesting to see.

Can Michael Johnson's expertise save Williams' mechanics vital pit stop time?

Good news all round for Cartek

While Cartek was busy launching its latest safety product at Autosport International, the coolant Level sensor, the company received notification that its ever-popular solid state battery isolator is to be a mandatory safety part in the new Formula Ford EcoBoost car, which was also being showcased at the same exhibition.

But if this wasn't enough good news for Cartek, the company also received word that there was a podium lock-out at the Dubai 24hr by AMG Mercedes SLS GT3 cars, all of which were also using its electronic battery isolators. MD of Cartek, Neil Armstrong, said 'We were delighted with the news that we were to become a major component supplier to this latest generation of Formula Ford.' And went on to say, 'then we receive news that cars using the same crucial product finished first, second and third in the gruelling 24-hour race. There can be no better way of demonstrating a product's reliability than with a result like that.'

The SEMA Award Winning

High Performance Injectors

"Its not how much fuel you supply the engine, its how efficiently it burns that gives you the power and performance"

Flows from 300cc up to 1100cc

The ASNU High Performance Injectors have been designed specifically for Motorsport, with one main feature in mind, burning as much of the fuel as possible.

Providing the maximum atomisation will ensure the best air/fuel mixture for your race engine, giving you power and performance as well as stability, economy and pollution control.

The ASNU Injectors have 7 laser cut holes that control the fuel delivery and Atomisation, producing smaller droplets that will burn easier and better.

Fuel deliveries are from 300cc to 1100cc in 50cc.steps

ASNU High Performance Injectors

E-Mail: sales@asnuinjector.com Tel: +44 (0) 208 420 4494

Web Site: www.asnuinjector.com

OBR

Control Systems

WHY FOLLOW WHEN YOU CAN.....LEAD

OBR DELIVERS FOR JUNO...

Juno CN2011 car

Paddle Shift System

We are delighted that Juno Racing Cars selected a complete OBR control system for installation in their 2011 SSV3 CN cars

Custom CAN switch panel and Power Control Module

EFI Euro 4 ECU

"We have been impressed with the quality and capability of the products supplied. The support offered by OBR is excellent too"

Ewan Baldry, Owner - Juno.

EFI TECHNOLOGY

MOTORSPORT INDUSTRY ASSOCIATION MEMBER

WWW.OBR.UK.COM

Ole Buhl Racing (UK) Ltd is a world leader in the supply of motorsport electronics. Our range of innovative products are used in the world's most demanding environments ensuring performance and reliability.

AUTOSPORT INTERNATIONAL Engineering Show

In association with Racecar engineering — The International Journal of Motorsport Technology

TWO DAYS IN JANUARY SAW...

- OVER 28,000 TRADE VISITORS
- 5,000+ OVERSEAS VISITORS
- 55 COUNTRIES REPRESENTED
- £800+ MILLION WORTH OF BUSINESS GENERATED

Thanks to everyone who came along this year

PUT THE DATES IN YOUR DIARY

10 & 11 JANUARY 2013 | NEC BIRMINGHAM UK

www.autosportinternational.com/trade

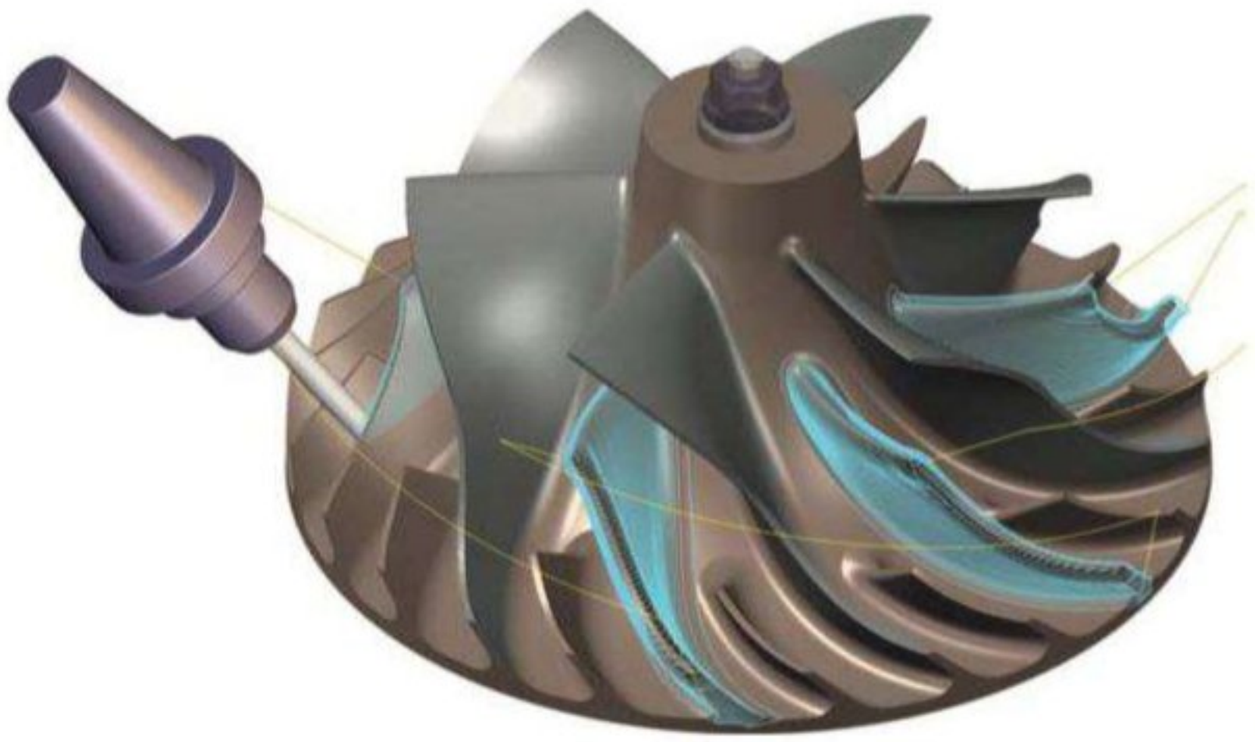
SOFTWARE

CNC Mastercam X6

US-based CNC Software has announced the release of Mastercam X6, the latest version of its CNC control software. The software features extensive improvements in useability, while allowing more intuitive creation of tool paths.

Features such as Blade Expert greatly simplify the tool path creation process for any multi-bladed parts, including fans, propellers, impellers, turbines, marine screws and more. There is no limit to the number of blades, splitters, or sub-splitters that can be programmed. The overall result is improved machine efficiency and more effective removal of material.

See www.mastercam.com for more information



DATA LOGGING

MoTeC CDL3 kits

Data logging and ECU specialist MoTeC has unveiled a new range of plug and play dash / logger kits. CDL3 Track Kits package together professional quality components, including shift lights, buttons, GPS and high quality wiring with plug-in power, all at an entry-level price. The kits are designed for quick set up, requiring no prior experience and no electrical expertise. They simply plug together and are ready to race in minutes, making them perfect for club-level motorsport, track days or driver training. Customers can choose between the CDL3 Track Logging Kit, complete with 8Mb logging and MoTeC's i2 data analysis software, and the CDL3 Track Display Kit, a non-logging version that can be upgraded at any time with the data logging option.

Accessory looms are also available to allow the CDL3 to be connected to a vehicle's existing ECU.

See www.motec.com.au for more information

HARDWARE

GEMS LDS4 steering wheel

UK-based engine management specialist, GEMS, has revealed its latest product, the LDS4 steering wheel, developed in conjunction with bf1systems. The wheel uses GEMS' AMOLED LDS4 dash as its main driver screen and has eight buttons and five rotary switch inputs that are all configurable via the dash, as well as 11 multi-colour shift lights. A fully configurable CAN bus is provided for communication with other vehicle systems. This steering wheel is targeted at the professional racing team looking for a complete steering wheel and dash system.

Additionally, GEMS has also released a new carbon mounting bracket to allow its DL10 dash / logger system to be steering wheel mounted.

See www.gems.co.uk for more information

SUSPENSION

ANZE custom suspension

The name ANZE Suspension may not be familiar to European racers, but the company's range of custom-built dampers and strut assemblies have seen considerable success in the US. The company specialises in providing custom-built front strut units for a wide range of production cars, with body sizes and valving to suit customer applications. The company also has an exclusive tie up with Penske Racing Shocks, giving their customers access to some unique features, usually only available on top-end products for markets such as F1 and IndyCar. If you are in need of a custom suspension strut, ANZE Suspension can probably accommodate your needs.

See www.anzesuspension.com for more information

HARDWARE

Holley Ultra HP carbs

Carburettor company Holley recently released its new range of Ultra HP carburettors. A number of new features and upgrades have been engineered into the new range of carbs, most notably their all-aluminium construction, which makes them 38 per cent lighter than Holley's equivalent four barrels. Totally re-designed fuel bowls increase fuel capacity by 20 per cent and have new internal baffling to help control fuel slosh, a fuel trough to direct fuel to the jets and a fuel shelf, which minimises aeration and promotes more consistent metering. The new unit also features a host of other detail changes intended to provide more accurate fuel metering and greater performance.

See www.holley.com for more information

MARKET·CONNECT·SELL

THANK YOU!

On Behalf Of Over 1,000 Exhibiting Companies,
We At PRI Thank The Racing Industry
For A Fantastic 2011 PRI Trade Show!

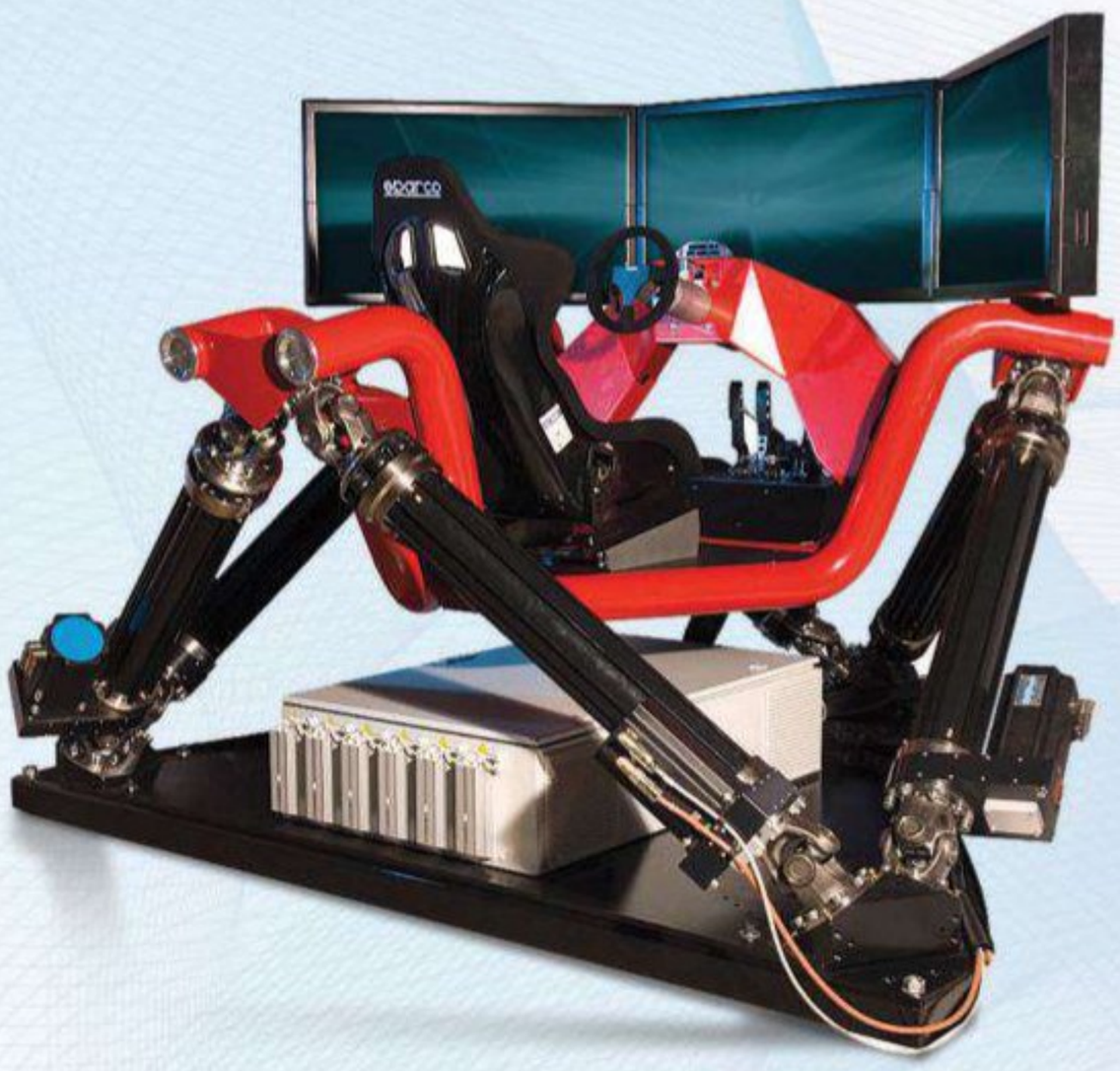
Steve Lewis
Producer
Performance Racing Industry Trade Show

NOVEMBER 29-DECEMBER 1, 2012 • ORLANDO, FLORIDA • USA

www.performanceracing.com

cruden

We don’t need to tell motorsport professionals that simulators can help racing drivers learn new tracks...



...but did you know that the latest generation simulators from Cruden can be used to evaluate new components and race set-ups?

...to plan race strategies, develop and assess engineers and design race tracks?

...or to teach drivers and engineers how to work around problems occurring in the middle of a race?

Adding a simulator to your team to stay ahead of the competition may not be as expensive as you think. Cruden is manufacturing and installing a growing number of bespoke simulators and components for motorsport engineering companies large and small, globally.

We work hard to significantly reduce vehicle development cost and time, providing cost-efficient, reliable simulators that interface seamlessly with your own simulation software and race data.

Find out more – www.cruden.com/motorsport

Cruden Europe
info@cruden.com
+31 20 707 4668

Cruden America
info@cruden.com
+1 949 209 0210

Cruden Asia Pacific
info@cruden.com
+61 3 9589 1304

cruden

AUTOSPORT INTERNATIONAL Engineering Show

In association with Racecar engineering

Back on track

The premier UK motorsport trade show proves there is stilll plenty of optimism in the industry in Europe

BY SAM COLLINS

The motorsport industry once again made its annual trek up to England's West Midlands region and the National Exhibition Centre for the Autosport International show. Run over four days, the event features just about everything you could imagine in the British motorsport scene. Every current grand prix team sent at least one show car and others such as Caterham sent real cars, freshly returned from Brazil.

The really serious business takes place over the first two days of the event, with the *Racecar Engineering*-backed Autosport Engineering show, where anyone who is anyone in European motorsport engineering gathers, and many exhibitors were shocked at just how busy the aisles were. Many stands were mobbed for both days of the show, leaving many wanting more time to meet up with the people they needed to see.

Curiously, there was not a vast amount of new technology on display, companies obviously choosing to keep their new wares under wraps, perhaps due to confidentiality agreements or perhaps not wanting to give away their unfair advantage to rivals.

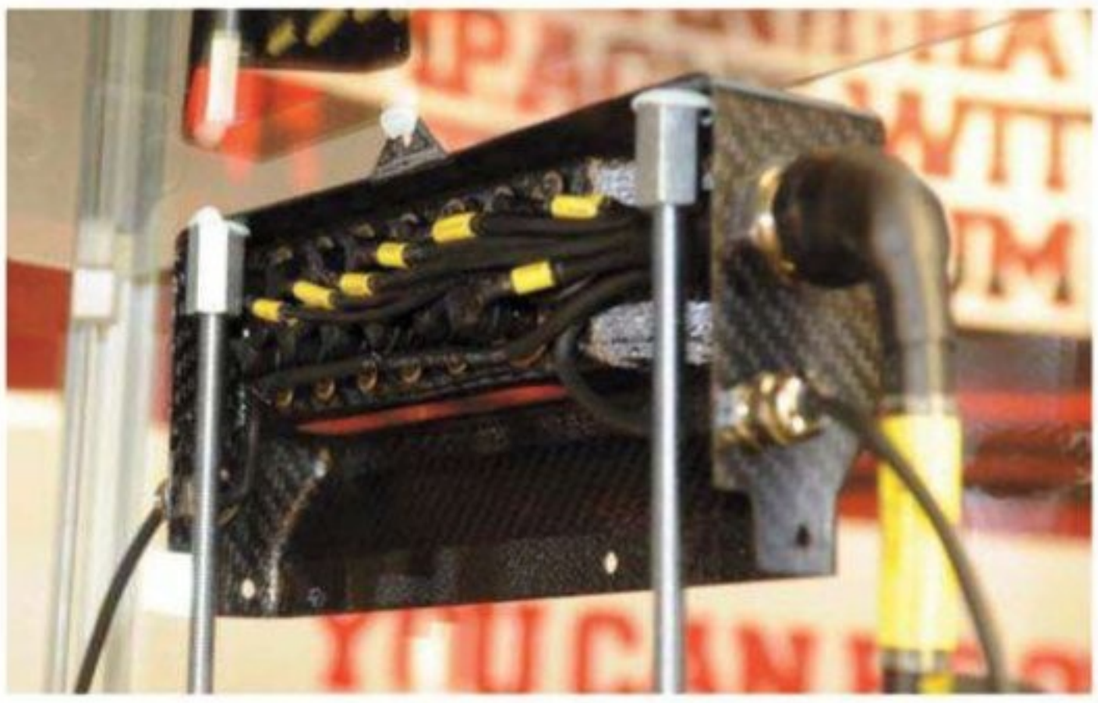
That's not to say there were no new products of note, there were, you just had to hunt for them!

The English thermal barrier specialist, Zircotec, is a perfect example of this. While it showed off its uprated Zircoflex foil, it kept another exciting product tucked away only to be shown to the right customers. *Racecar Engineering* will have full details next month!

NASCAR's switch to fuel injection has seen some of England's leading electronics specialists pick up vast amounts of business from the other side of the Atlantic, amongst them DC Electronics and St Cross Electronics, both of whom were exhibiting Sprint Cup wiring looms at the show.

Connector specialist, Deutsch Autosport, always has something new to show off at Birmingham and this year was no different. Its new range of through-bulkhead connectors in particular attracted a lot of interest. Developed from the firm's range of defence products, they allow complete removal of two sections of wiring loom whilst leaving the connector in place. There are already a range of sizes on offer and the firm plans to expand the range as the market dictates.

With the growth in demand for specialised wiring looms and connectors from the USA, lead times could have become a big concern, as the were in late 2009 and early 2010. However, at least one firm we spoke to has increased capacity to meet the demand. A new 24-hour assembly area has been opened at Servo Interconnect. The operation will initially concentrate on the assembly of the popular Deutsch AS Standard range of connectors. These are medium and high density circular connectors designed specifically for motorsport.

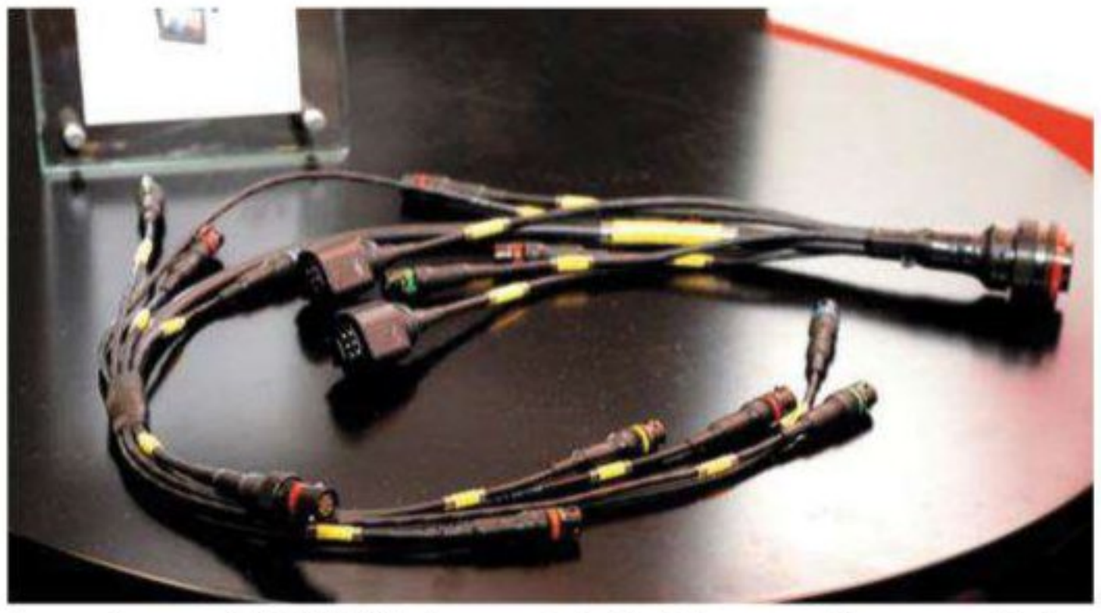


English firms still lead the way in wiring loom and connector technology

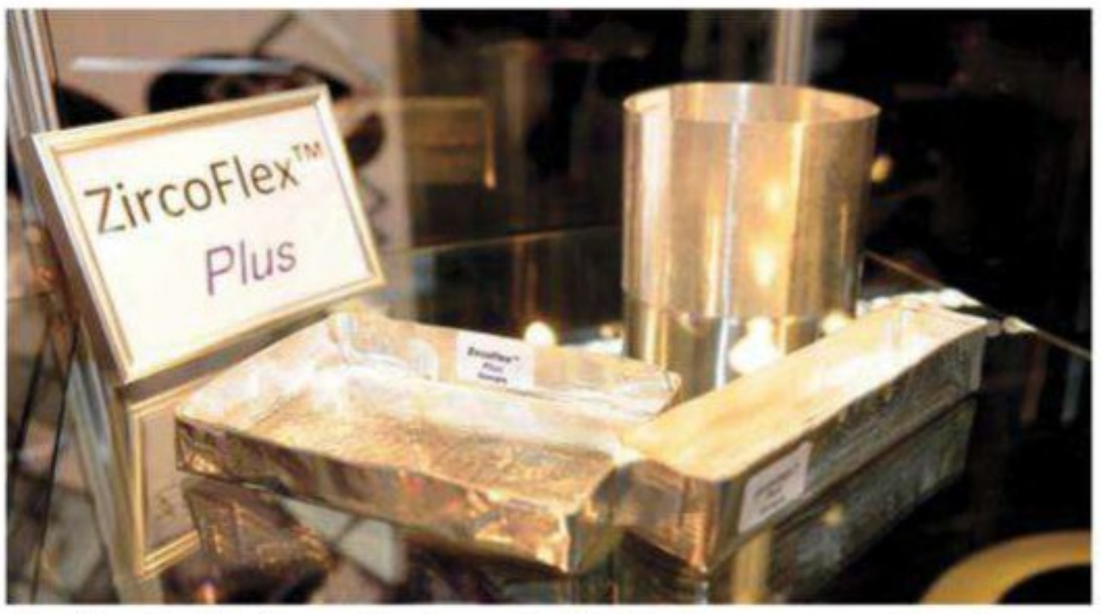
OPEN TO THE PUBLIC

Running alongside the Engineering show is the mainstream motorsport show, aimed primarily at the general public, but even here technical interest could be found. Simulator specialist, Cruden, for example, launched substantial upgrades to its Racer Pro simulator operating software. The uprated programme now features a set-up tool and telemetry analyser. The former allows engineers to change vehicle settings such as dampers, wing settings and throttle mapping whilst the simulator is being driven, avoiding the need to stop the test and re-set the simulator. The telemetry analyser allows race engineers, drivers and driver coaches to evaluate vehicle performance and driving style as the simulated run takes place or after the session as a download. Instant feedback from data such as lap and sector times, speed, throttle, brakes, steering angles and gears, in addition to many other vehicle parameters, can be used to maximise valuable simulator time. Additionally, with interfaces to Pi ToolBox, MoTeC, Bosch Windarab or Magnetti Marelli Wintax software available, engineers can analyse simulated telemetry channels as if recorded from the real car and overlay them with actual track data.

Dallara showed off its new for 2012 Formula 3 chassis. It appears to be the only car built to new rules



Connector specialist, BF1 Systems, celebrated the year with new products...



Zircoflex flexible thermal barrier material is finding many uses in motorsport

...and exciting technology on show on their award-winning display stand

Zircotec's performance exhaust coatings remain an industry standard

'Demand for Cruden's Racer Pro software, and its advanced functionalities and applications, is increasing among race teams, from Formula 1 to GP3 and F3,' says Frank Kalff, Cruden's commercial director. 'With the telemetry analyser, drivers no longer have to wait a full lap, climb out of the tub and sit behind a monitor to see the latest data, the operator can pause the simulator at any given time and pull up a set of selected data.

'This can be displayed on a simulator screen or an external LCD / plasma screen or beamer. Simulators have never been so valuable to off-track testing.'

WEATHERING THE STORM

After a couple of wobbly years due to the volatile economic situation worldwide, the motorsport industry seems to be finding its feet once more. The Autosport Engineering show had undoubtedly grown in size and many companies we spoke to were reporting their best ever years. With the Eurozone crisis still a major factor in all areas of business it remains to be seen how the industry weathers the storm in 2012, but the outlook in Birmingham in January was certainly optimistic.

STAND AWARDS

BF1 Systems were one of a number of electronics firms celebrating a great business year. They showed off with this superb stand and picked up the award for best in show. Other award winners included IS Rayfast for best single stand and Renishaw for best manufacturing technology stand

DYNAMICMETALS

TITANIUM AND SPECIALIST METALS

The UK's Largest Independent Stockist of Titanium and Specialist Metals.

Aerospace metals for the most demanding of applications.

T: +44(0) 1442 212 340
E: sales@dynamicmetalsltd.co.uk

ISO9001:2008 FS 572651

AS9120 REV A FS 572651

www.dynamicmetalsltd.co.uk

Show stoppers

Just some of the highlights of the 2012 show

Photography by **Jeff Bloxham** and **LAT**

RECEPTION

They enjoyed the show, particularly the suspension technology on offer

Claire Furnell of Project 100 enjoys *Racecar Engineering's* Land Speed Record edition at the show

Editor, Andrew Cotton (left) with ex-editor, Quentin Spurring. Note which one has a glass of wine...

Nadine Geary's Honda RA107 club racer attracted a lot of attention on the *Racecar Engineering* stand. It will be a forthcoming Aerobytes project car

MIA AWARDS

The proud recipients of the 2011 MIA Business Excellence Awards line up with Lord Drayson, Chris Aylett and representatives of the sponsors

Anders Hildebrand of Anglo American Oil picks up the Small Business Of The Year award

Flybrid founder, John Hilton, (left) accepts the Technology And Innovation award

PRI's Arianna Maugeri (left) presents the Export Achievement award to Dave Cunliffe of DC Electronics

The New Markets award went to fire extinguisher systems specialist, Lifeline Fire and Safety Ltd

Red Bull Racing won the Team Work award

AUTOSPORT INTERNATIONAL Engineering Show

In association with Racecar engineering

Lord Drayson showed off his all-electric Time Attack car just before the show and announced his Formula E ambitions

Bath University engineering student, Gemma Hatton, was keeping things in order on the *Racecar Engineering* stand. We're not sure about the company she has in this picture though

A standard combustion-engined Lola LMP coupé was on display on the *Racecar Engineering* stand

Ginetta cars had a display at the show as well

There was a huge variety of interesting machinery on show. Here the front suspension of a Brisca F1 Stock Car

Racecar Engineering's staff writer, Lawrence Butcher, leaning on a table

The updated Formula 2 car was unveiled, complete with its Yokohama tyres

THE INAUGURAL GRAHAM JONES AWARD

Gill Sensors were the deserving recipients of the first ever Graham Jones Award for the most innovative product on show at the Autosport Engineering show

He worked so hard all weekend that deputy editor, Sam Collins, shrunk three feet, though his hair grew by more

Racecar engineering
The International Journal of Motorsport Technology

PIT CREW

Editor
Andrew Cotton
Deputy editor
Sam Collins
News editor
Mike Breslin
Design
Dave Oswald
Chief sub editor
Mike Pye
Staff writer
Lawrence Butcher
Contributing editors
Paul Van Valkenburgh
Technical consultant
Peter Wright
Contributors
George Bolt jr, Simon McBeath, Danny Nowlan, Mark Ortiz, Ian Wagstaff, Charles Armstrong-Wilson
Photography
LAT, Gavin D Ireland,
Deputy managing director
Steve Ross
Tel +44 (0) 20 7901 8011
Email steve.ross@chelseamagazines.com
Head of business development Tony Tobias
Tel +44 (0) 207 901 8026
Email tony.tobias@chelseamagazines.com
Senior ad sales executive
Lauren Mills
Tel +44 (0) 207 901 8026
Email lauren.mills@chelseamagazines.com
Publisher Luke Bilton
Publishing director
Sarah Arthur
Managing director Paul Dobson
Editorial
Racecar Engineering, Chelsea Magazine Company, Liscartan House, 127-131 Sloane Street, London SW1X 9AS, UK
Tel +44 (0) 207 901 8000
Advertising
Racecar Engineering, Chelsea Magazine Company, Liscartan House, 127-131 Sloane Street, London SW1X 9AS, UK
Tel +44 (0) 207 901 8000
Fax +44 (0) 207 901 8001
Worldwide subscriptions
CDS, Tower House, Sovereign Park, Market Harborough, Leics LE16 9EF UK
Tel +44 (0)1858 438749
Fax: +44 (0) 1858 434958
Subscription rates
UK £72 (12 issues)
USA $135 (12 issues)
ROW £84 (12 issues)
News distribution
COMAG, Tavistock Road, West Drayton, Middx UB7 7QE
Printed by Wyndeham Heron
Printed in England
ISSN No 0961-1096
USPS No 007-969

recycle
www.racecar-engineering.com

Bye bye Peugeot. Hello Toyota

The loss of Peugeot to endurance racing is certainly not the end of the world, as Toyota launched its new LMP1 at Le Castellet and Porsche is already single cylinder testing in preparation for its 2014 entry to endurance racing.

Peugeot's was a snap decision. Invitations had been sent out to journalists to its launch on January 31, the ACO had been contacted on the day of the decision with its entry forms to the WEC, and the team was preparing for an endurance test in Sebring. They received the news just as they were about to start. They turned around and went home, leaving the awning still standing in the paddock.

The speed of the decision was reminiscent of Porsche's decision in 1998, when Wendelin Wiedeking stood up at the Porsche awards and abruptly announced an end to the endurance racing programme, with Allan McNish having already tested the new car, David Brabham set to sign for the manufacturer, and the world eagerly anticipating its contest against Toyota, Mercedes and BMW.

What made Peugeot's decision particularly hard to fathom was that it had already spent the money developing the car, the hybrid system and had completed a solid 33-hour test in January, so was good to go. The money was spent, the programme set, so what changed?

The decision to withdraw was clearly taken by someone who had an eye firmly on the finances of the company, and the announcement pointed to the company's major focus, which was to get back to the business of selling cars. It was a crossroad for the company – the Hybrid4 concept was entirely in keeping with its new cars, but the cost of going racing, having posted profit warnings in August and with thousands of redundancies coming, made it look a frivolous activity.

The reaction from Citroën's team principal, Yves Matton, was reassuring for the World Rally Championship, at least in the short term. No manufacturer with Sebastien Loeb, a national hero, could withdraw at this stage and leave an eight-time World Champion without a drive. The merchandise and exposure from Loeb makes it an effective programme.

Eurosport.com quoted Matton as saying, 'I see everyone from the team this afternoon to tell them I have confirmation from Mr [Frederic] Banzet, the manager of [Citroën] brand, that our programme continues and we have guarantees to be here in the future.'

The World Rally Championship is hardly stable ground, with rights holder, Convers Sports Initiatives, going into administration at the end of 2011 (*REV*22N2). Ford committed to the championship until 2013, after the FIA confirmed its commitment to ensuring the future of the series for now.

The ACO was clearly unhappy with Peugeot's decision, pointing out that the WEC was developed at the behest of the manufacturers, particularly Peugeot. Having delivered everything that was requested, Peugeot's decision was as stunning to the ACO and to the FIA as it was to the watching world. The feeling among teams was that the decision was disrespectful.

"The feeling among teams was that the decision was disrespectful"

The ACO had every right to be upset. Under the contract agreement between the ACO and the FIA, no fewer than two manufacturers must be entered into the WEC, and that must rise to three in 2014. Toyota's programme may have saved them from defaulting on this contract and, with Porsche and Audi clamouring for the 2014 regulations to delay until 2015 for their introduction, their world has shifted slightly.

There is still little doubt that manufacturers will come to Le Mans, but the ACO must release the final regulations, and soon. Audi and Porsche are both talking redline in terms of dates for the release of the regulations, and Peugeot's withdrawal merely increases the pressure on the ACO to get it right.

All the ducks need to be lined up for a board to commit to signing off the significant budgets needed to promote a brand on the tracks, and so it was encouraging to see in the week following Peugeot's withdrawal that Toyota launched its TS030 Le Mans Prototype as expected, Ford its new NASCAR and MG a British Touring Car Championship programme.

The news ended January on a high note after all.

EDITOR
Andrew Cotton

PAGIDRS

Brake control from green light to chequered flag.

Designed and manufactured in Germany,
proven at race circuits across the world.
This time at the WTCC race in Oschersleben, Germany,
where Franz Engstler chased the factory teams to become
the first private-entry overall race winner in a WTCC event –
using Pagid RS!
Optimal brake performance, perfect friction right from the start,
stability at high temperatures and minimum pad and disc wear.
Race winners don't ask for anything less.

www.pagidracing.com · info@bremsentechnik.de
+49 6003 82 910

Pagid is a registered trademark of TMD Friction

WHAT'S IT FEEL LIKE ON THE OTHER SIDE OF THE FENCE?

FIND OUT.

*Scan code with your smart phone or go to www.performancefriction.com/racecarengQR/Fence

www.performancefriction.com

NEW! Visit our facebook shop!

PERFORMANCE® FRICTION BRAKES