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WAR BABY

Re-creating the RS3100 Capri spawned by the Ford-BMW Touring Car wars

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A blurring of the lines

As you will see when reading the news pages, Aston Martin, Jaguar and Lister have produced so-called "continuation" versions of their most iconic models. In the case of the Aston, it's the DB4GT, for Jaguar it's the XKSS which follows up on the Lightweight E-Type of a few years ago, and for Lister it's the Lister Costin coming hard on the heels of the "Knobbly". At the moment, with the exception of the Shelby Daytona Coupe, it's a peculiarly British thing but with Aston and Jaguar charging upwards of a million pounds for these limited edition models, I'm sure it won't be long before other manufacturers jump on this lucrative bandwagon. The question for a magazine like this is whether we should be covering such cars.

On the one hand they are not replicas but are being built by the same companies that originally produced the cars. In Lister's case they even say that some of the former craftsmen who worked on the originals have still played a part in the modern edition. Lister also states that the new Costins will be built as exact replicas of the 1959 cars, constructed at its workshops in Cambridgeshire using the original jigs.

Aston maintains the new DB4GTs will be constructed to the same lightweight specification, combining original construction techniques with modern advances, each car being built with the original specification tubular frame clothed in thin gauge aluminium. It's the same with Jaguar with the chassis numbers of the nine cars being built being adorned with period chassis numbers from the XKSS chassis log.

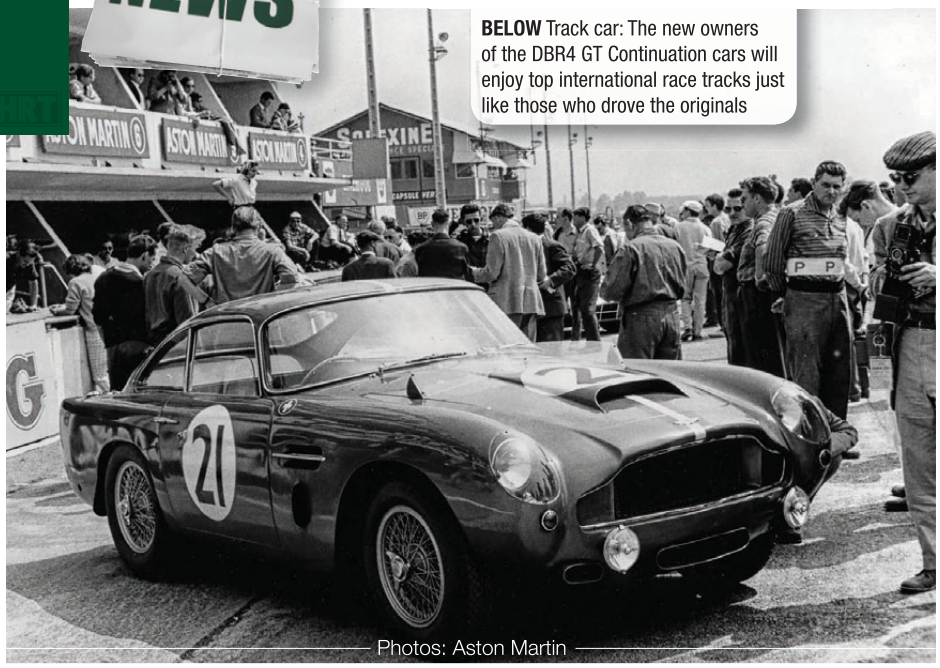
So what should we make of these cars? On the one hand it's a clever marketing exercise by the car companies, making some iconic models from the past knowing that such is the limited production run that they are almost guaranteed to sell them all. Should they be allowed to race in historic events if the owner wishes to do so? I am sure that from the Puritans' point of view, the one I alluded to in the previous issue they have no right to be considered historic vehicles as they weren't actually built "back in the day".

However, it's not just about the car companies. What about the suppliers? In this issue alone, we feature a number of products that preserve historic race cars. WOSPerformance, for example, produces dynators – alternators disguised as dynamos while Vintage Parts Supply and Performance Projects have co-developed replacement Lagonda water pump assemblies that look and perform exactly like the original units, without which many such cars would be forced off the road. Jenvey Dynamics has developed the Heritage throttle body with Aston Martin specialist GTC Engineering that boasts all the plus points associated with Individual Throttle Bodies yet manages to marry these with the subtle, understated looks of a period carburettor so that it does not look out of place in the engine bays of classic and retro vehicles. It even comes to more mundane items, US company Aurora Bearings producing a rod end that went out of production almost half a century ago but which is back in demand by historic racers.

If the demand wasn't there, these specialist suppliers and many like them would not exist, they would be producing their wonderful bespoke products for other industries, automotive or otherwise.

So bravo to Aston Martin, Jaguar and Lister for reproducing such wonderful cars and more power to the elbow to the independent specialists for what they do, whether it is bringing old cars back to life, fabricating new 'old' ones or providing specialist parts. This is a great industry, one driven by passion from top to bottom and we cannot let the naysayers have their way. HRT

William Kimberley
Editor



BELOW Track car: The new owners of the DBR4 GT Continuation cars will enjoy top international race tracks just like those who drove the originals

Photos: Aston Martin

Aston Martin to continue the DB4 GT line

Andrew Charman

ASTON MARTIN is to follow the examples of Jaguar, Lister and Shelby American with a series of new examples of classic competition cars. A run of 25 'Continuation' versions of the DB4 GT are to be built at the same workshops in Newport Pagnell, Buckinghamshire where the original evolution of the production DB4 was created in 1959.

The move follows Jaguar's recreations of the Lightweight E-Type and XKSS models, the Lister Jaguar 'Knobbly' continuation and Shelby American's Daytona Coupe.

The Aston Martin DB4 GT was built with a shorter chassis than the DB4, with its weight reduced by 85 kg to 1269 kg and the headlamps faired in for more aerodynamic efficiency. The 3.7-litre straight-six engine was uprated, gaining triple Weber carburettors, to produce 302 bhp compared to the 240 bhp of the stock DB4.

The car was aimed firmly at competition, being created in the same year that Aston Martin scored an overall win in the Le Mans 24 Hours with the DBR1, and the DB4 GT won its first race at Silverstone, driven by Stirling Moss. In total 75 examples were built between 1959 and 1963, eight of them special lightweight versions of which most survive today, being valued at well over £3m each.

Now the Aston Martin Works department, based at the original workshops in Newport Pagnell, is building 25 track-only cars, continuing the chassis numbers in sequence from the last version finished in 1963, no 0202R.

The cars will be to the lightweight specification and Aston Martin says they will combine original construction techniques with modern advances enabling improvements in engine performance, handling, braking and safety.

Each will be built with the original specification tubular frame clothed in thin-gauge aluminium, though the accuracy of the body panels will be digitally measured before they are hand finished.

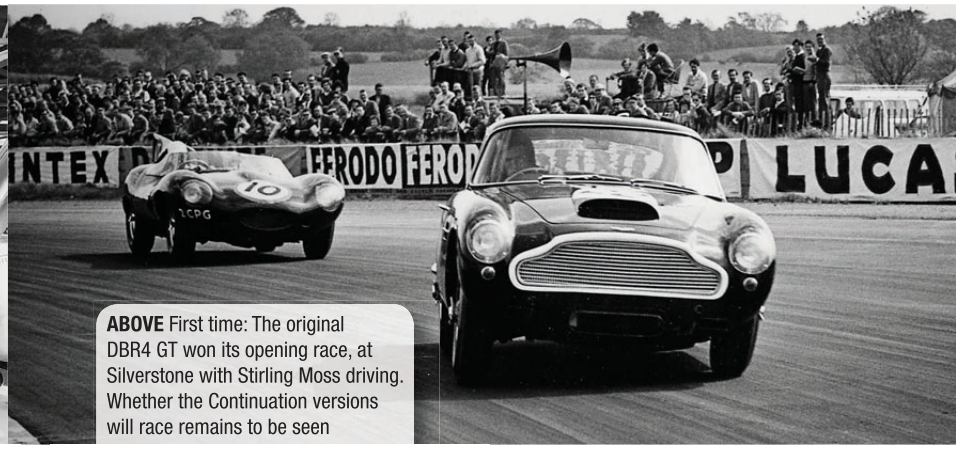
The engine will be a modern version of the original six-cylinder unit designed by Tadek Marek with a 340 bhp output, driving the rear wheels through a four-speed manual transmission and with a limited-slip differential included.

Owners of the DB4 GT Continuation cars will also be given access to a bespoke two-year driving programme on leading international race circuits, with tuition from expert Aston Martin personnel including multiple Le Mans winner Darren Turner.

What is not clear at this early stage is whether the Continuation cars are likely to be eligible for, or race in, major historic events.

Aston Martin has also not revealed a price for the 25 cars though industry sources suggest they will cost £1.5m each, and that all 25 have already been reserved. The first examples are expected to be delivered in the third quarter of 2017. HRT

ABOVE Home base: The same recently-refurbished Newport Pagnell workshops that produced the original DBR4GT will be the home of the Continuation versions



ABOVE First time: The original DBR4 GT won its opening race, at Silverstone with Stirling Moss driving. Whether the Continuation versions will race remains to be seen

Lister Motor Company

ABOVE Body beautiful: The continuation cars will recreate the sleek lines of the original Lister Costin, seen here at the 2015 Goodwood Revival

Lister revives its Costin aero pioneer

Andrew Charman

THE LISTER Motor Company is to produce continuation versions of the Lister Costin sports racer. Like the Aston Martin DB4 GT (see separate story) the Lister Costin was created in 1959. It followed the Knobbly, subject of Lister's most recent continuation car, and was effectively a version of that car with a new, and at the time pioneering, aerodynamic bodyshell.

This shell was created by Frank Costin – brother of Mike Costin who helped create the Cosworth DFV engine – a noted aerodynamicist, working for Lotus and most notably Vanwall in Formula One.

Lister Costin cars raced throughout the 1959 season and have since proved very successful on the historic scene – in 2016 winning the Le Mans Classic and Sussex Trophy at Goodwood.

As with the previous Lister continuations the new Costins will be built as exact replicas of the 1959 cars, constructed at Lister's Cambridgeshire workshops using the original jigs and even taking input from three former employees of the company, all now over 80 years old.

The same engine employed in the Knobbly continuation models will be fitted to the Lister Costin cars. Built by Crosthwaite and Gardiner it is a period correct wide-angle straight-six engine equivalent to the Jaguar unit used by the 1959 cars. It will produce 337 bhp at 6,750 rpm and 295 lb/ft of torque at 4,250 rpm.

Racing specification versions will be supplied with a full FIA HTP passport, allowing entry into the Stirling Moss Trophy that includes races at Brands Hatch, Silverstone Classic, Donington Historic, Spa and Portimao.

Each car will cost £295,000 + VAT and will also be available as fully-legal road versions for an extra £12,500.

According to Lister Motor Company CEO Lawrence Whittaker the chance to produce new versions of what was the last 1950s Lister racing car and a hugely important car to the company, is special.

"Brian Lister was ahead of his time by realising just how important aerodynamics were to performance – and who better to employ to design that super sleek body that Frank Costin," said Whittaker. "The fact that the car has become so successful in historic racing today shows just how they got things right back in period.

"I'm also very proud that we are continuing the tradition of hand-building cars at George Lister Engineering in Cambridge, using many of the traditional methods that were used in 1954, as well as some of the original engineers. We are keeping Brian Lister's legacy alive."

The first Lister Costin continuation cars are expected to be delivered in early 2018. HRT

Goodwood to honour 'Archie' Scott Brown

Sophie Williamson-Stothert

GOODWOOD'S 75th Members' Meeting on 18-19 March is to feature a full grid of Lister sportscars going head-to-head in the all-new Scott Brown Trophy.

Celebrating 60 years of what is arguably Lister's most famous model – the 'Knobbly' – 30 Listers, including those powered by Jaguar and Chevrolet units, will go wheel-to-wheel at the traditional season-opener in March.

The name Scott Brown is synonymous with Lister. Despite being severely handicapped as a result of his mother contracting German measles during pregnancy, William Archibald 'Archie' Scott Brown was one of the most naturally gifted drivers of his era. In particular, he enjoyed huge success behind the wheel of a Lister-Jaguar 'Knobbly', named for its curved bodywork. HRT

Goodwood

ABOVE Goodwood Members' Meeting is honouring 'Archie' Scott Brown in an all-new Scott Brown Trophy race for Lister sportscars


Jaguar Cars

ABOVE Only nine examples are destined to roll off the production line

Is the "new original" Jaguar XKSS bound for glory?

Sophie Williamson-Stothert

THE first genuine Jaguar XKSS to be built in almost 60 years has made its world debut at the Petersen Museum, Los Angeles. The XKSS, finished in Sherwood Green paint, has been created by the Jaguar Classic engineering team, and only nine examples are destined to roll off the production line.

Often referred to as the world's first supercar, the XKSS was originally made by Jaguar as a road-going conversion of the Le Mans-winning D-type, which was built from 1954-1956. In 1957, nine cars earmarked for export to North America were lost in a fire at Jaguar's Browns Lane factory in the British Midlands; meaning just 16 examples of XKSS were built.

Earlier this year, Jaguar announced that its Classic division would build the nine "lost" XKSS sports cars for a select group of established collectors and customers. The new one-off model is the summation of 18 months of research and will be used as a blueprint from which the nine continuation cars are built.

The nine cars will be completely new, with period chassis numbers from the XKSS chassis log, and will be sold at a price in excess of £1m each.

"The XKSS is one of the most important cars in Jaguar's history, and we are committed to making the 'new original' version absolutely faithful to the period car in every way," said Kev Riches, Jaguar Classic engineering manager. "From the number, type and position of all the rivets used – there are more than 2,000 in total – to the Smiths gauges on the dashboard, everything is the same as the original cars, because that is the way it should be."

The XKSS is the second continuation car to be created by Jaguar, following on from the six Lightweight E-types that were built in 2014. This project helped the team learn to engineer cars that are faithful to the specifications to which they were built in period, and this knowledge has been enhanced in creating the "new original" XKSS.

The modern XKSS is a period correct continuation, built using a combination of original drawings from Jaguar's archive and modern technology. The Jaguar Classic engineering team scanned several versions of the 1957 XKSS to help build a complete digital image of the car, from the body to chassis, and including all parts required.

The body of the XKSS is made from magnesium alloy, as it was in 1957, and because the original styling bucks do not exist, Jaguar Classic produced a new, bespoke styling buck based on the original bodies from the 1950s. The bodies of the nine new cars will be formed on this buck, using a traditional process called hand-wheeling.

Jaguar Classic's engineers worked with the original frames and produced CAD to support build of the chassis. In partnership with the Classic team, frame maker Reynolds – famous for their 531 tubing – was briefed to craft bespoke new parts using imperial measurements, rather than metric. The frames are bronze welded in the same way as the period XKSS chassis tubing.

The continuation cars feature period specification four-wheel Dunlop disc brakes with a Plessey pump, and Dunlop tyres with riveted two-piece magnesium alloy wheels.

Under the bonnet, the XKSS is supplied with a 262 bhp 3.4-litre straight six-cylinder Jaguar D-type engine. The unit features completely new cast iron blocks, new cast cylinder heads and three Weber DC03 carburettors.

Inside, the "new original" XKSS features perfect recreations of the original Smiths gauges. Everything from the wood of the steering wheel, to the grain of the leather seats, through to the brass knobs on the XKSS dashboard, is precisely as it would have been in 1957.

Minor specification changes have been made only to improve driver and passenger safety. The fuel cell, for example, uses robust, modern materials to support throughput of modern fuels.

With more than 10,000 man hours going into building each of the new XKSS cars, customer vehicles will be hand-built beginning this year with deliveries expected this year. HRT

Historic specialist acquires Chevron

Andrew Charman

LONG-established race car manufacturer Chevron has been bought by historic preparation and restoration specialist WDK Motorsport. The move to acquire the Chevron brand, which dates back to 1965, is part of the expansion plans of WDK following its purchase in 2015 by VV Capital LLP, run by former Brands Hatch circuit owner Nicola Foulston.

WDK Motorsport was formed in 2010 by Ian Cox, Kevin Drew and Simon Turner and the Stockbridge, Hampshire, based company has since built a reputation as a top-level historic race car preparation and restoration business – WDK prepared cars have won the most recent two FIA Historic F1 championships.

Cox becomes managing director of the new company, with Nicola Foulston joining the board alongside Christopher Tate, managing director of Donington Park circuit and whose CV also includes overseeing the building of Northamptonshire oval circuit Rockingham Motor Speedway. HRT

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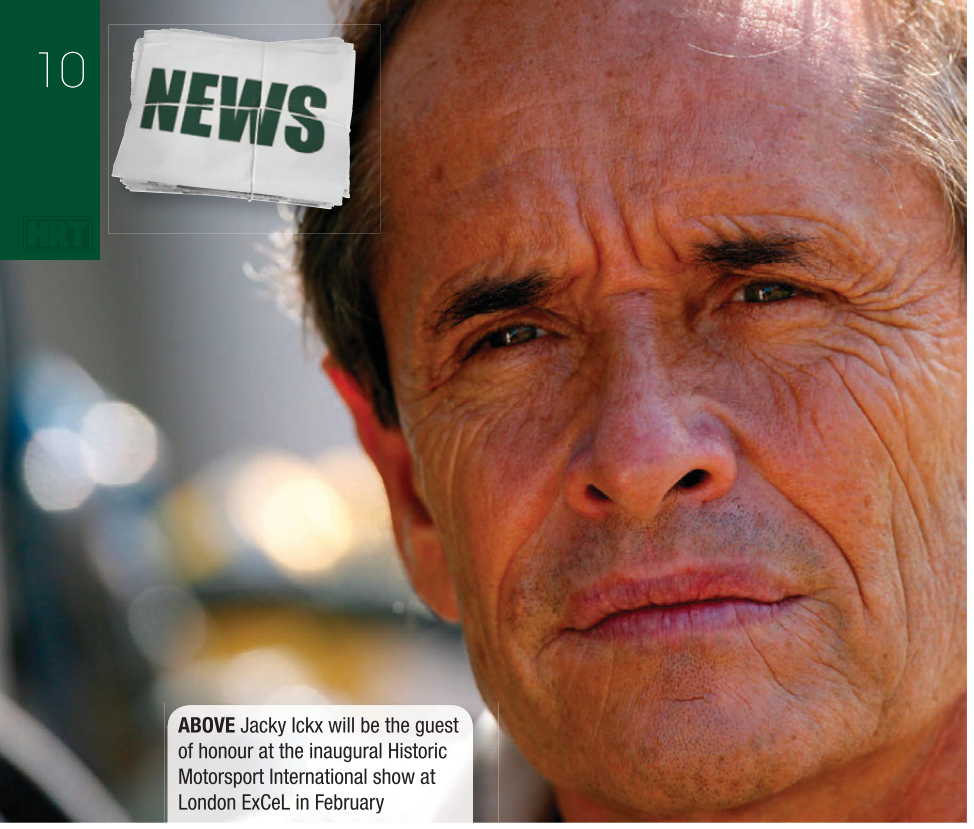

ABOVE Jacky Ickx will be the guest of honour at the inaugural Historic Motorsport International show at London ExCeL in February

Jacky Ickx to open inaugural Historic Motorsport International show

William Kimberley

THE great Jacky Ickx will be the guest of honour at the inaugural Historic Motorsport International (HMI) show and will officially open it at 12 noon on Thursday, 23 February. He will also be honoured at the Gala evening on Thursday at The London Classic Car Show that takes place alongside HMI.

Although in its first year, the show at London's ExCeL is really gathering momentum. Among the exhibitors at this new event are virtually every motorsport club running historic racing and rallying events in the UK and Europe over the coming season.

It includes the Historic Sports Car Club, organiser of the Silverstone Classic, Motor Racing Legends and the Historic European Formula One Race Car Entrants, better known as FORCE.

They will be joined by a wide variety of other series and event organisers including the Heritage Touring Cup and the Classic Endurance Racing series, the Historic Grand Prix Cars Association, Masters Historic Racing and Historic Motor Racing News, which runs U2TC for Under 2-litre Touring Cars and Pre-1963 GT for classic sports cars, Equipe GTS, the Endurance Rally Association, which runs epic long distance rallies such as the Peking to Paris, and the Classic Sports Car Club. French based Peter Auto will also be exhibiting and will have a Group C endurance racer on its stand as well as an historic Formula 2 car ahead of a new-for-2017 championship.

HMI will be marking several significant anniversaries, including 50 years of Formula Ford and the Ford DFV and 60 years of racecar manufacturer Crosslé.

An important element of the show will be the industry side of the business. The International Guild of Specialist Engineers has committed itself to the event and will be present with a stand along with founder Michael Scott and president Tony Southgate.

As a new member of the Guild, DC Electronics will be exhibiting its range of sophisticated products. Widely known and respected in the higher echelons of motorsport on both sides of the Atlantic, with a unit in Mooresville, North Carolina in addition to its head office in Malden, Essex, it has recently become a great deal more involved in the historic car market, working for such clients as JD Classics.

Last year it developed a range of electrical power-assisted steering (EPAS) systems for this market which it has now further refined. Where the ECU was part of the steering column, it is now a separate entity, which is not only helpful from a packaging point of view, but has made the entire system more customisable.

"By removing the ECU from the steering column and going with a different system, it has allowed us to make it a little bit smaller and easier to mount with mounting points on the front and rear of the unit while we've also incorporated a different range of controllers as well," said David Cunliffe, DC Electronics CEO. "It means that we now have a complete range where the controllers can be mixed and matched with the motor gearboxes. As a starting point, it means that for just under £1,000 it's now possible to buy an electric power-assisted steering system that includes the motor, the wiring harness and the controller while at the other end of the range, costing around £6,000 for the full motor torque system that's fully controllable and adjustable. So whatever the customer wants, we've got something in our range that's relevant for them. It means that if someone buys our Pro Street unit and then decides they want to use their car on the track, they can simply upgrade the controller without having the need to change the mechanical installation."

The Historic Motorsport conference programme, a public forum on Thursday and Friday, will examine a wide variety of topics including scrutineering and eligibility, the challenges for organisers and promoters and the landscape of historic rallying.

The Historic Motorsport International will be held alongside The London Classic Car Show, now in its third year and looking to build on the record 33,000 visitors who visited the 2016 event. Tickets to Historic Motorsport International 2017 are now available from www.historicmotorsportinternational.co.uk and start at £24 for single adult entry (£27 on the door on the day). HRT

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NEWS

Group B returns to Race Retro

William Kimberley

ABOVE Around 70 Group B and C rally cars are expected to participate in Race Retro's live action arena

RACE RETRO is expanding its live action for 2017 as the pre-season opener continues to develop its bespoke Rally Stage with the sporting organisation Rallying with Group B. Held at Stoneleigh Park, Warwickshire, from 24-26 February, the outdoor action takes place on Saturday and Sunday, with around 70 Group B and C rally cars expecting to cross the start line.

"Rallying with Group B has provided cars for the live action element of Race Retro for the past two years, building its offering each year," said event director Daniel Nwaokolo. "This year we plan to expand on the great work they have been doing even further by inviting historic rally cars from all eras and their drivers from across the UK to come and join the fun."

"Race Retro is one of the highlights of the historic rallying calendar and we are thrilled to continue our long term involvement with this fantastic event and the new owners Clarion Events for the foreseeable future, bringing these amazing cars to Stoneleigh Park, where fellow enthusiasts can enjoy seeing these cars doing what they do best," said Tim Foster, Rallying with Group B organiser.

The show will also be celebrating 50 years of the Cosworth DFV with a collection of cars that includes the Williams FW08 driven by Keke Rosberg to win the 1982 World Drivers' Championship that has been curated by Mike Costin, who along with Keith Duckworth gave his name to the powerplant.

"The Cosworth DFV is synonymous with the greatest era of Formula One and to have the display curated by designer Mike Costin, one of the greatest engineers of our time, just makes it even more special," said Nwaokolo.

There will also be a celebration of 40 years since the reopening of Donington Park, a tribute to Lotus the cars and bikes of motorsport legend John Surtees.

Tickets are now on sale for Race Retro, held from 24th-26th February at Stoneleigh Park, Warwickshire, with free parking and a free showguide for all visitors. For the latest updates and ticket information, visit www.raceretro.com HRT

Lotus 49 celebration at Autosport International

A truly incredible collection of Formula 1 heritage is set to go on display for the first time at Autosport International. Classic Team Lotus have confirmed all seven remaining Lotus Type 49 racing cars will be present at Europe's foremost motorsport show between 12-15 January.

The show at the NEC marks 50 years since the Ford Cosworth DFV powered Lotus 49 first raced – and won – with the legendary Jim Clark behind the wheel at the Dutch Grand Prix in Zandvoort.

This collection of F1 cars on the Classic Team Lotus stand in Hall 20 (Stand 2270) represents the very first time that all seven remaining race machines will be together under one roof. HRT

ABOVE Graham Hill's 1969 Monaco-winning Lotus 49 will be one of the cars on display at Autosport International

Fiskens celebrates 25 years in the Mews

Sophie Williamson-Stothert

TO celebrate 25 years of business in its London location, specialist historic car dealer Fiskens opened the doors to its newly-refurbished showroom during a glitzy champagne reception at the Queens Gate Place Mews in Kensington in October.

When Fiskens was founded in 1991, the Mews had been a hive of activity for almost a century with coachbuilders, trimmers, painters and dealers all busily working together under the shadow of the Grade II listed archway that marks its entrance.

A spokesperson at Fiskens said: "If Paris and Milan are the world centres for fashion, and Dublin the only place to buy a proper pint of Guinness, then London – and specifically Queens Gate Place Mews in Kensington – is the spiritual home of the historic car trade." HRT

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THE MIGHTY METRO

The 1980s are remembered fondly as a halcyon period for rallycross, where the Group B cars banned from rallying found refuge. **Hal Ridge** reports on the rediscovery and restoration of one of the most memorable cars of the era

THERE are few things that say "iconic competition car" more than an MG Metro 6R4. In rallycross terms, one dressed in a black, red and gold Silkolene livery immediately invigorates memories of the sport's heyday – the Group B era of the late 1980s and early 1990s.

The irony of this story about one of the most memorably-liveried cars in the dual-surface sport's history, however, is that when owner Adam Keeler bought it, he wasn't looking to renovate a rallycross car.

As a rally man, former competitor Keeler obtained his dream machine, and only later found out that it was one of the most evocative cars in rallycross history. It was, therefore, only fitting that the Yorkshireman return the machine to the livery with which television star Tiff Needell raced in the 1989 MSA British

Tom Banks

Trevor Coulson

ABOVE & LEFT Will Gollop's engineering talent took the Metro 6R4 to new heights

Rallycross Grand Prix at Brands Hatch, as teammate to Will Gollop.

"I had always wanted to own a 6R4," says Keeler. "To cut a long story short, a friend put me in touch with the owner of this car – which was for sale as a rallycross and sprint car – but it was in the north of Finland.

"The owner only spoke three words of English and was due to go on a six-week holiday in a fortnight's time. If I waited, I knew other prospective buyers would be on my tail. So, less than a week after first being in touch with the owner, a friend and I sailed to Rotterdam, drove through Holland and Germany, then on to Denmark and all the way up Sweden, before heading into Oulu in Finland braving the ice and snow of winter to buy the car."

RACED – AND ROLLED!

On his return, Keeler began further research into his acquisition. Originally built as a right-hand-drive rally car by preparation experts Rally Engineering Development (RED), rallycross driver Ray Greenbank bought it, raced it and rolled it. That was before it was acquired by front-running European Rallycross driver Gollop for Needell to race in the Grand Prix. When the car was later sold, Gollop's G-Tech concern converted it to left-hand-drive for its new owner, which is how it remains today.

"I couldn't decide what colours to dress it in. I'd really bought it to be a rally car, but I decided that the Needell livery was what it was famed for, so that's what we would do," explains Keeler. "Word got out that I had bought it, and I got invited to demonstrate it at the World Rallycross Championship event at Lydden Hill in 2015. ▶

"We had four weeks to change it from its blue and white colours to the Silkolene livery, and get it ready for Lydden. The previous owner had painted everything; every nut, bolt, wipers, washer nozzle – everything. We had to get it back to a point where we could paint it properly. Industrial paint stripper wouldn't really touch it, so I got the DA sander out. You could see all the different paint jobs it had endured in its lifetime; from etch primer, white and blue to yellow and black. It was like the rings on a tree."

NAKED TRUTH

Using a combination of paint stripper, largely applied by Keeler's enthusiastic 82-year-old mother, and sanding, the car was returned to bare metal and composite panels before being repainted. "It didn't look particularly nice underneath either, but all of the rose joints were new and everything was greased up properly," he explains. "It might have looked tired but it was in very good shape and, remarkably for a rallycross car, it was straight."

> **"It might have looked tired but it was in very good shape and, remarkably for a rallycross car, it was straight"**

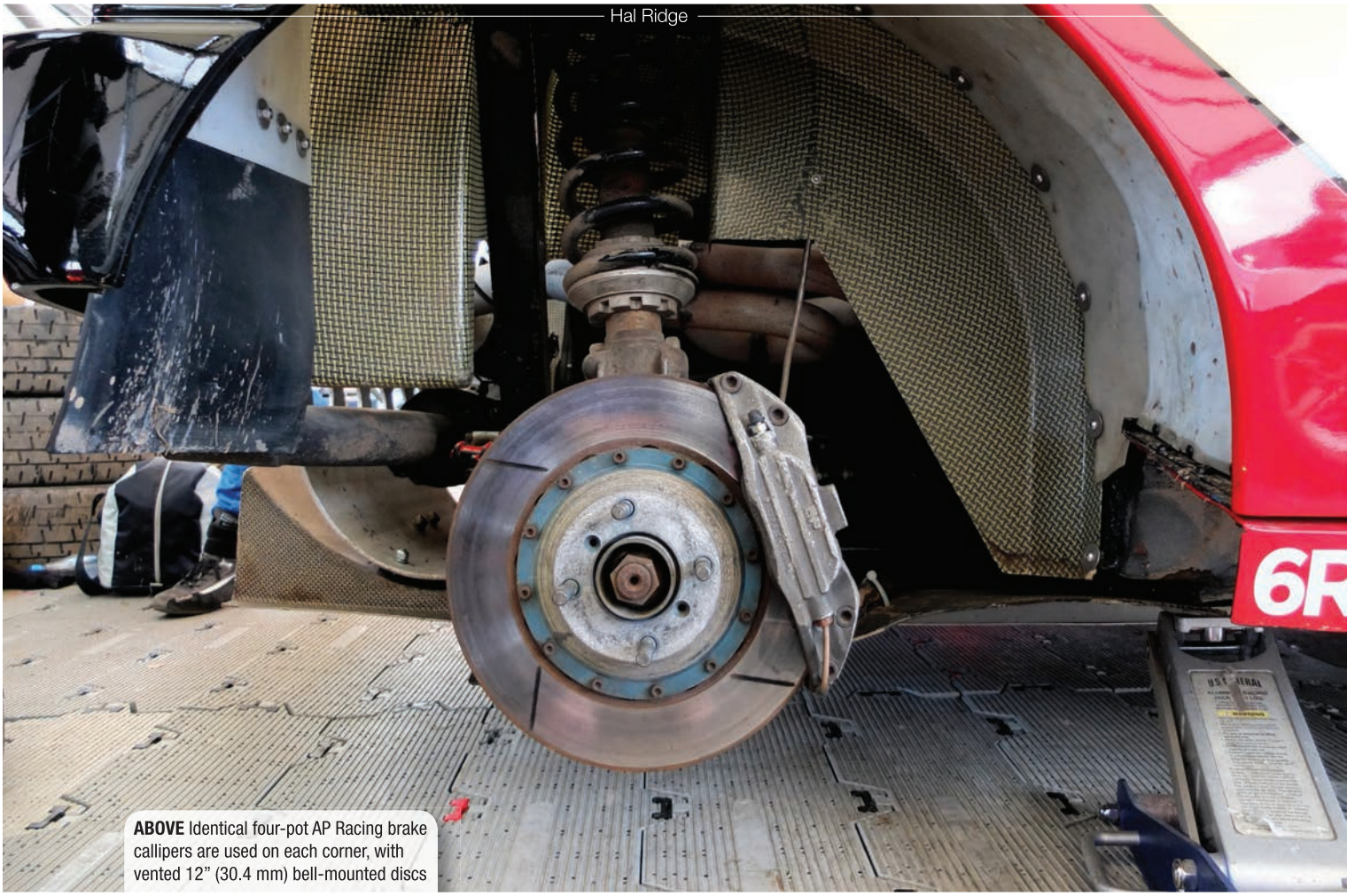
As a precaution, before he even fired up the mid-engined car, Keeler had 6R4 specialist Pete Slights change the timing belt, for peace of mind. "Everyone told me to change the belts, because if you lose a belt, the engine's gone," he continues. "It's a good job we did too. Pete said the belts that came off had been on there about 15 years, going off the markings."

This car isn't the machine that Gollop won the European title with in 1992 (a BiTurbo monster) but, instead, is a rare naturally aspirated car, running what is known in 6R4 lingo as an "international" engine, which is fundamentally a homologated works-spec 3.0-litre V6 unit.

"Basically it's a Formula 1 DFV engine," says Keeler. "When Group B cars were banned from rallying (in 1986), most rally engines had to be sleeved down from a 3.0- to a 2.8-litre with a single plenum or a 2.5-litre twin plenum. My car is still a 3.0-litre, and has the full international fuel injection system."

Austin Rover bucked the trend of the Group B era by creating a naturally aspirated car to compete against the turbocharged opposition. The theory was that drivability would offset any top end power deficit, while turbo'd rivals battled lag. But, as turbo technology increased, that gain was short-lived. The longitudinally-mounted (with an inboard gearbox) international spec 3.0-litre ▶

Hal Ridge



ABOVE Identical four-pot AP Racing brake callipers are used on each corner, with vented 12" (30.4 mm) bell-mounted discs

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ABOVE Keeler describes the aluminium dash as "a work of art"

Hal Ridge

DOHC V-90 motor, known as the V64V (V6 with four valves per cylinder) had a bore of 93 mm and a 75 mm stroke. The top-spec engines, of which Keeler's 6R4 is one, produced 410 hp, revving to more than 9,000 rpm with torque figures at around 365 Nm. Ignition and fuel injection is provided by a Lucas Micos electronic system, and the exhaust system's silencers run no baffles. "It pops and bangs all the way. People comment on how great it sounds, and it does," confirms Keeler.

Despite the large air-intake side pods on the 6R4, there's no hiding from the fact that the engine is behind the cockpit, without the efficient airflow a front-mounted motor would enjoy. To ensure that it remains at a "safe" temperature, Keeler has fitted additional cooling fans. "As a rally car, this would have had two big oil coolers in the back," he explains. "That's at the front in my car (as is the oil tank and battery), so my auto electrician has added large fans on thermostats to draw the heat out of the cooler, as well as the large water radiator it's next to. We've done the same on the rear, to pull the heat out of the back door. It's as a safeguard really."

Other changes Keeler has made to the machine to protect its longevity include rebuilding the transmission, fitting filters in the baffles of the five-speed dog leg RND gearbox, along with having every component crack tested for fatigue.

"The guy I bought the car from was great, but spoke very little English," says Keeler. "Most Clubman 6R4s (200 road going cars were required to be produced alongside the rally machines to meet FIA homologation rulings) were fitted with a synchro box, but rally and rallycross cars had dog boxes.

"I thought I'd bought the car with a synchro box, but when we lost the (twin plate) clutch and had to take the box out anyway, the guy that does my transmission work said 'the good news is that it's a dog box, the bad news is that it's not in a good way'."

IMPROVED LUBRICANTS

"We rebuilt it, using the very latest seals and bearings," Keeler adds. "Because the box is built in sections, if something goes wrong in one section it can destroy another, so we've also put filters between each area in the baffles, to try and prevent that from happening. We always use a specific oil too, and specific amounts. Lubricants are much better nowadays."

> **"Because diffs are the Achilles heels on these cars, a lot of Scandinavians use a BMW diff"**

The ex-Needell, four-wheel-drive 6R4 utilises a pair of limited slip differentials, front and rear, driven by individual prop shafts. The rear differential is mounted to the side of the engine's sump, with one driveshaft running through the sump to the left rear wheel.

Neither diff in Keeler's car is the type originally intended for the application by Austin Metro. "I was disappointed when Pete Slights looked at the car, because he told me it had a BMW front differential, not 6R4," explains Keeler. "We then found out that, because diffs are the Achilles heels on these cars, a lot of Scandinavians use a BMW diff. It's got a cast iron casing, so you can't destroy it. I told Will (Gollop) and he thought it was a great idea, so I kept it. I managed to break the rear diff when using the car, so I've put a heavy duty one in the rear now, too."

Most rallycross 6R4s featured a torque ▶

split of 45/55 (as standard the norm is 35/65). As is the case with most of the dual-surface racers, Keeler's machine is geared for acceleration over top speed, meaning close ratios, so much so that he can pull away in second gear. Inside the transfer box, the step off gears are another thing on Keeler's "to do" list, and will be changed to 1.1:1. "I also want a 1.3:1 step off gear, which would give me about 130 mph, for when we do other things (other than rallycross demos). Obviously the acceleration won't be so good, but you don't need that if you're not in a rallycross race," he says.

Engineer and racer Gollop worked hard on all aspects of developing the 6R4 with his privately owned G-Tech Motorsport team, even instigating his own step off gears at the time he was competing for European crowns. "You really have to warm the car up before you use it and go through procedures to warm the engine and transmission. You can't just fire it up," explains Keeler. "To start it from stone cold, you have to take off the oil pump covers and remove the belt, prime the engine then put it back together beforehand," he notes.

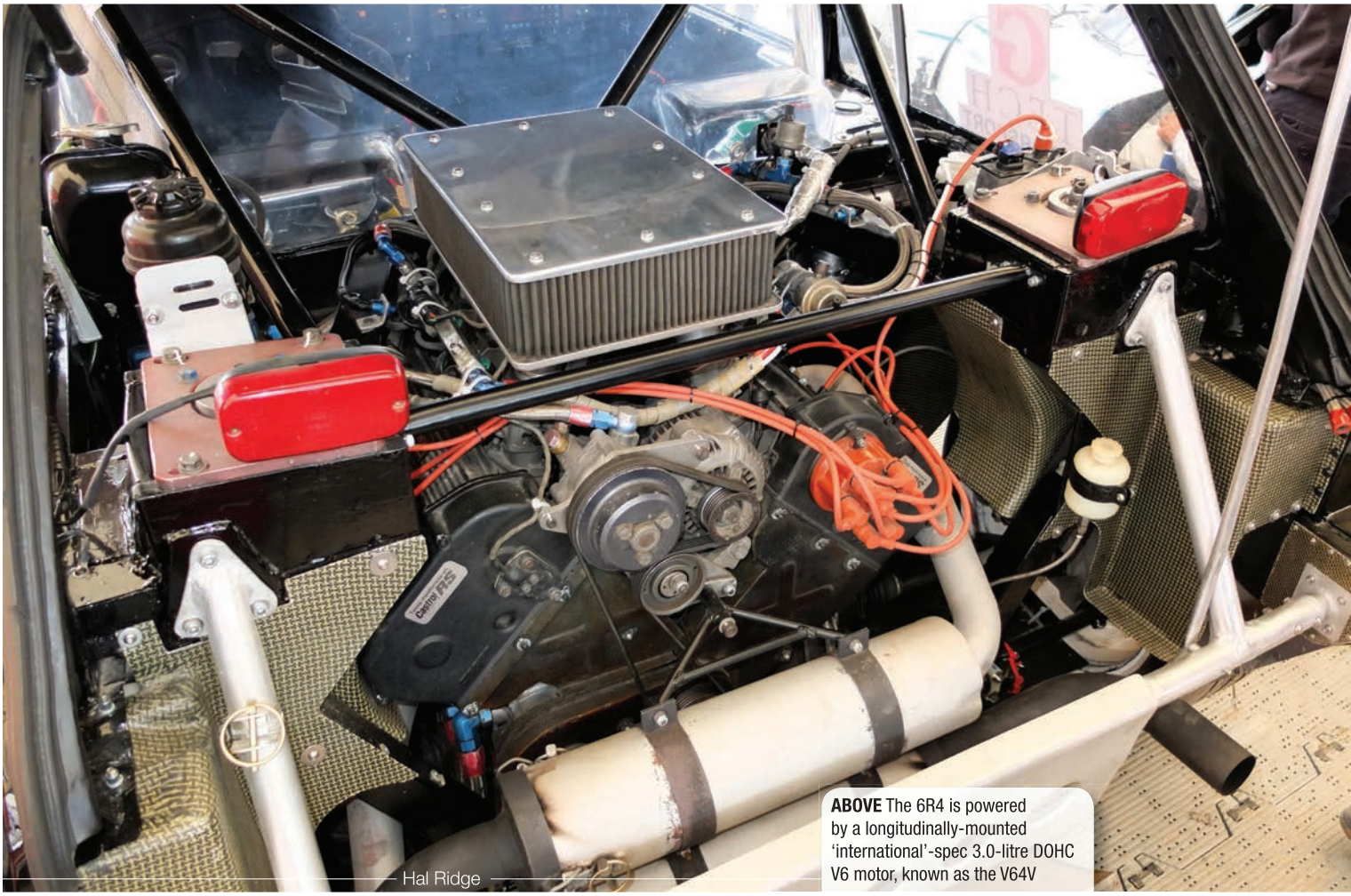
Thanks to a well set up front differential that does away with the understeer that often plagues 6R4s, Keeler says his car handles "fantastically". Created by Austin Rover, the 6R4 was conceived using strong links with the Williams Formula 1 team and, as such, top F1 designer Patrick Head was involved in the design concepts.

F1 INFLUENCE

The 6R4's suspension is of a coaxial spring and strut design front and rear, with rose jointed lower wishbones for adjustment, below the cast aluminium uprights. The rear wishbones are the reverse of the front, while the major adjustment for camber and castor is done at the top of the strut. Keeler's car features Bilstein gas filled units all round.

"They're pretty much as standard, with adjustable (spring) platforms. They were great in their day and for the next 20 years were probably the best you could get," says Keeler. "The springs are long because you need the travel. People have converted 6R4s to modern three-way adjustable stuff, but my car handles fabulously, although it does want to swap ends on you if you're not careful because of the short wheelbase. Mine doesn't run an anti-roll bar on the front. People took them off for gravel use, but if I do some more tarmac stuff in the future, I'll probably have one made."

The car does have power steering but, unlike early 6R4s that had a pump driven off the front diff (that would then slow and stop in slow corners), this pump sits on top of the engine and is driven off the same belt as the alternator from the bottom cam pulley. The steering rack is also different to standard, its origins being from the Opel range. ▶



Hal Ridge

ABOVE The 6R4 is powered by a longitudinally-mounted 'international'-spec 3.0-litre DOHC V6 motor, known as the V64V

Group B outlaws ruled the land

THE MG Metro 6R4's brief life in the World Rally Championship was curtailed when Group B cars were outlawed by the FIA in 1986. Nevertheless, the machines quickly found a home in rallycross, joining Ford RS200s, Audi Quattros and Peugeot 205 T16s.

Will Gollop introduced the first 6R4 to rallycross in 1986, when he drove a plain white, naturally aspirated car in a November Lydden Hill Winter Series event – a solid championship at the time. The Canterbury driver then used the same car in the MSA British Rallycross Grand Prix a few weeks later.

Austin Rover had run privateer deals for works-spec cars in rallying, with drivers like Mike Stuart competing in the British Rally Championship running in full 410 bhp 3.0-litre international specification. Stuart's car was bought by rallycross racer Michael Shield for the 1987 season and, two years later, the Yorkshireman became the youngest ever British Rallycross Champion in the machine. That soon started a trend, with the following six British titles won by 6R4s in various specifications.

The first turbocharged cars entered the scene in 1987, built by Norwegian Dagfinn Larsen and driven by Larsen and Arne Rasmushaugen. Gollop (who only ever built his machines with his G-Tech concern rather than buying a complete item) developed a BiTurbo engine with tuner Cliff Humphries in the winter of 1989. The 2.3-litre motor brought the car into the 1100 kg weight limit, while the Norwegian cars, based on larger capacity engines, were 200 kg heavier and less nimble. Several drivers used 3.5- and even 3.8-litre naturally aspirated engines in 6R4s in the search for more power.

The 6R4 was responsible for some significant happenings in the sport. It brought the return of Swede Per Eklund, adapting his rally car to return to the rallycross arena, where he continues to work to this day. But, the greatest accolade for the British-built machines came in 1992, when at the close of the Group B era in rallycross, Gollop won the FIA European Rallycross Championship title in his BiTurbo car. The Englishman remains the most recent British driver to be crowned at the highest level in the sport.

Northern Irishman Lawrence Gibson won the British Rallycross Championship in 2008 driving a naturally aspirated car against significantly more modern turbocharged machinery, the last major title for the 6R4. HRT

ABOVE The 6R4 is well-known for being sideways

Identical four-pot AP Racing brake callipers are used on each corner, with vented 12" (30.4 mm) bell-mounted discs. "I was keen to know if I should upgrade the brake size, but everyone I asked said to leave them as they are, and they were right," says Keeler. "I have put a bias wheel in now, though. I always felt it needed a bit more brake on the front to settle the car into corners and we can change for the conditions too now."

Keeler has a range of wheels for the brakes to sit under, but commonly uses 16" for the running his does, due to the availability of tyres. "In period the car ran a set of 15" Dymags (di-cast magnesium), which are 10" wide at the rear and 7" at the front. You can't get tyres for them now, because they are metric sizes," he explains.

AGGRESSIVE STYLING

Aside from the wailing V6 engine in the rear, the stand-out aspect of the 6R4 is its waywardly aggressive styling, grown from Austin Rover's Metro supermini. The integral roll cage not only acts as a safety cell for the crew, who sit in a confined utilitarian cabin, but also to increase the torsional stiffness of the chassis. Most rallycross cars also featured an additional horizontal cage bar, to protect the driver.

Clad with composite panels, Gollop's cars were infamous for rarely having the homologated door-mounted side pods attached, with the English engineer finding no gains for them to be fitted. And, in rallycross where inevitable contact occurs, it was one less thing to get damaged. It was a similar story with the front spoiler. To accompany the exotic panels, most 6R4s have aluminium roofs, but not Keeler's. "It's been on its roof twice, as far as I know, so it has a steel roof now which is pop-riveted on," he chuckles. "It would be nice to have an aluminium one, although you won't find one now. It's just part of the history of the car now, so that's fine." The car also features aluminium sills, something Gollop confirmed as his own concept to Keeler at its first Lydden Hill airing after the refurb.

The interior of Keeler's 6R4 is a

Trevor Coulson

ABOVE The car is known to have been on its roof twice during its hard life

“Nothing comes close to the workmanship of the 6R4”

combination of new and old, while keeping as much as period as possible, new seats, harnesses and fire extinguishers (plumbed-in and hand-held as an extra precaution) have been added. The fuel tank sits in a steel box behind the driver, in its original location. A self-diagnosed perfectionist, Keeler shares an eye for detail with his 6R4’s former owner Gollop, and says his biggest headache in the project was recreating the exact livery that Needell used at the ’89 Grand Prix. Ironically, at the event, the competing cars hardly turned a wheel, so foggy was the Brands Hatch circuit that organisers had to run cars one at a time, awarding positions for the best lap times. Gollop won.

“I was going to put a works dashboard in the car, but if you look at the aluminium one in it closely, it’s a work of art. Will knew how to put these cars together. Nothing comes close to the workmanship of the 6R4, with all the folds and flanges, and I’m not changing it,” says Keeler. “The hardest bit was actually getting all the decals right. It’s been tough finding period pictures, but with friends and the internet we managed to put it back to how it was. I’m a bit pedantic, but it’s the minor details that make Will’s cars stand out. For instance, when you have a big bonnet scoop, most people would just paint into it, but not Will. They were masked off, so we did that, too.”

GOOD MEMORIES

Needell, an accomplished racer in a variety of disciplines as well as being a television host – most famously on Top Gear and Fifth Gear – recalls his time of driving the 6R4 at the Grand Prix fondly. He competed in the event in 1988 and ‘89. “It was absolutely mega. I had a smile on my face all the time. The 6R4 was just so sideways and so controllable,” he says. “How Will ever got the starts he did, I’ve no idea. The turbo cars would make better starts; I’d go from first to fifth, then spend the rest of the race climbing back up. You had to be on the ball from the word go – the starts were so critical. I remember the brakes on the 6R4 were amazing. The Brands Hatch circuit was great – one of the best rallycross circuits ever. It was a wonderful weekend, but then the bloody fog came down.”

Clearly delighted with owning and driving his pride and joy, Keeler is also conscious that by investing in the longevity of his 6R4, it protects its future existence. “Before I got into cars, I was into motorbikes. I never thought anything else would give me a buzz like that, until I drove a 6R4,” he explains. “It’s not like driving a modern rally car – it’s very agricultural. The gear change is very precise, but goes in with a thud and clonk. It has a heavy clutch – it’s rudimentary. You’ve got to give credit to the people who competed in them; it’s a very confined, warm, noisy, and quite unpleasant place to be. And, in rallycross certainly, I don’t think Will gets as much credit as he deserves for what he did as an ambassador for Great Britain, and the 6R4. I love it and, at the end of the day, we’re just custodians of these cars; it’s all about safeguarding them for the future.” HRT

First of the Few

Motoring author and historian **Guy Loveridge** on the heritage and future of the very first Connaught motor car

THE Connaught motor car was born from a desire of two ex-RAF officers which, in the immediate post-war years, was to go motor racing and to do it "their way".

Those officers, Rodney Clarke and Michael Oliver, had initially established Continental Cars Ltd at Send in Surrey, to deal primarily in Bugatti motor cars. However, it soon became obvious to them that not only would Bugatti not be offering a decent new product to rival its pre-World War II output, but they were not going to be offered the UK Agency either.

The pair cast about for suitable underpinnings as actual cars were in short supply at the time – the maxim being "export or die!" for those still struggling to recover from war-time production British industry. There was, however, a chance to use a proprietary chassis, with modifications and an engine, that could be readily tuned to increase performance.

THE CONNAUGHT CANVAS

Oliver chose the Lea-Francis chassis as a platform and its 1767 cc four-cylinder engine as the power plant. The development work on the engine was shouldered jointly by Mike Oliver and Peter Monkhouse at Monaco Engineering at Watford. The success they achieved is that, in standard 'Leaf' form, the power output was an RAC-rated 64 bhp. When they pronounced themselves satisfied with their improvements – which included raising the compression ratio; fitting a quartet of Amal carburettors; and carefully polishing and balancing the pistons, conrods and crankshaft – a special exhaust system was designed and fabricated using a Burgess silencer.

The apparently small radiator grille actually opens into specially designed ducting to allow the use of a small radiator and also a dedicated air feed to the carbs. By then, using premium fuels, the car was producing a genuine 107 bhp. Pretty impressive for a 1948 car of 1800 cc. This power was conveyed to the wheels through a close ratio four-speed gearbox, again sourced from Lea-Francis driving through a Borg and Beck high duty clutch plate.

The brakes were specified as either Ferodo for road use, as all of these L series cars were road registered, or Mintex liners on all four drums for competition work. The subject of this article, MPH 329, is the very first of the line and was used by Kenneth McAlpine

BELOW At Goodwood Revival 2015 – Loveridge reunited with the sister L2 by new owner Paul Lovett for The Fordwater Trophy

Jeff Bloxham

Guy Griffiths

ABOVE Kenneth McAlpine in MPH 329 leading home a Connaught 1-2 at Blandford Camp in 1949

for nearly three seasons. It's having its brakes refurbished by Mintex at its historic Sherburn in Elmet facility, where the team will be fitting the latest friction material to enhance the car's performance for next season.

ENGINEERING A LEGEND

The original Connaught project had, to some extent, been bankrolled by Kenneth McAlpine, scion of the famous construction family. His Maserati had been looked after by Oliver and Clarke in the opening couple of seasons post-1945 and he enthusiastically backed the new project, being first in line for the L2, as the production "sports-racing" car was to be labelled. McAlpine used the car for races and hill climbs. He had success at Goodwood, Boreham, Ibsley and Silverstone amongst others. He even went to Belgium and competed with the "sports car" in Chimay's "Grand Prix Des Frontiers", finishing 4th in his heat. By 1951 Connaught Engineering had formalised McAlpine's racing activities and the racing car construction business: all vestiges of the old Continental Cars fell away, other than remaining in the cars' name – CON(tinental) AU(tos)GHT.

The chassis received modifications aimed at improving the handling and road holding. To these ends the suspension was re-worked with stiffer shock absorbers and a change to spring rates. The Lea-Francis semi-elliptic springing was retained all around, but specially sourced Girling heavy duty shock absorbers were fitted and a great deal of attention was devoted to reducing the classic "pre-war" car's tendency to "dive" at the front under heavy braking, as measures were taken to absorb not just road "shocks" but also front end brake torque.

The team also fitted a higher ratio steering box, which reduced the ratio from the standard 16.7 to 1 down to a more sporting 13 to 1. This exact car was tested by *Motor Sport* magazine for its September 1949 number, straight after ▶

ABOVE Ian Kellett of IK Classics, seen here with Loveridge in Ian's workshops, will be overseeing the preparation to bring MPH 329 back to the track in 2017

BELOW Leading an ex-works Aston Martin DB2/4 through the chicane in the sister car – AHC 82 – at The Revival in 2008

the L2 Connaught "factory team" had put up a noteworthy showing at Silverstone in the Bugatti Owners' Club event.

The tester, presumably the late Bill Boddy himself, noted that the car was most willing to rev and declared that he was "encouraged to 'go off the clock', the rev counter reading to 6000 rpm, and it is a fact that the makers declare the safe maximum to be 6,500 rpm." Boddy goes on to declare himself impressed with both the performance and handling of the L2, noting that it displayed an "ability to go round corners at very high speeds with no conscious steering actions" and how the car provided "exceedingly good roadholding yet scarcely betraying the rigid I-section axle".

Boddy's only criticism of the car was levelled at the brakes, which had indeed hampered both Clarke and McAlpine at that Silverstone meeting, saying that "The brakes had some tendency to fade, which air-ducts might obviate". Overall, however, the test clearly impressed as he closed the half-page feature noting that "This car is a most interesting proposition... the price of the normal "Competition" two-seater Connaught is £989, or £1,275 with p.t., and we understand that delivery can be made in 4½ months." In the same issue, a report of the August 13th Goodwood B.A.R.C. Members' Meeting, where founding Chairman of the Guild of Motoring Writers Laurence Cade was Secretary of the event, reports that in the "First five-lap handicap, Waring's Alvis led the first two laps after which it was swamped by Rodney Clarke's and Kenneth McAlpine's identical Connaughts. McAlpine could make little impression on Clarke and, thus, the two Connaughts finished an impressive first and second – they now have slots cut in the front-end fairing to direct air to the brakes." Clearly racing experience, and perhaps Boddy's mention of brake-fade, had been noted.

Later in the day McAlpine took MPH 329 to another second place in a 10-minute handicap, coming home just .02 seconds behind Jason-Henry in his Le Mans specification Delage, even though the Connaught was giving away 1790 cc in engine capacity! Earlier in the summer, McAlpine had taken MPH 329 to Prescott for the Bugatti Owners Club's ▶

ABOVE Rascasse – the old Gas Works Hairpin

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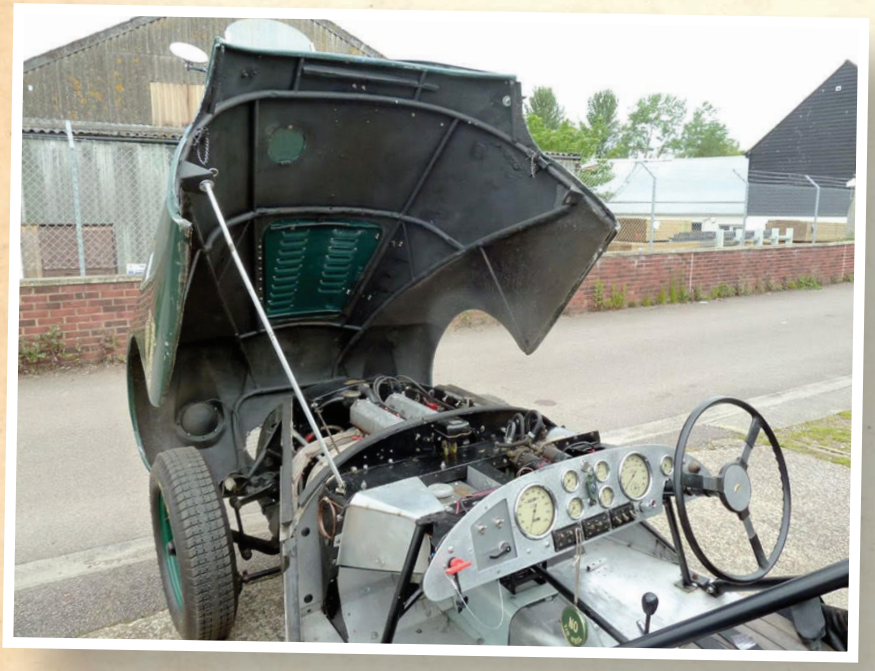
speed hill climb – a most worthwhile trip as he returned with a class win in the up to 3-litre class. At the end of the first full season of competition the Connaught L2s had garnered many class and overall wins and the small team based at Send in Surrey was encouraged to be slightly more ambitious for the 1950 season.

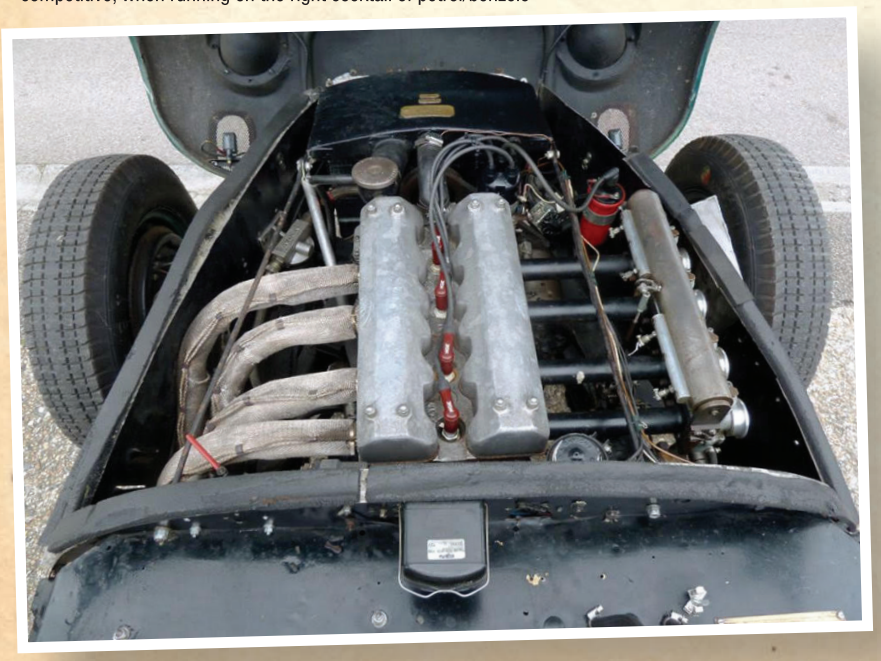
Ambition is not something that the Connaught organisation could be accused of lacking. In fact, from a season of what was essentially "club" racing, it decided to set its sights rather higher and leapt directly into international competition for 1950. Also, not the apparently logical step of running International Sports Car events such as The Tourist Trophy, Le Mans 24 Hours, Spa or the Nürburgring, Connaught decided to enter a two-car team in a Grand Prix!

The international racing classes, or formulae, have always been essentially based upon engine capacity and thus the Connaught team realised that its highly-developed Lea-Francis based engines, with a 1767 cc capacity could, perhaps, be competitive, when running on the right cocktail of petrol/benzole. Thus, entries were presented to the authorities at Chimay and a pair of Connaught L2s were duly accepted.

ABOVE The team's original brochure



ABOVE & BELOW The Connaught team realised that its highly-developed Lea-Francis based engines, with a 1767 cc capacity could, perhaps, be competitive, when running on the right cocktail of petrol/benzole



This was a real adventure, for 1950 still saw the ravages of World War II across the continent of Europe and foreign travel was hampered by currency restrictions, customs carnets and the inherent risk of transporting anything across said continent. Undeterred, the two-car team with drivers (and owners!) Clarke and McAlpine lined up for their respective heats of what was a two heats and a final event. Annoyingly, Clarke had mechanical troubles and failed to complete his heat, but in the other McApline found that he liked the public road circuit there and brought the Connaught home – a sports car, remember, and road legal – in an amazing 4th place.

Come the final and the Connaught was a little "off song" after its exertions and McAlpine wisely retired the car and Belgian ace and jazz musician of note Johnny Claes took the win in a fully-fledged Formula II HWM/Alta. But, the point had been made and orders for the L2 began to be taken and the team was able to look towards its ultimate goal, that of producing a Grand Prix challenger itself. That story is outside the remit of MPH 329. However, it should be noted that less than five years on from that plucky showing at Chimay, the full Connaught Grand Prix team of single-seater racing cars took on and beat the Maserati and Ferrari teams at Syracuse,

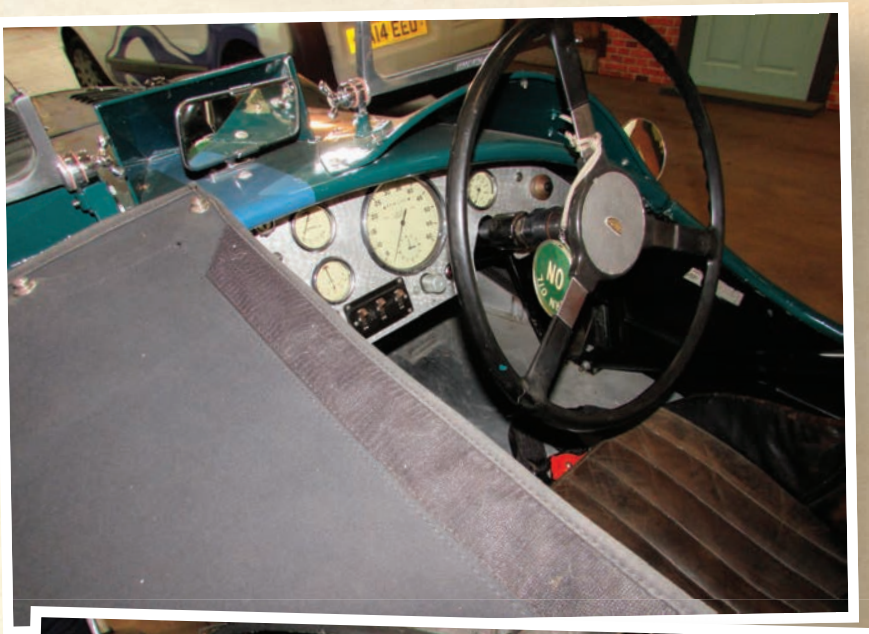
with Tony Brooks taking a resounding win for the team which was, even then, still based at Send and financed by Kenneth McAlpine as barely more than a "hobby". This was the first "all-British" Grand Prix win since Sir Henry Seagrave triumphed at the French Grand Prix in 1922. Not for the lack of trying, of course, but the ending of a 33-year wait is certainly worthy of note in my book.

By the end of the 1950 season, and with many more wins under her tyres, the "old" L2 was deemed to have served her time. The more aerodynamic L3s had been introduced and the Connaught company had the LSR and then ALSR on the drawing boards, cars which would take it to Le Mans and the Tourist Trophy at Dundrod. The car was sold off, no doubt with the epithet of her numerous race successes and then her "second life" as a well campaigned club racer, with spells as a road car in between.

BACK TO THE SCRAPBOOK

From the scrap book that came with her, she was "restored" in the early 1960s and painted a slightly unbecoming "Post Office Red" because "my mate worked at the GPO garage and could get the stuff easily!" By the mid-1960s MPH 329 had been given to Graeme Simpson as a 21st birthday present. "I really wanted an XK 150, but the one at the garage was £200 more than the Connaught, so I was given the old girl instead. By my mother, bless her!" he noted. Simpson took the car back to the track and earned a photograph and "honourable mention" in the first *Autosport* magazine of the 1970s, where the report of the Boxing Day Brands Hatch meeting pictured him and noted the "unusual" nature of his choice of mount.

Historic racing was getting started as a definite "thing" by the mid-1970s and MPH became something of a mid-field regular in JCB and Lloyds and Scottish Championship events. But, the call of ambition was never far away and she was sold once more, this time to an Australian who whisked the car to the far side of the world where she was on display at the York Motor Museum near Perth, Western Australia, for most of the1980s. Returning ▶



ABOVE & BELOW The development work on the engine was shouldered jointly by Mike Oliver and Peter Monkhouse at Monaco Engineering at Watford. The success they achieved is that, in standard 'Leaf' form, the power output was an RAC-rated 64 bhp

to England just before the end of that decade she was again fully restored and repainted in a deep British Racing Green and then campaigned actively and regularly in races under the auspices of the HGPCS, HSCC and VSCC by Mike Lester. Subsequent owners have included Dr Michael 'Spike' Milligan, who had the car alongside his A-Type Grand Prix Connaught, Peter Cox, David Duffy and from 2009 until this summer John Rogers.

A YOUNG BOY'S DREAM

It is here that I enter the car's illustrious history. I was competing in my Dad's 1956 "Lawrence Tune" Morgan +4 at the second running of The Chateau Impney revival hill climb. Having written the definitive history of the original event (*Speed Trial* – Douglas Loveridge Publications), I had seen that the Connaught was entered in the H&H Auction there, and also the rather misleading claim that Mike Hawthorn had driven her. Undeterred, I went to have a look in between my runs and, given my own history of having been a director of the "reborn" Connaught Motor Company in 2005/2006 I decided that, given some juggling of funds and the parting with a few other cars, I would very much like the chance to be the car's new owner.

Basically, it ticks all my personal boxes for a competition car. It has a great history; it's a Connaught (I have always loved "minnow-makes" who strove against the odds to reach success) and I have raced one of MPH 329's sister cars, AHC 82 at Goodwood and Monaco – it's basically a vintage car with the refinements of the post-war years bolted onto it. Dad and I sat in the auction hall and watched as the sale progressed. The Costin in the auction made a spectacular figure for what it was and we exchanged a nervous glance or two, but I insisted we were "OK"!

The car was bid at, but failed to reach a level where I believed it to have sold. I made Dad sit on his hands and, once the car had been knocked down as "provisional", went to speak to the H&H back office team. Within half an hour it became clear that the room bids were not enough but that what I wanted to pay would win the day and I walked out of the Impney exhibition hall the very proud new owner of the very first Connaught. The car that started a bright and brief "works" effort that sees a number of the cars still competing today.

The future is looking pretty bright for MPH 329. Mintex is, as noted, upgrading the brakes with its latest compliant competition lining material and Ian Kellett is looking forward to getting stuck into preparing her for a season of racing this year. I hope to be able to get out in her as often as other commitments allow. Being a motor racing commentator does not always dove-tail so wonderfully with being a competitor, sadly, but I know there are a few meetings at which I shall be free to drive.

I have linked up with the current owner of AHC 82, my fondly enjoyed drive at Goodwood and Monaco in 2008, as well as at the Goodwood Revival again in 2015, to form "Connaught Motor Racing Limited" – a loose convenience to offer a "team" to race organisers – while FISCAR have given us an enthusiastic welcome and we hope to have both cars running at the Bentley Drivers Club's July meeting.

I will be trying to enter MPH 329 for the Monaco Historic Grand Prix in 2018. Seems a fitting 70th birthday present for the old lady, given her continental adventures of 58 years before, wouldn't you agree? HRT

BELOW Loveridge at the Monaco Historic GP 2008 in sister L2 AHC 82, one of the customer cars. This ignited his passion to own his own L2, and marked the first time an L2 had raced at Monaco

Welcome to The Big League

Historic racing doesn't get any more serious than the monsters of Group C. **Chris Pickering** delves under the skin of Aston Martin's works entry

A FEW years ago at the Le Mans 24 Hours the third fastest speed trap reading of the weekend was set at 210.1 mph. Nothing unusual about that, you might think. Except it didn't come from one of the 1,000 hp four-wheel drive LMP1 cars. It wasn't even set during the main race. Instead, the speed that eclipsed all bar two of the 2014 works entries (and missed the top spot by less than 1 kph) was posted by a 24-year-old Group C car in the Le Mans Legends support race.

It's a vivid illustration of just how potent these iconic machines still are. They sit at the very top of the historic motorsport tree; faster and more sophisticated even than the cars in the FIA's Historic Formula 1 Championship.

A small industrial unit at the end of a bumpy lane in rural Essex might not be the first place you'd expect to find one of these machines, but looks can be deceiving. John Danby Racing (JDR) is home to several Group C cars. And we've come to see one in particular.

Aston Martin only actually ran a full works team for one season in Group C. Chassis number five was the last to leave the factory in 1989, and it was the ultimate incarnation of the AMR1, fitted with a lightweight chassis and a 6-litre Callaway-developed V8 producing over 700 bhp.

Historic racer Paul Whight has owned the car for nearly 20 years, sharing it during that time with some of the biggest names in sports car racing, including former Aston Martin works drivers Brian Redman and David Leslie. Most recently, it picked up a win and a second place at the 2016 Dix Mille Tours event, where Whight co-drove the car with French ace Nicolas Minassian.

Nestled in the corner of the workshop, it looks the business, with a purity of lines that the fussier LMP cars of today simply can't match. You might say that's reflected in the engineering, which is relatively straightforward by modern standards. True, it uses a carbon-Kevlar monocoque, slick tyres and a range of aerodynamic devices, but apart from that there isn't a great deal to separate it from, say, a Lola T70 in terms of complexity. Performance, however, is night and day different, with vast reserves of power, matched by colossal aerodynamic grip.

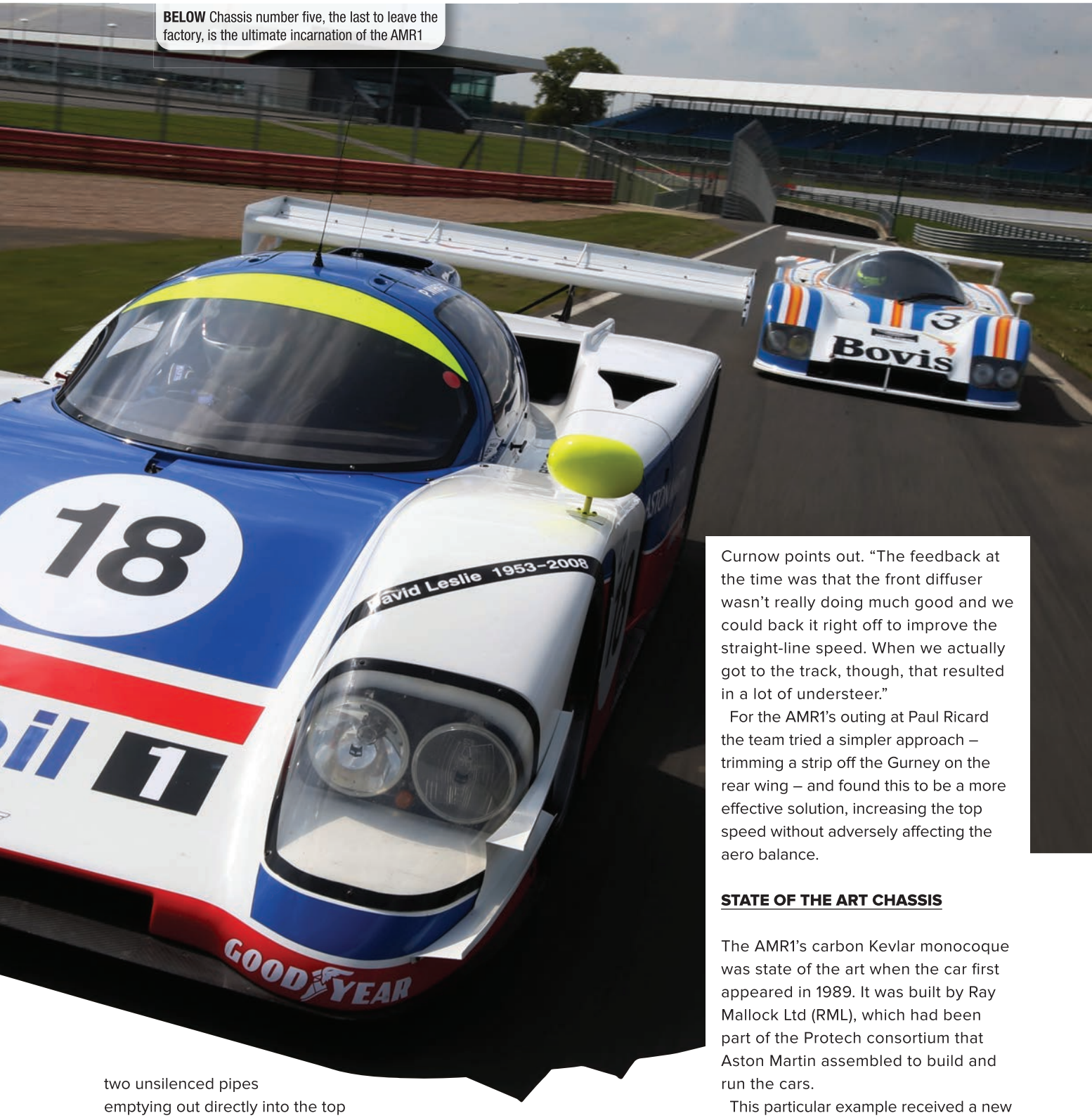
"Some Group C cars were built specifically as customer cars and they were designed for that role. The factory cars, on the other hand, can be rather more demanding," admits JDR manager Ross Curnow. "Even compared to the historic Formula 1 cars they require quite a lot of looking after; you need a minimum of two people on the car at all times."

AERO ISSUE

The AMR1 is a car defined by its aerodynamics. At the tip of the nose there's a small splitter and a discrete pair of vents that channel air towards the front brakes. Slightly further back (hidden under the bodywork) there's a hinged section in the flat floor that can be tilted upwards to create an adjustable front diffuser.

There's an elegant simplicity to the whole of the nose section. The front wheel arches are open at the back to vent pressure and improve cooling. In-period the car also sometimes ran a pair of small diveplanes just ahead of the front wheels, although these are rarely used now.

At the tail end, that brutally short rear overhang conceals a sizeable rear diffuser, which rises up almost all the way from the middle of the car. One of the decidedly modern features is the use of exhaust blowing, with the



BELOW Chassis number five, the last to leave the factory, is the ultimate incarnation of the AMR1

two unsilenced pipes emptying out directly into the top of the diffuser. Finally, there's a large single element rear wing – adjustable, of course – with a Gurney flap sticking up on the trailing edge to provide yet more downforce.

But downforce was never the problem. Drag was – and to a certain extent still is – the AMR1's nemesis. It's a hugely quick car by any normal measure, but at the end of the long straights it can concede as much as 20 mph to the fastest Historic Group C machines. In the past the car has been sent to the wind tunnel at MIRA in an attempt to alleviate this issue, but without a moving ground plane the results have proved to be of limited benefit.

"A static wind tunnel is great if you want to adjust things like ride heights, splitters and wing settings, but you really need a moving floor to look at underfloor aerodynamics," Curnow points out. "The feedback at the time was that the front diffuser wasn't really doing much good and we could back it right off to improve the straight-line speed. When we actually got to the track, though, that resulted in a lot of understeer."

For the AMR1's outing at Paul Ricard the team tried a simpler approach – trimming a strip off the Gurney on the rear wing – and found this to be a more effective solution, increasing the top speed without adversely affecting the aero balance.

STATE OF THE ART CHASSIS

The AMR1's carbon Kevlar monocoque was state of the art when the car first appeared in 1989. It was built by Ray Mallock Ltd (RML), which had been part of the Protech consortium that Aston Martin assembled to build and run the cars.

This particular example received a new tub from RML around seven years ago, and it's proved relatively straightforward to look after, explains Curnow: "Carbon chassis are no harder to look after than aluminium monocoques. You have to keep on top of the components due to the loads involved – crack testing is mandatory every year for things like wishbones and uprights – but that's not really any different to other serious historic racers." ▶

Jeff Bloxham

ABOVE Drag was, and to an extent still is, the AMR1's nemesis

Inside that carbon Kevlar cocoon there's a relatively simple layout, with the usual bank of switches plus a MoTeC Sport dashboard display, which also doubles as the data logger. It's a neat, tidy cockpit, with a centrally-mounted air vent just in front of the windscreen to provide de-misting. You can forget any notions of air conditioning, though: the vent is fed by a simple pipe that runs down to an opening in the nose.

The structure behind the monocoque looks rather like a modern LMP3 car, with the engine used as a semi-stressed member, supported by two tubular steel A-frames that extend right back to the gearbox. Higher up, a pair of struts bolts on to the cylinder heads to provide additional bracing.

With a relatively plentiful budget at their disposal, the Aston Martin engineers who designed the AMR1 eschewed the usual off-the-shelf transmission options for a bespoke five-speed transaxle. As with the rest of the powertrain it's angled upwards by around three degrees to make space for the diffuser tunnel, and its layout was rather unusual for the time. Instead of packaging the gear ratios behind the differential, where they could be easily accessed, they're placed in front. This helps to shift the centre of gravity forwards, but it's not the most popular feature with the mechanics who have to look after it.

"It's not a quick job to remove the ratios," says Curnow with a tone that implies this may be something of an understatement. "Modern transaxles often follow the same approach, but they're designed to come apart much faster; Audi got to the stage where they could change the whole rear end in less than four minutes. If you go to a race ▶

BELOW The adjustable front diffuser and brake ducts are visible with the nose section off

Photos: Chris Pickering

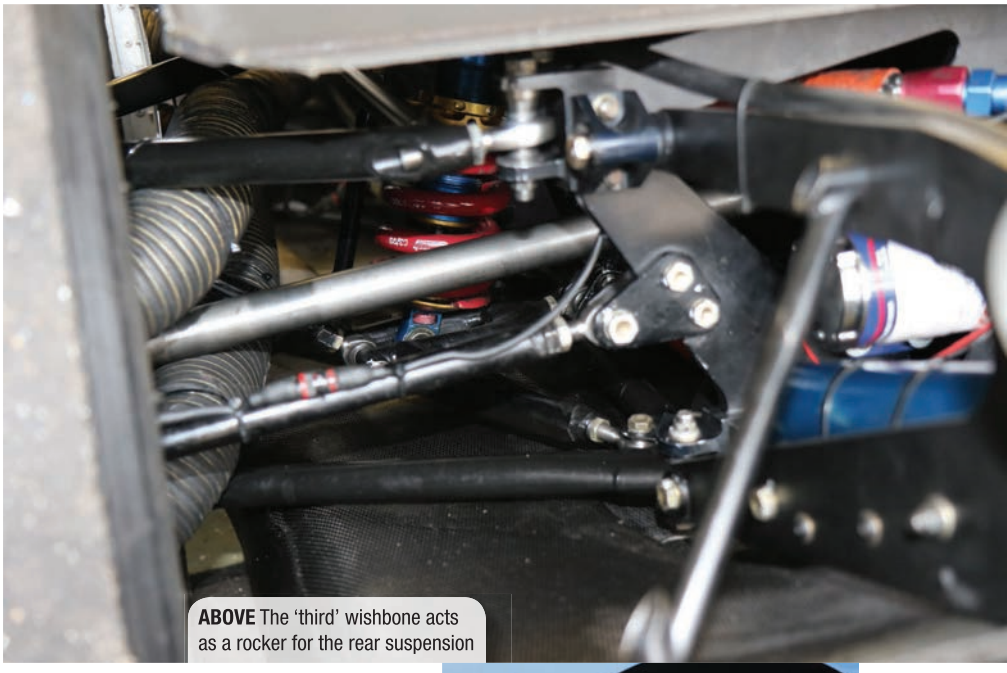
with the wrong ratios in this one you're in for a long night!"

The rear suspension uses double wishbones and what – at first glance – looks like a straightforward outboard damper setup. It's actually a pullrod-activated system, though. Look carefully and there's a pivot arm sticking off the side of the gearbox. The pullrod runs down to this arm, causing it to rotate up and down with the wheel – much like a third wishbone – while the damper attaches about two thirds of the way along its length. This means that changing the length of the arm and the point where the damper attaches would allow you to vary the suspension ratio, much like swapping the rockers on a modern inboard setup.

The front suspension, in contrast, is a fairly traditional design, with unequal length wishbones and outboard coilover damper units. Such is the difference in length between the top and bottom wishbones, however, that the upper mounting points are separated from the tub by fabricated steel pylons. These also double as the top mounts for the dampers, which are Dynamics units all round fitted with Hyperco springs.

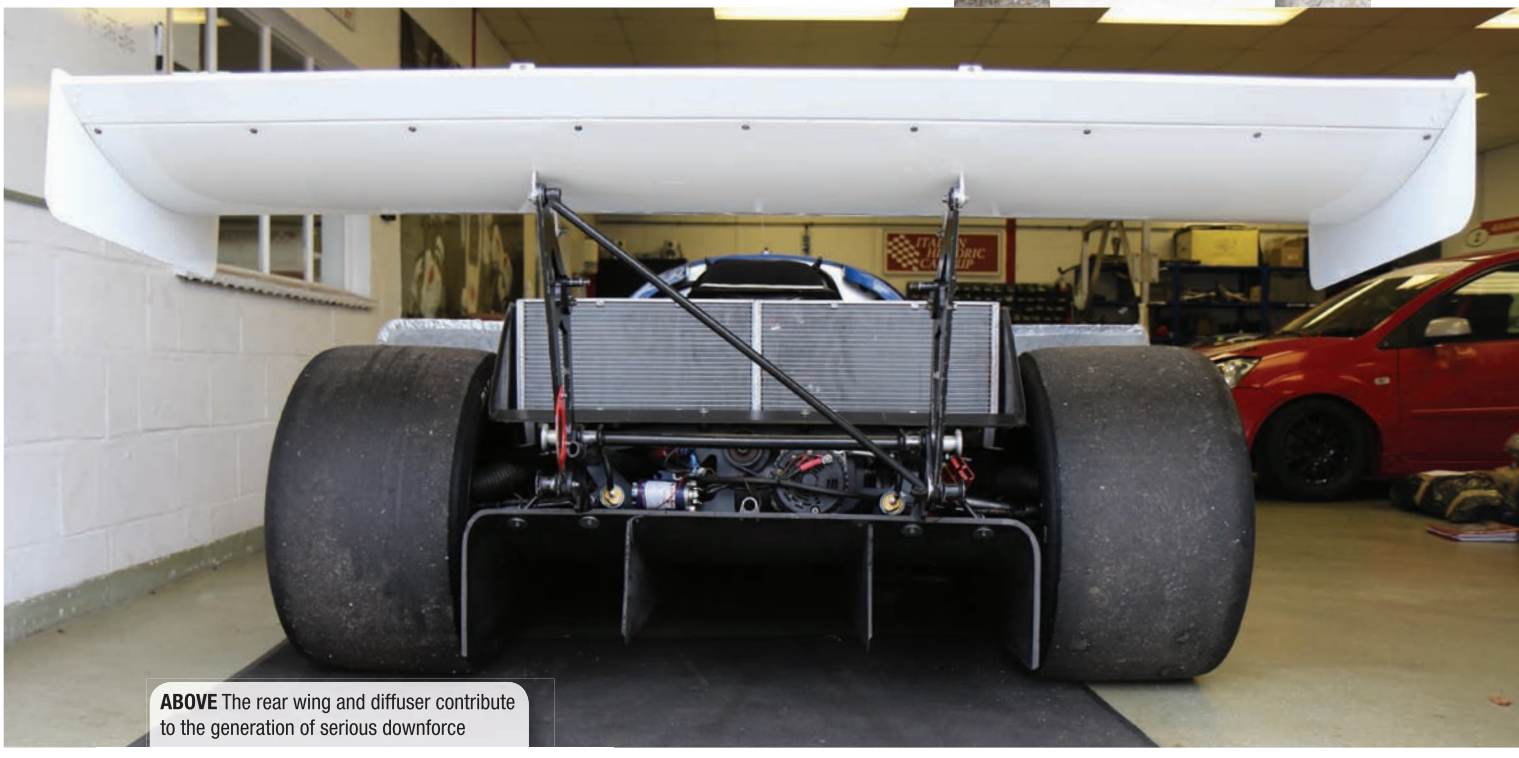
The AMR1 followed contemporary F1 thinking with minimal suspension movement and very high spring rates to provide a stable platform for the aerodynamics. It uses 2,500 lb/in springs on the front with some 3,500 lb/in on the rear. "We've also got a set of 4,500 lb/in springs," notes Curnow. "They're monstrous compared to anything on a modern car and that's something we'd like to see if we can change."

During its works career the AMR1 ran an early carbon-carbon brake system. Since then it has switched to a more conventional setup with AP Racing steel discs and Ferodo pads. The wheels are lightweight magnesium designs, which are hollow in construction ▶



ABOVE The 'third' wishbone acts as a rocker for the rear suspension

ABOVE The car now uses AP brakes and Avon tyres



ABOVE The rear wing and diffuser contribute to the generation of serious downforce

(making fastidious crack testing all the more important). They're clad in the mandatory Avon slicks or wets, which are supplied by the Group C Racing series' official tyre distributor, BMTR.

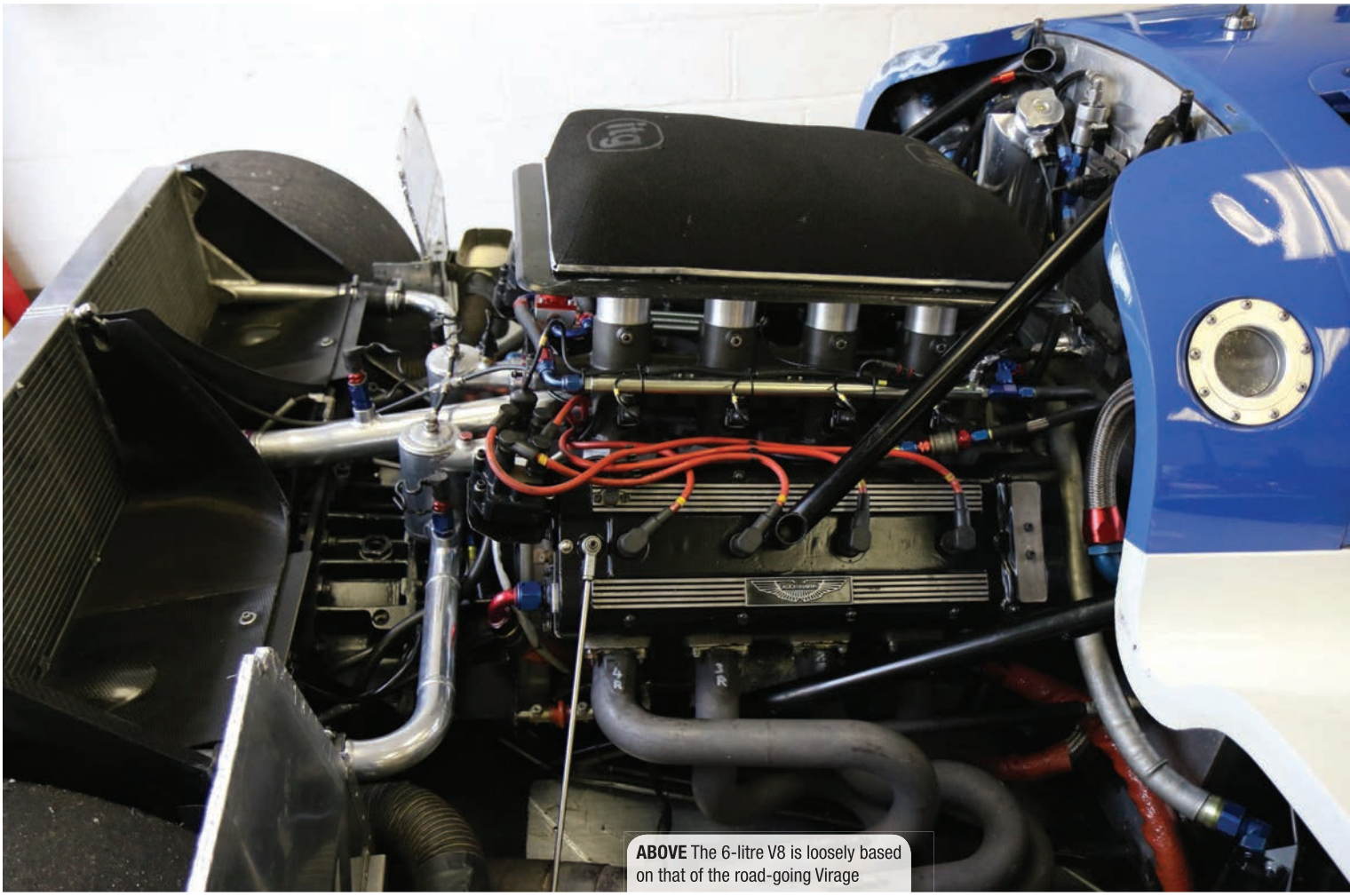
There are a few concessions to modernity on this car, and one of the most interesting additions is the electric power steering. It's a fully-mappable system from DC Electronics, which mounts onto the column, leaving the original steering rack in place and unmodified.

"We've been working with DC quite a lot on a number of more recent cars," says Curnow. "This system gives you a lot of freedom to tailor the characteristics. If anything we've got a bit too much assistance currently, but you can calibrate it against anything you want, including speed, load and steering angle. You can also put in variable assistance, so it's quite heavy down the straight but it starts to open out when you go round a hairpin. It does take quite a lot of testing to perfect, though."

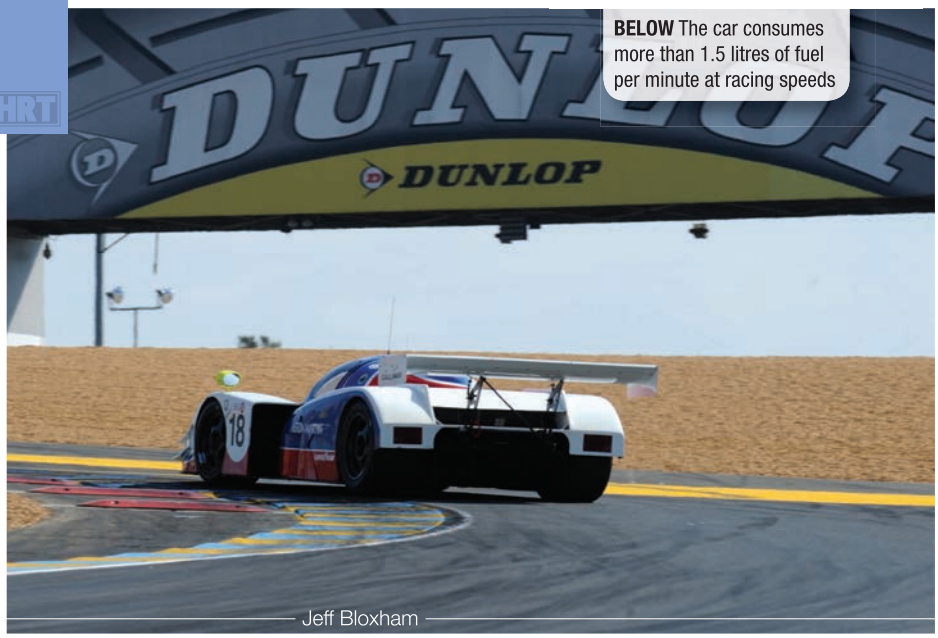
ABOVE Exhaust blowing the diffuser is one of the car's more modern features

T70 ENGINE LINEAGE

Geoff Page Racing, based just down the road in Maldon, currently looks after the engines, with two fitted in rotation (one as the race engine and another as a spare). They're loosely based on the 5.3-litre V8 used in the contemporary Aston Martin road cars, which could trace its roots right back to the Lola T70 Mk3. The block is production-based, but the cylinder heads are bespoke aluminium items developed by Callaway with quad camshafts and four valves per cylinder in place of the stock two-valve design. ▶



ABOVE The 6-litre V8 is loosely based on that of the road-going Virage



Jeff Bloxham

BELOW The car consumes more than 1.5 litres of fuel per minute at racing speeds

Originally, AMR1/05 was fitted with a 6-litre engine, which was swapped towards the end of its works season for an upgraded 6.3-litre unit. However, the original 5,998 cc capacity was reinstated in preparation for its historic racing debut in 2001 and it's remained that way ever since.

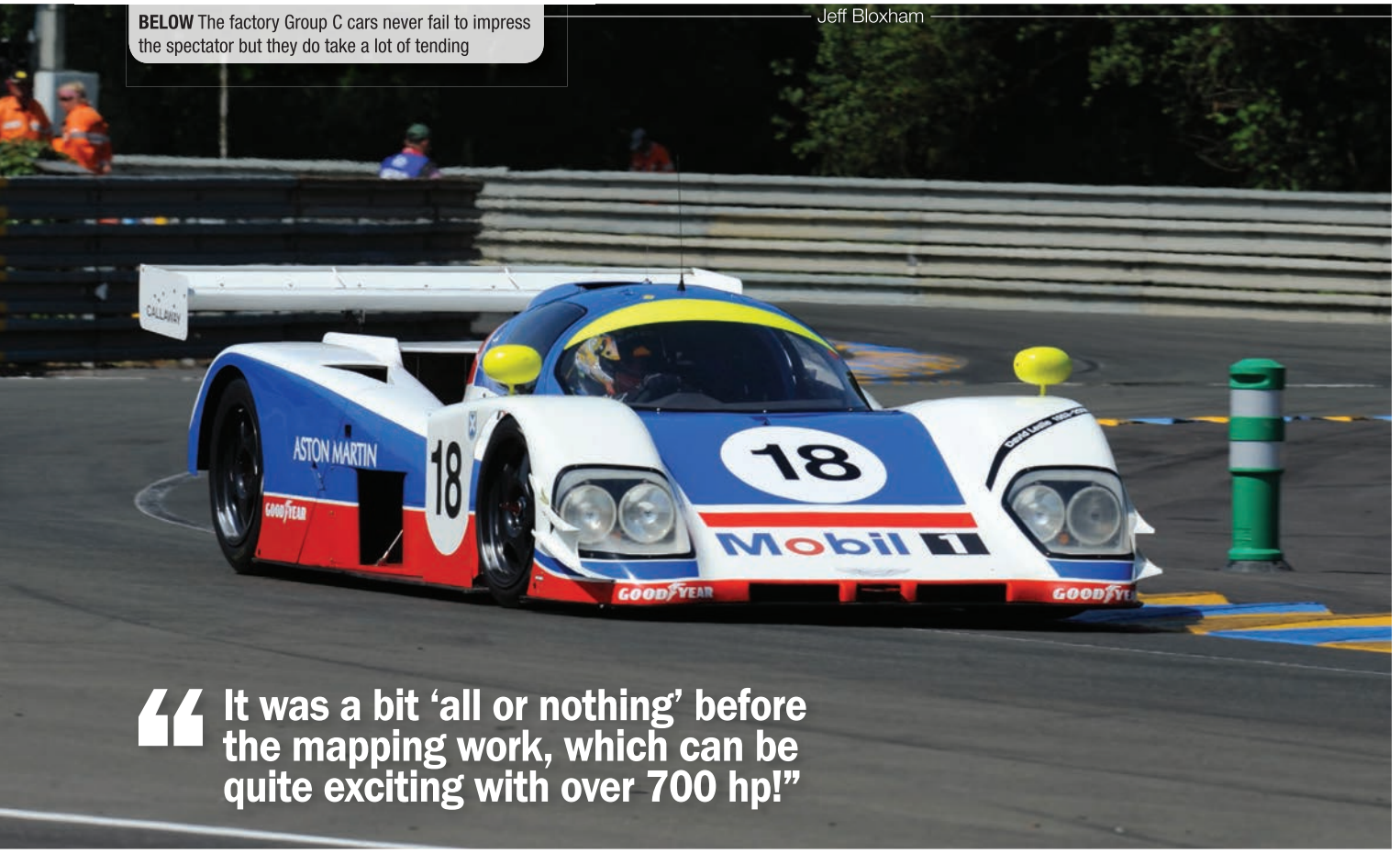
There is a smattering of off-the-shelf parts, on account of the engine's production-based origins, but they're largely confined to things like seals and gaskets. A lot of the major internal components are bespoke, which can create challenges. For instance, at the last rebuild it transpired that the piston rings were no longer available. Faced with limited material on the existing pistons to re-machine for the fitment of new rings, the team instead decided to go with a fresh set of Mahle pistons.

Two giant rear-mounted radiators, fed by vents on top of the rear haunches, help this 700 bhp monster to keep cool. It's a slightly curious mounting position, while the sidepods – where you might expect to find the radiators – are instead home to the engine and gearbox oil coolers, fed by the rectangular ducts on the side.

Getting the AMR1 warmed up and started is a simpler process than you might expect. A set of water heaters (attached to the dry-break couplings visible on the coolant pipes) help to bring the engine up to temperature, along with a similar system for the engine oil. First, the spark plugs are removed and the engine is spun until it reaches the correct oil pressure. At that point the plugs go back in and the engine can be started.

"It's pretty much the same procedure with all our high-end cars," comments Curnow. "Once it's warm we can usually just go and start it. The only unusual thing is the oil pressure – it runs almost 12 bar on the dyno and a good 7 or 8 on track, but it fluctuates quite a lot."

ABOVE The interior, including modern dash logger



BELOW The factory Group C cars never fail to impress the spectator but they do take a lot of tending

Jeff Bloxham

> **"It was a bit 'all or nothing' before the mapping work, which can be quite exciting with over 700 hp!"**

The AMR1 originally ran with a Zytek control unit, but it has since been fitted with a new loom and a modern ECU from Life Racing. Lambda sensors are now fitted on both banks, giving the option of closed loop mixture control. Or at least in theory: the minimal length between the sensor and the opening into the diffuser leads to some odd effects that can make it tricky to get a reliable reading when the engine is in-situ.

Electronic engine management was still somewhat in its infancy when the AMR1 was built. As a result, most people agree that substituting a modern system is the best option for cars of this era, and it needn't be a particularly big job.

"It's a pretty straightforward exercise," says Curnow. "We use a modern crank trigger setup with off-the-shelf ASNU injectors, so it's all pretty easy to configure. After Geoff [Page] had done the engine rebuild he sent it down to TDI in Thurrock for some mapping work to optimise the driveability. It was a bit 'all or nothing' before, which can be quite exciting with over 700 hp!"

A good management system is also crucial to looking after the engine, he points out: "This system can shut an engine down far quicker than a driver if, for instance, the oil pressure drops. There's lots of safety cut offs and it also gives us brilliant logging – we can see the difference bank-to-bank, for instance."

Being naturally aspirated, the AMR1 doesn't require quite such exotic fuel as the turbocharged Group C machines, but it still needs high quality 102-octane. It also has a prodigious thirst, consuming more than 1.5 litres per minute at racing speeds from the centrally-mounted 90-litre tank. In preparation for the 2016 season JDR commissioned a new fuel tank from Jonathan Tubb at Advanced Fuel Systems.

"The new tank is great, but getting it in was a challenge," notes Curnow. "Not only is there a very small aperture to get the tank in, but we had to try and get four scavenge pumps, two main lift pumps and all the associated pipework in there. It turned out to be a three-day job in the end!"

POSITIVE RESULTS

The 2016 season was a busy one for JDR. Alongside a host of other commitments, the AMR1 arrived shortly before the season opener at Jarama. This gave just enough time to swap the ratios and carry out a basic setup and inspection before the car was loaded into the transporter. Things went well at the track, with Tom Kimber-Smith putting in a strong performance until an engine issue forced retirement.

Upon return it was stripped down to a bare shell, with the major suspension and steering parts sent off for crack testing. With the car in bits, the race engine went off for a rebuild (since when it's performed faultlessly) and the new fuel tank was installed.

The race-winning outing at Paul Ricard later on in the year proved the car's potential and it's testament to the work put in by JDR.

"I'm pleased with what we achieved with the car in 2016, but there's definitely more we could look at it in the future," comments Curnow. Top of the list is lowering the ride height and getting more heat into the rear tyres, he explains. There's also the ongoing question of aerodynamic optimisation. It's unlikely the high-downforce AMR1 will ever set any speed trap records of its own, but more race wins could certainly be on the cards. HRT

Photos: Virtual Motorpix/Glen Smale

ABOVE More than 40 years on from its finest moment, the de Cadenet Lola still looks in impressive shape

SUGAR GIVES YOU GO

In 1976 a small private British team stood proudly on the podium at the Le Mans 24 Hours, having finished third. **Glen Smale** looks into how they achieved it

ALAIN de Cadenet, a well-known and enthusiastic motor racing figure, has many race miles under his belt. He is also never short of a quip when handed the microphone in interviews, as this writer learned while listening to his entertaining accounts from around the world when he spoke at the Credit Suisse breakfast at the Goodwood Revival. But back in 1975, he took the Lola T380 that he had bought from Eric Broadley, and together with experienced wheelman Chris Craft, they entered the Le Mans 24 Hours race.

That first event with the T380 in 1975 was both a disaster and a success. It was almost disastrous because with de Cadenet behind the wheel in the dead of night, pieces of the car's bodywork began to lift off, and large bits lay strewn across the track. Cars following the Lola were fortunate in that no real accidents occurred, but several competitors were forced to pit to have tyres replaced and damaged bodywork removed. Keith Greene, the team manager, recalls the situation, "The one big problem we had was with the bodywork coming loose and lifting, which of course didn't show its head in practice. I borrowed every Dzus fastener and every piece of gaffer tape in the paddock. If we'd had any problems on Sunday morning, there would have been no way we could fix it because it would have taken half an hour to get the bodywork off, and to stick all the tape and the Dzus fasteners on again."

The trouble the de Cadenet team had was that too much air was getting into the car, and this was lifting the bodywork and placing strain on all the fasteners. This not only made the car slow in a straight line, but also caused the rear bodywork to fly off during the night. These challenges aside, Craft was able to set the fastest race lap that year, 3m 53.80s at a speed of 130.504 mph. Despite all the problems with the car, the team and drivers did a sterling job to finish in 15th place overall. The success that year came from the fact that they had learned where and how to improve the car for the following season's event.

For the 1976 race, Craft insisted that they sort out the aerodynamic problems first. "We were really interested in

trying to be aerodynamically efficient in a straight line," he says. "In 1975 we had been particularly slow down the straight in comparison to what we thought we ought to be doing. I used to get very frustrated because, if you're not pulling the best that you can down the straight, then over 24 hours you're losing a lot of time."

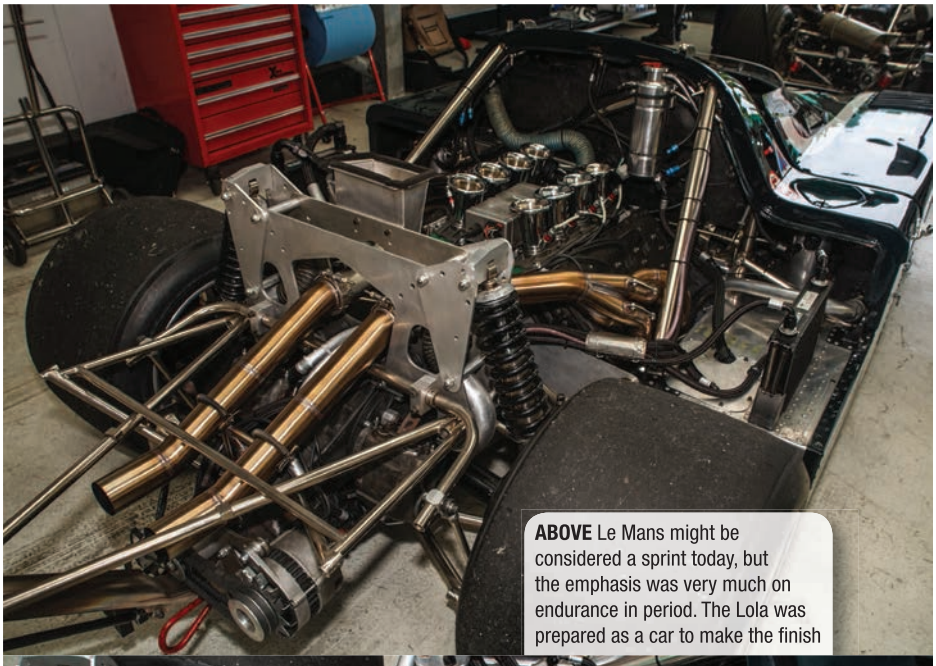
As a first step to resolve this issue, de Cadenet, Craft and Len Bailey took the car to MIRA and stuck tufts of wool on it and poured oil on the body. "We watched it in the wind tunnel, then we tried different ride heights, but quite honestly I don't think we did anything to it," Craft recalls.

"That is why in the end we stuck it down the M4 between junction 16 and 17, and we even took a journalist with us to prove that it would pull the speed. We should have done it at night but he [Alain] forgot to put headlights in it, so we did it at dawn. We were pulling about 214 mph, which is what we were aiming for. It was quite a small car, but I think we just pushed the front splitter out a bit more, dropped the ride height, and jacked the back up."

> **"I borrowed every Dzus fastener and piece of gaffer tape in the paddock"**

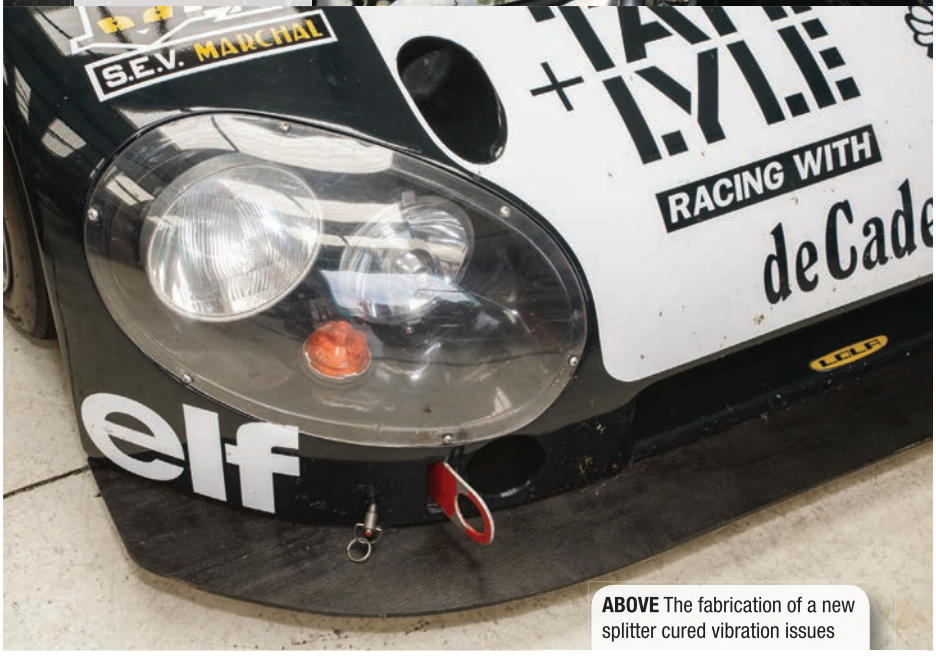
Dick Crosthwaite and John Gardiner of Crosthwaite & Gardiner fame did much of the rebuild on the '76 car. "We employed Dick and John for the Le Mans week as our mechanical team and they brought along two more of their regular staff," recalls Greene. "A couple of Alain's friends came along to fetch and carry tyres and odds, I was there to run it and engineer it, and then Alain and Chris drove it. We had nothing, as far as I recall, we didn't even have a spare set of spark plugs for it!"

The engine was not a new one, and according to Greene it had definitely been rebuilt by Cosworth knowing that they wanted it as a Le Mans engine, ▶



ABOVE Le Mans might be considered a sprint today, but the emphasis was very much on endurance in period. The Lola was prepared as a car to make the finish

ABOVE Performance gains have been made in the DFV in terms of compression



ABOVE The fabrication of a new splitter cured vibration issues

and not a Formula 1 unit. It was given 'softer' cams and it was 'as sweet as pie' and never missed a beat Greene adds: "We ran the engine to a maximum of about 9,700-10,000 rpm, when at the time in Formula 1 they were running them at 10,500-11,000 rpm. I thought that was enough of a margin to give us performance, but also to give us some additional reliability."

Greene laid down very strict rules for the two drivers. He called for good clean gear shifts and to stick to these rev limits to give them a good chance of reaching the end of the race, not least because they simply had no spares.

The team had fitted a front splitter for the car that proved a bit flimsy and which vibrated at speed. At first they were unsure of what was causing the vibration, as this was quite pioneering technology back in '76, so Greene pushed the splitter back slightly and this reduced the problem. Now more certain of what was causing the shaking, he proceeded to make a new one from stiffer L72 aircraft spec aluminium which solved the issue.

However, Greene had a dilemma on his hands: he wanted to keep their practice laps to a minimum as they had no spares should anything go wrong, but of course the drivers needed track time. In the time that they did have, Craft was able to qualify the Lola in 10th place on the grid, ensuring that they were within reasonable reach of the front-runners.

"We didn't do a lot of running before the race, because we were comfortable with the setup and the boys were quite happy as we were doing sensible laps," Greene reports. "On the Friday, we went through everything to make sure that what little spares we had were ready to go."

Le Mans 1976 was an incredibly hot year, as Craft remembers, "The car ran very well mechanically but we had a problem with the drivers suffering from heat exhaustion, because the heat in the car was enormous. I made it worse for myself by getting the mechanics to cut a piece of metal to fit inside my shoe, but that just made it worse. My feet just gave up, because pressing down at full throttle on the straight made me black out, so I would rush off to get the Chinese guy to massage my foot between stints."

What caused the problem was the radiator in the front had a deflector plate ▶

ABOVE & BELOW If you can't stand the heat: all's fine now but in that '76 race a deflector plate slipped down, directing hot air straight back at the bulkhead and pedals

De Cadenet Lola T380 technical specifications

ENGINE

Configuration	90° V8
Bore	85.6 mm
Stroke	64.8 mm
Capacity	2993 cc
Firing order	18364527
Compression	11.8:1
Inlet valves	35 mm
Exhaust valves	30.5 mm
Inlet camshaft lift	10.4 mm
Exhaust camshaft lift	10.4 mm
Camshaft timing	102°
Power output	460 hp @ 10,500 rpm
Torque	255 lb ft @ 8,500 rpm

BRAKES

Callipers	Lockheed
Front disc	260 mm x 28 mm
Rear disc	290 mm x 28 mm

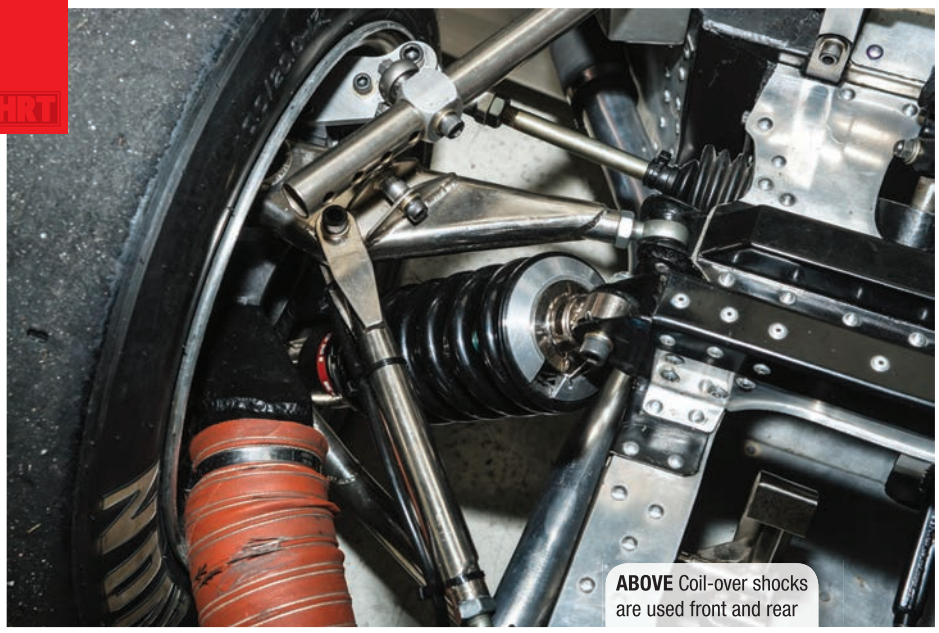
GEAR RATIOS (Le Mans)

CWP	9/31
1st	12/37
2nd	16/40
3rd	15/30
4th	19/29
5th	19/23

DIMENSIONS

Length	4450 mm
Width	1720 mm
Height	1200 mm
Wheelbase	2460 mm
Weight	860 kg

Chassis number	Lola T380 HU 01



ABOVE Coil-over shocks are used front and rear

to direct the hot air up and over the car. It transpired that the deflector had slipped down, and the hot air was blowing straight back at the bulkhead and the pedals, but once the problem was fixed it no longer bothered the drivers.

Craft recalls another incident which, with hindsight sounds amusing, but at the time certainly wasn't: "I remember trying to adjust the mirror on it once and nearly losing my arm. I forgot that when you put your hand up at over 200 miles an hour, you're likely to find it around the back of the car somewhere."

The T380 ran faultlessly throughout the 24 hours, and while lying in second place overall the team decided to have one last unscheduled tyre change. During this stop the front wheel nut jammed and they took eight valuable minutes to get it free again, losing second place in the process. But third place overall in the world's greatest endurance race was probably more than they, and many others in the pit lane, ever thought possible.

DE CADENET LOLA T380 IN DETAIL

The Lola Chassis Log shows that HU01 was invoiced to de Cadenet in March 1975, and it was supplied as a rolling chassis finished in British Racing Green. Looking under the skin of the Lola, one sees a V8 3-litre Ford Cosworth DFV engine located behind the driver, still mated to its original Hewland DG300 5-speed gearbox.

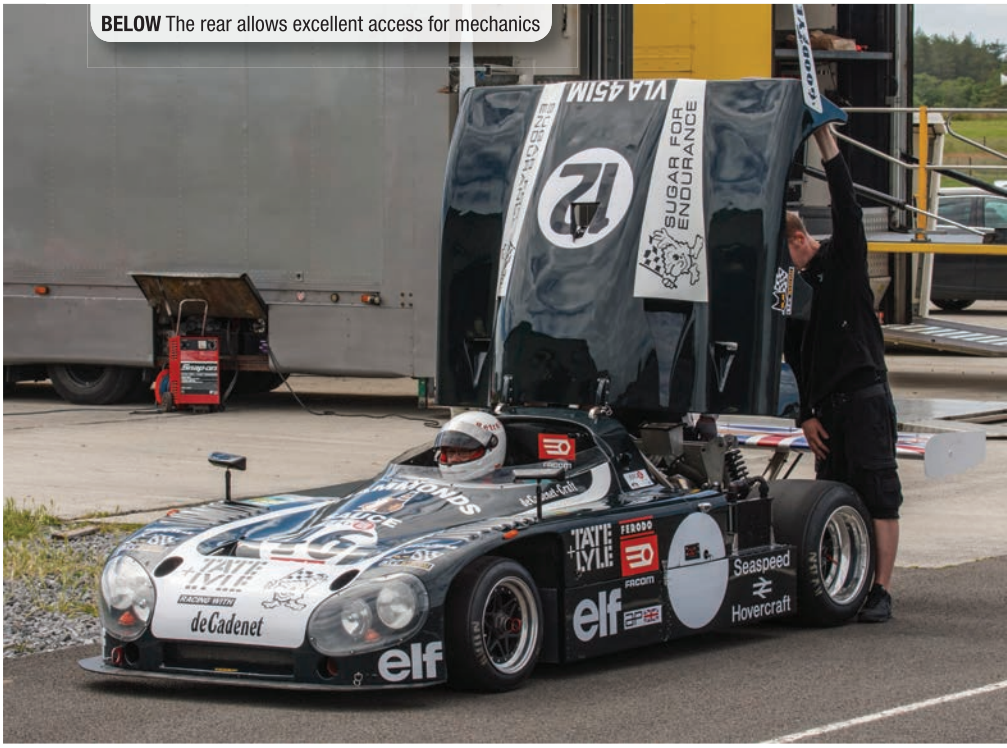
The car is today prepared and maintained by Paul Knapton of Xtec Engineering. "It still had one of the original DFV engines from the 1960s, so when we got the car in 2011 we took that out because we wanted to preserve it," he says. "The car has period cylinder heads on it, but they are second-hand cylinder heads because we wanted to keep the cylinder block, sump, original cylinder heads and cam carriers as a complete unit. We then swapped all the auxiliaries like the oil pump, fuel pumps, metering unit, inlet trumpets and the throttle slides over to the new engine."

When asked how they kept the Lola maintained and competitive on the current Historic scene, Knapton replies, "We have stuck with the original engine specification from 1976, using the same valve sizes and original bore and stroke, and all we have done is built in some reliability. Performance-wise, we have made a few little gains along the way with compression and things like that, but nothing out of the ordinary."

Any work on the engine at a race would require the whole back end to be lifted up, being hinged at its forward edge just behind the driver, but this gave excellent access to all the mechanicals. Perhaps the only potential hindrance to accessing the engine during the race were the two outside rear wing supports that were fixed to the rear bodywork at the one end and to the wing endplates at the other. Once the two 3/8-inch bolts on the wing endplates had been loosened with an air gun, the bodywork could be lifted, and so in practice it didn't slow down the procedure much. The two side plates also provided an excellent promotional opportunity as Greene adds with a smile, "I'm sure that Alain had free Goodyears, or if not free, they would have been cheap!"

The Lola runs with Cosworth pistons as well as a Cosworth oil pump, but it has been fitted with aftermarket Arrow conrods. The car is fitted with a Lucas mechanical fuel injection system, so it has a Lucas fuel pump and metering

BELOW The rear allows excellent access for mechanics



ABOVE The airflow off the hump is an excellent feeder to the rear wing but, aerodynamically, these were innocent days

unit to match this. Knapton adds: "Geoff Richardson (Geoff Richardson Engineering) supplies a lot of our engine parts; he is the go-to man for Cosworth DFV parts."

Today the Lola competes in the Peter Auto series, this is the group that runs the Le Mans Classic and the other Classic Endurance Races. The competitors in these series have Avon A37 mandated control tyres. The car runs very well and is certainly competitive, as Knapton explains, "When we first took it to the Le Mans Classic in 2012, the car's owner shared the driving with Andy Meyrick, a professional driver, and he won the first part of the three-part race. Overall it may have been just a few seconds off the winning Mirage's lap times, but the Lola is by comparison quite a heavy car." The Lola was built to ensure that it got to the end of the Le Mans race, but back in 1976 it was more of a 24-hour endurance event than the sprint race it is now.

When asked why the Lola had inboard rear disc brakes, Greene replies, "It is a design feature to a degree, but the biggest reason is that it is unsprung weight. Outboard discs also sometimes contribute to wheel failures because the inside of a wheel is extremely hot. The discs for Le Mans are pretty big, heavy and wide and the rear discs usually last the whole 24 hours, but we normally change the front discs at midnight." The discs are painted with temperature paint on their circumference. This is so the team can see how hot the discs are at certain intervals. The temperature paint changes colour and each colour represents a temperature code when it changes, which is a useful way of staying on top of disc condition during a race.

It was the Porsche prototypes that brought the *Langheck* to prominence with the 917 LH, and the advantages of this aerodynamic aid were not lost on other teams too. Greene explains, "I'm sure you are familiar with the *Langheck* Porsche with the rear spoiler, well we achieved that with the Lola by putting the wing much lower and also further back, so there is more leverage and less downforce, and therefore less drag. At that time, there wasn't an awful lot known about that aerodynamic stuff, it was trial and error more than anything. The air flow off the shape of that hump was a good feeder to the wing, and there was a good gap between [the body] and the leading edge of the rear wing."

> **"I remember trying to adjust the mirror at over 200 mph and nearly losing my arm!"**

The Lola's suspension is a double wishbone setup with coil-over shocks at both the front and the rear. The anti-roll bar has been drilled with five holes for secure adjustment. It is also essential to nail everything down in the race car as much as is reasonably possible, ensuring that components or panels don't work loose over the 24 hours of racing. A hard jolt when a driver rides the kerb or when he forgets to reset the brake bias in changeable driving conditions, thereby locking a wheel and flat-spotting a tyre, mean the resultant forces felt through the chassis can loosen just about any component or panel on the car. Greene explains, "You only have to flat-spot a tyre when you're doing 200 mph – it will shake the eyes out of your head." With this in mind, the Lola T380 was built for endurance and not sprint racing.

The main sponsor was Tate & Lyle (with the strap line 'Sugar for Endurance' emblazoned down the rear bodywork) and de Cadenet would have done a deal with Elf for fuels and lubricants. Seaspeed probably gave Alain a free ferry trip, and Facom Tools a free toolkit. The Marchal lamps were actually fitted at Le Mans and they were allowed to place a sticker above the lamps. Hammond Sauce was a sponsor that Craft brought to the team.

Finishing in third place overall was a mightily impressive result for a team made up of enthusiastic helpers, all well qualified in their field, but on a budget that was just a fraction of the bigger teams. To finish on the podium at Le Mans where one competes with the best in the world, is to really stand at the top of the motorsport world, and that is what de Cadenet and Craft did on 13 June 1976. Today, 40 years on, this important example of successful British motorsport history is maintained and prepared for battle in the Le Mans Classic race every other year. RT

ORANGE BLOSSOM SPECIAL IS BACK ON TRACK

It is said that old 911s never die. **Glen Smale** tracks down one that has been working particularly hard and still keeps more modern machinery honest

THE Orange Blossom Special is well-known as a sleek, streamlined express train often seen depicted on postcards. But the original train to bear this name didn't start life as a streamlined special, it was in fact an older train consisting of a heavy steam locomotive pulling sleeper coaches through America's southern states.

In the same way, our 'Orange Blossom Special' started life as a humble 1972 Porsche 911 E. Besides benefiting from an extended wheelbase, its most important feature that year was its new, enlarged 2.4-litre engine, which now boasted an output of 165 bhp at 6200 rpm. Little is known about this car's early years, but in the 1980s it was converted into a 911 RSR 3-litre replica for competition use. The car was very successful and won 30 races in its first season, but a few years later it was again sold and unfortunately found itself neglected in the corner of a barn, where it remained for many years.

In the early 1990s, Richard Chamberlain had a chance encounter with the abandoned ex-racer and was eventually persuaded to buy it. Chamberlain prepared the car for the AMOC (Aston Martin Owners Club) Intermarque Championship, and although he was very successful with it, he wanted to boost its performance and so replaced the 3-litre engine with a 3.2-litre unit.

"We thought we would put a turbo on it, so three years later we got the first turbo engine to run properly. We then spent over a year (1997/98) just blowing up engines and not even driving the car, let alone racing it!" Chamberlain laughs. "The only reason we got the engine running properly was because we took it to John Judd, the engine builder. I was concerned because I thought they probably wouldn't want to talk to me, and even if they did, I probably wouldn't be able to afford the bill. But they were brilliant. Yes they were pricey, but it ran perfectly and we didn't put a spanner on it for a year. In fact, they did not alter the engine specification, they just built it and most importantly, mapped it correctly."

Over the years Chamberlain had accumulated a lot of 935 parts which found their way onto the car, and so it became known as a 935. Some success followed, but in the mid-2000s, and still running the 3.2-litre engine with twin KKK turbos, he decided the time had come to "put on some aero" as he casually puts it. A flat floor was fitted that extended from the front wheel centreline to the rear wheel centreline, from where a diffuser stretched rearwards.

'WHAT LOOKED RIGHT' TECHNIQUE!

A flat wooden splitter with a raised centre section was fitted at the front, and the car was given a one-piece Kremer-style 935 K3 nose, while the 993 GT2 rear end featured a full width dual element rear wing. This aero combination had been done by the 'what looked right' method, and as Chamberlain admits, "I suppose unsurprisingly it wasn't very good. The important figure to watch though is the lift-to-drag ratio, so a ratio of 1:1 would mean you have as much downforce as you have drag, and that is very poor. It is actually very easy to put downforce on a car, but downforce can be very expensive in that it creates tremendous drag."

Once the decision had been taken to develop the car's aero, the Chamberlain team used Porsche's Moby Dick 935 long tail as their starting point. The Moby Dick aero package was a low drag one,

ABOVE A full-width rear diffuser with strakes is key to the aero package

All photos: Virtual Motorpix/Glen Smale

ABOVE The 935 flies around Rockingham, for our test day, as if glued to the tarmac

and Chamberlain wanted to combine low drag with additional downforce that was generated from under the car, with the full width diffuser. To achieve this, they looked to the Bob Akin Coca-Cola 935 which was itself modelled on the Kremer 935 K4, and to develop this further by means of state-of-the-art CFD software.

In 2012 Chamberlain did no racing at all, choosing instead to spend the time developing the car further. The following year it was decided that the only way to make the car go quicker was to try and bring its aerodynamics into the 21st century. "With a short wheelbase air-cooled 911, that is quite a challenge, and so everything was up for grabs," says Chamberlain. "We had the car scanned by OR3D in Wrexham, and using two different scanners, they created a 3D image of the car using cloud point data. We then used a 3D CAD package called SolidWorks, but importing it into SolidWorks is actually very tricky, and so my son Matthew, who has a PhD in Robotics, did all of that. This gave him a model of the car as it was, and he could then run his computational fluid dynamics programme using the base model of the car."

With an estimated starting L:D ratio of 1.3:1, the Chamberlain car did have more downforce than drag, but only just. "Matthew had the task to improve that, and he could alter almost everything except the windscreen rake and the front end," says Chamberlain. "Altering the windscreen rake was a huge job and I just said to Matt, 'I want to go racing, I don't want to get involved in this exercise!' I didn't really want to change the front end because it is a very big one-piece moulding, and I just thought that was going to be really expensive."

QUEST FOR FRONT DOWNFORCE

The team changed the front splitter, which had been effectively no more than a piece of plywood with some endpieces, to one that had a proper aerofoil shape with a raised centre section. If any car needs downforce at the front it is the 911, because it lacks any meaningful weight in this area. To aid this, the floor of the Chamberlain 935 was raised slightly. The raised section of the splitter feeds air into a central front diffuser, which exits through two large ports on either side underneath the doors. Apart from the diffuser, the floor – which is fabricated from carbon honeycomb – is flat as far back as the start of the pickup points for the rear suspension.

The 935 is fitted with a full-width rear diffuser with seven strakes. According to Chamberlain this works really well, as he explains, "When the air goes under the car it enters the diffuser, and the cross-sectional area at any point along the diffuser increases towards the rear, as air doesn't like to decelerate. Therefore, in order to fill the diffuser, it has to pull more air underneath the car, and so this works the diffuser harder and speeds up the air underneath the car. If you speed up the air, you reduce the pressure, hence you get downforce on the flat floor."

A critical factor was the positioning of the rear wing in order for it to be energised by the air exiting the diffuser. The wing, which is their own design, is called a twisted cord. The angle of attack can be adjusted, as can the cord width along the length of the wing. Chamberlain explains, "The air that comes over the ends of the wing is relatively clean, but to make the centre of the wing work is quite difficult because the air comes tumbling off the roof. We have raised up the rear window of the car because we are trying to delay the air separation, but nevertheless it is still turbulent."

On either side of the front nose are a pair of diveplanes. As Chamberlain points out, these are quite critical as you can gain or lose a lot depending on their size, angle and shape. He explains, "If you get them to work, they can help to reduce the drag because they clean the air that flows along the side of the car. You generate vortices that seal the bottom of the car to the track, which means that the ▶

ABOVE The slippery lines of the CTR K4 took Porsche's Moby Dick 935 long tail concept as the starting point

ABOVE The switch to Öhlins dampers has helped generate more grip on turn-in

underneath acts solely in pulling the car down, and doesn't act as much in pulling air under the car from the sides. This is also the effect of the side skirts."

On each end of the front splitter are experimental footplates which, in time, will be moved inboard for increased effectiveness as part of a planned winter 'minor' reshape of the front end. Neat fins run up the edge of the front fenders from the nose to the windscreen, and their purpose is to generate vortices down the side of the car. High pressure normally builds up underneath the wheel arches, which contributes to lift, but this air is allowed to escape through the rear of the front wheel arches which is completely open. Slits cut into the top of the front fenders also help to relieve pressure under the arches.

Three air intake scoops are located on each side of the car just behind the B-pillar. The lower air intake is for the gearbox oil cooler, while the middle one is for the engine intercooler. The top air scoops, where the rear quarter lights would be, are the fresh air intakes for the turbos. Some of the air from the front diffuser exits under the door, and to prevent this mixing with the air moving past the side of the car and thereby creating drag, a small 'fence' directs this cool air into the intakes in the rear fenders.

As the car is seen here, it is fitted with a Kremer K3 front end but it has been given two large air exit vents in its upper surface. Air is fed into the front-mounted radiators via the sizeable air intake in the lower nose and these two vents in the bonnet allow the hot air to escape. Around 90 per cent of the air entering the nose intake is for the engine oil cooler, while the lower horizontal section of this intake is split in two, each section feeding air to the front brakes.

All of the improvements to the aerodynamics have resulted in significant additional loads on the suspension, and some comprehensive upgrading was required in this department. The front hubs are updated versions of the original Kremer K3 magnesium uprights, these being fabricated from 7075 aluminium by Chamberlain's company, CTR Developments. The car runs Porsche 917 centre lock hubs, and the bottom wishbones, fabricated by CTR, are fully rose jointed. All the suspension pickup points have been optimised by CTR with the aid of a computer package.

"We did fit Penske dampers initially, but we have switched to Öhlins which we find better," explains Chamberlain. "They use a different principle in damping and they have very low hysteresis, which means there is very little stiction. That enables the car to generate a lot more grip on turn-in."

INCREASED LOAD

The actual layout of the suspension is still the same as the 911/935. Although Chamberlain still has the original genuine K3 magnesium uprights and bottom arms, he chose to replace them due to the age of the magnesium castings, and the fact that today they are generating so much more load. "Interestingly, we do use the genuine 935 K3 steering arms,

and they still have the part numbers cast into them," he adds.

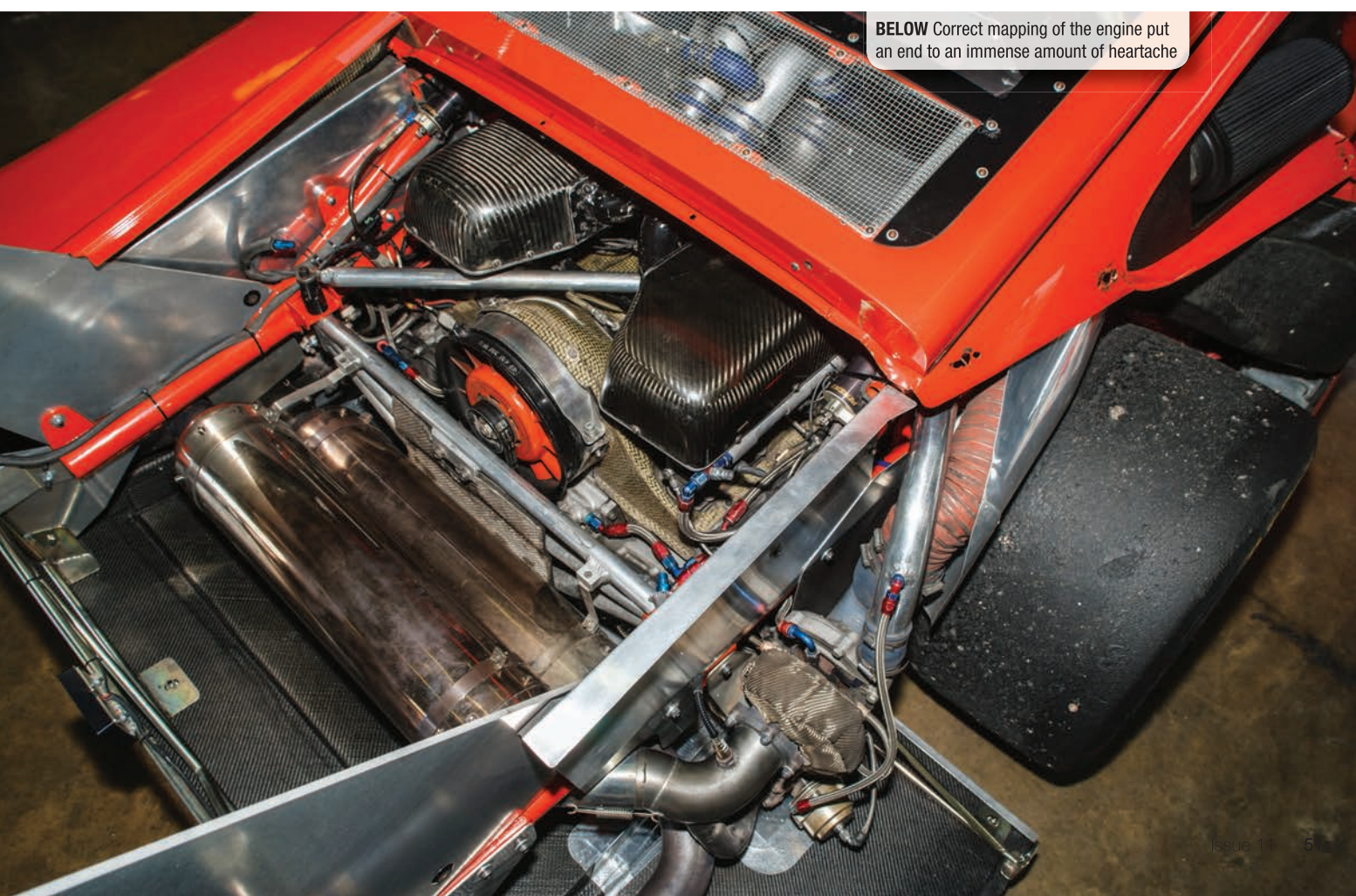
The wheels are forged with magnesium centres, but where the standard 935 used 16-inch diameter on the front and 19-inch on the rear, Chamberlain uses 18-inch all round today. This is dictated by the availability of race rubber, but they vary the tyre's width slightly depending on the circuit. Pirelli tyres are mandated in the GT Cup, but generally they use 11-inch on the front and 13-inch on the rear. The fuel tank is a full FT3 Kevlar bag tank by ATL and has five internal fuel pumps, consisting of three lift pumps and two pressure pumps.

The CTR K4 uses 930 Turbo rear arms which are the basic RSR centre lock axles with hubs, but the trailing arms have been machined to take bigger wheel bearings. The driveshafts are bespoke motorsport items from GKN. The Öhlins dampers are four-way adjustable and have a blow-off valve, so if the car hits a kerb, it blows off through the valve and doesn't launch the car into the air. The suspension travel on all four corners is monitored and logged. The logging data is time and position synched to the track position so the team can see what the car is doing at any point on the circuit. Linear displacement potentiometers are used to do this, as it helps with the setup.

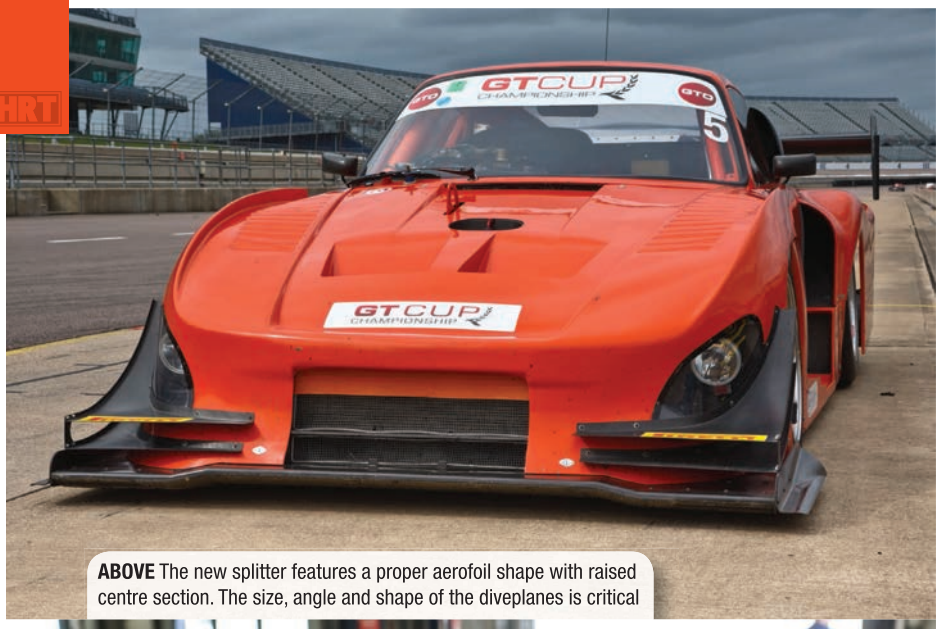
The suspension pickup points are completely different from the standard 930, and again these vary depending on the track. "If you raise the pickup points you get less squat and less traction, but it changes direction better so we fiddle around with that on different circuits," Chamberlain says.

Here is where lessons learned over many years of racing come into effect. The car has a bespoke rear anti-roll bar which runs above the trailing arms, whereas on a standard 911 and 930 they ran them at the bottom. Chamberlain again: "Because we have the diffuser we couldn't run the anti-roll bar through the middle of the diffuser, so we raised it so ▶

ABOVE The 'what looks right' technique for improved aero was replaced with a more scientific approach. The car was scanned to produce a CAD model as the starting point for investigation with CFD



BELOW Correct mapping of the engine put an end to an immense amount of heartache



ABOVE The new splitter features a proper aerofoil shape with raised centre section. The size, angle and shape of the diveplanes is critical

ABOVE Attention has been paid to making the centre of the adjustable rear wing work properly

as not to disturb the airflow."

The rear wheels are driven through a Hollinger six-speed sequential gearbox with a Geartronics full paddle shift system. While the clutch is a triple plate AT unit, the flywheel is made by CTR Developments. The 935 is fitted with power steering and it also runs with Bosch Motorsport ABS, which is fully adjustable for the amount of slip needed.

Air is collected by the air scoops and fed via K&N filters into the turbos. The 935 runs two full race Garrett GT 35 turbochargers, each fitted with their own intercooler. The turbos are supplied by AET while the intercooler cores are manufactured by Marston, an aerospace company. Each side of the engine has its own intercooler and the team aims to get the air intake temperature down to no more than 15° above ambient. The exhaust manifolds are made from Inconel by BTB.

The cooled air from the intercoolers is fed into the engine via a carbon plenum, one on either side, through individual throttle bodies into the cylinder head. The heads feature larger intake and exhaust valves with twin plugs. The pistons are bespoke to CTR and are made by Omega and fitted with Carrillo conrods, and these run in cylinders by Capricorn. The crankshaft is an original Porsche item, while the bearings are standard Glyco products. When questioned on the valve sizes, Chamberlain is a bit protective, saying, "It is a bit of a black art. People think the bigger the better, but that is not necessarily true. They are larger than standard, but the secret is in the valve shape and the valve seat shape." Engine management in the 935 is by MoTeC M600.

The compression ratio is quite low at around 7.5:1, but as Chamberlain shares, "We could run over 8, but then we would have to be much more careful with our mapping and use different strategies, because we don't run with knock control." Work was done to change the oil squirters that cool the pistons, and an O-ring groove machined in each cylinder to stop oil leaks. Some of the webs have been machined to accommodate the larger oil pump. The car uses fully synthetic Castrol 10/60, and for the gearbox the team uses Swepco.

PAINSTAKING PREP

The crankcases are Porsche 930, but each one undergoes 45 hours' worth of prep to turn a standard road car crankcase into one suitable for a 935. "We use a different form of shuffle pinning, so we pin both halves of the crankcase together but we don't use dowel pins like most people do, we have copied the old Porsche RSR method of using very special through bolts which go into housings either side, so it really holds it very well," Chamberlain explains.

Pit garages are notoriously draughty and cold, and last September morning where the Chamberlain 935 was undergoing tests at Rockingham Speedway, was no exception. But once the engine was fired up, all thoughts of how cold it was were soon dispersed by the rush of that flat-six. Running at 0.8 bar the engine develops around 530 bhp at 7200 rpm. "Although the rev limit is around 7800 rpm, at somewhere like Spa, we run the engine to 8300 rpm in sixth gear because it is pulling a lot of mph and it is just not worth changing the gear ratios. The engine is safe to 8500 rpm though," Chamberlain smiles knowingly.

That day at Rockingham was just a test, and so the pit sessions were spent adjusting the suspension and other settings. But out on track, the strikingly orange 935 was a pleasure to watch as Chamberlain navigated his car around the circuit as though it was glued to the tarmac. It is little wonder that this 935 is able to mix it with the Ferrari 458s and McLarens at the front of the field in the GT Cup Championship! RT

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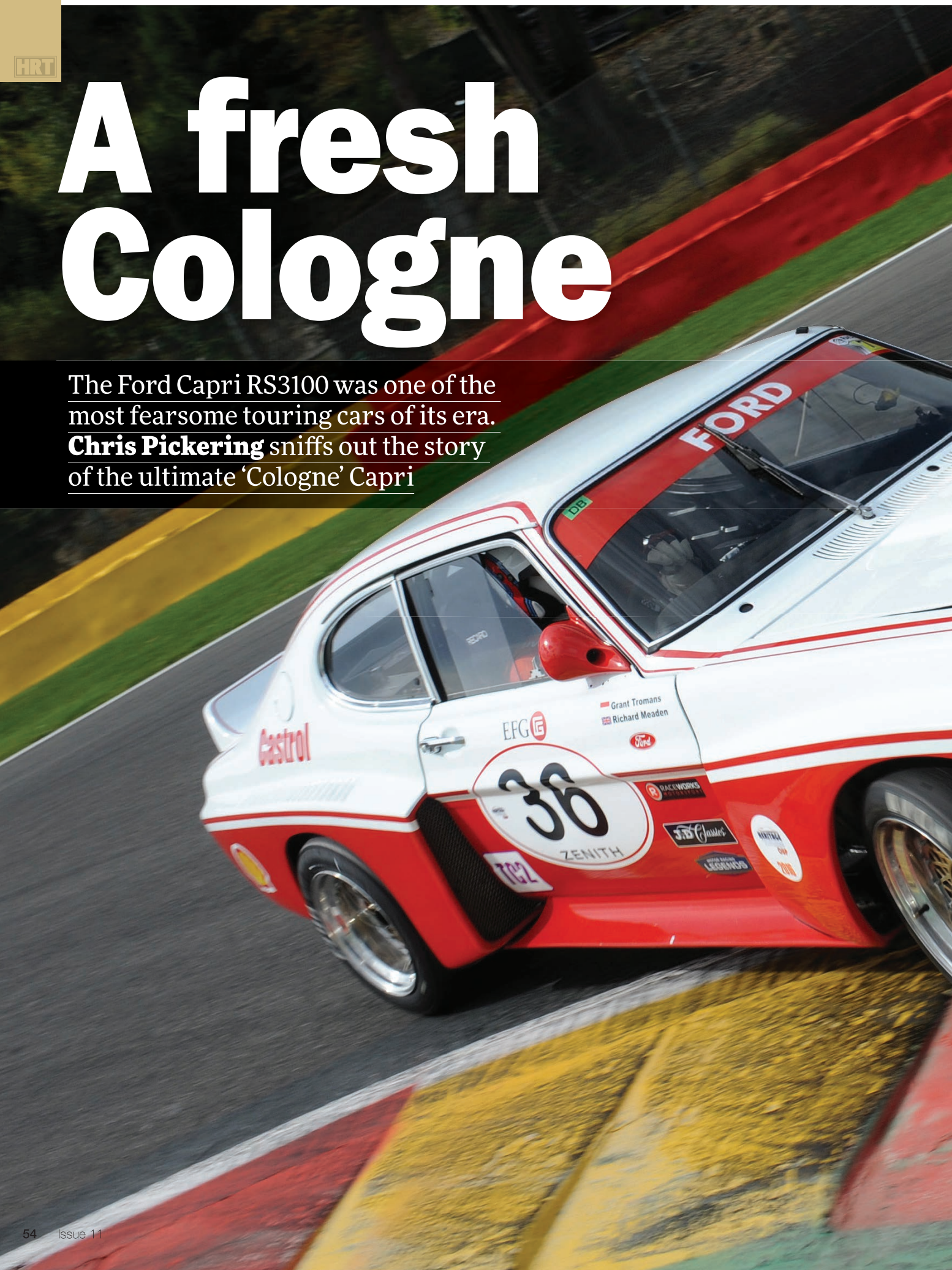
A fresh Cologne

The Ford Capri RS3100 was one of the most fearsome touring cars of its era. **Chris Pickering** sniffs out the story of the ultimate 'Cologne' Capri



THE first half of the 1970s saw Ford locked in an epic battle with BMW for the European Touring Car Championship. Formula 1 stars like Niki Lauda, Jackie Stewart and Jochen Mass traded blows on the track, while some heavyweight engineering talent pushed a rapid programme of development behind the scenes.

Both teams pulled out all the stops for the 1974 season, with the ultimate works Capri, the RS3100, going up against the spectacular 3.0 CSL 'Batmobile'. Later that year the oil crisis hit, forcing both manufacturers to scale back their efforts. It means the 1974 machines can justifiably claim to be the ultimate seventies touring cars, and they're now actively supported by a number of historic series, keen to tap into the glamour and excitement of the era.

Only three competition-spec RS3100s ever actually left the works. The car you see here, owned by Grant Tromans and co-driven by Richard Meaden, is as close as you're ever likely to get, having been painstakingly built to full works spec in 2011 by Ric Wood Motorsport.

With a few exceptions for modern safety equipment it follows the same Group 2 regulations as the works cars did in-period. It started life as a ▶

ABOVE The glamour of the seventies recreated with the Capri RS3100, painstakingly built to full works spec

Jeff Bloxham

Mk1 Ford Capri 3000 GXL, which used essentially the same steel monocoque as the RS3100 homologation specials. Just as with the original works cars, however, a fairly substantial portion of the structure has ended up being cut away, starting with the entire rear section of the floorpan that's been re-engineered to take a Watts linkage and a four-link axle.

"Effectively the RS3100 is a Group 4 Escort in long wheelbase form with a bigger engine," comments Mike Purse, director of Raceworks Motorsport that now runs the car. "The whole rear structure with the floorpan modifications and the suspension linkage is more or less the same."

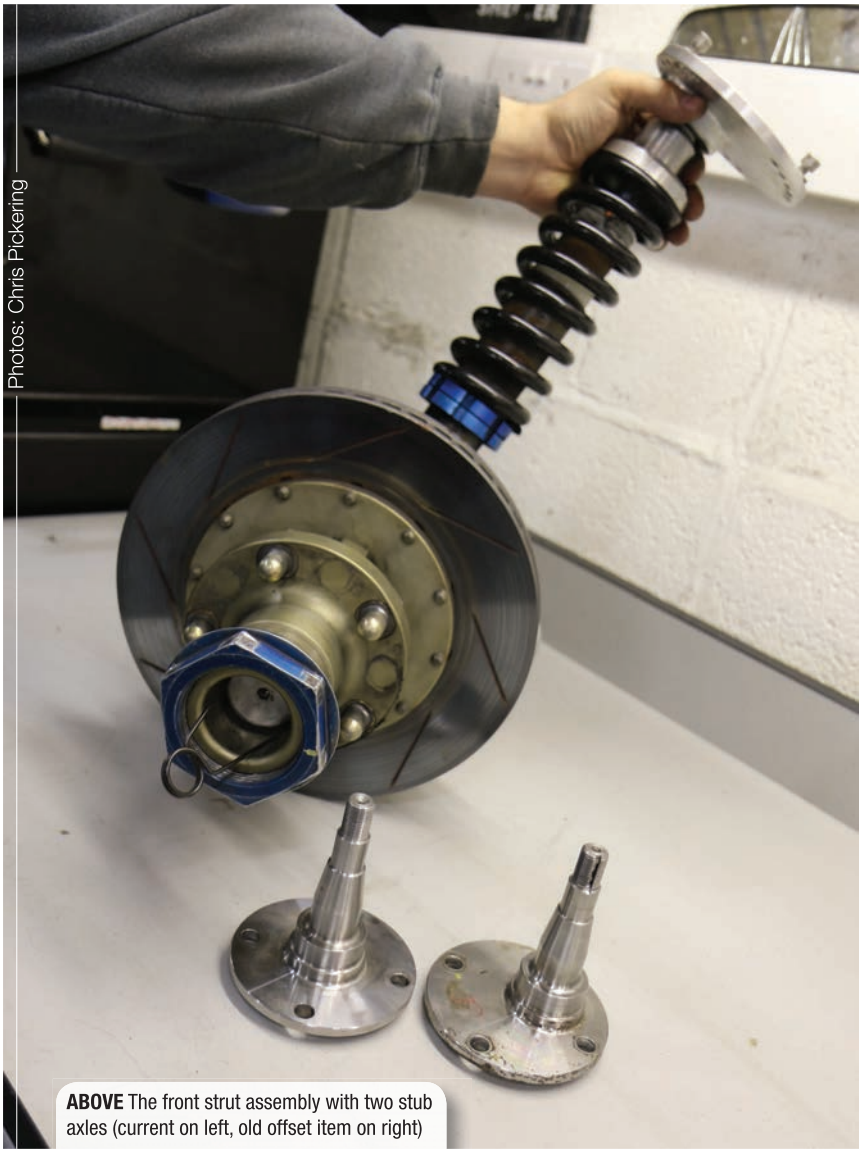
At first glance, the ubiquitous Ford Atlas rear axle looks quite small; almost dainty. But Purse assures us it's anything but when you try to lift it. Inside, there's a beefed up limited slip differential and hardened driveshafts, but the fundamental design is basically the same as that used on a multitude of Escorts and Capris. At present it doesn't even run a differential oil cooler, but the plan is to add one for 2017, alongside one for the gearbox.

The towers for the Watts linkage are welded to the rear chassis legs. At present there's little in the way of triangulation, and at the last round of 2016 the loads actually succeeded in rippling the floorpan. The plan is to re-skin it during the off-season and add some additional reinforcement, which opens up a degree of freedom with the geometry.

"We can only do what was done in-period, but the rules [regarding the axle linkage] were essentially free," Purse explains. "If you look at the papers for the Group 2 Escort we run, Ford had homologated half a dozen different links but they were all subsequently crossed out because they didn't actually need to be homologated. The good thing about that is that it gives us an indication of the various geometries they tried at the time."

The RS3100 was a very different beast to the Capri RS2600, upon which it's loosely based. Much like their arch-rivals at BMW, the Ford engineers in Cologne studied the Group 2 rules and pushed everything as far as they could. And in some cases somewhat further.

"We keep hearing about bits and pieces that were done in-period that we couldn't do now," says Purse. "For instance, the works cars allegedly used water-cooled brakes at one of the rounds in 1974, but they were never homologated to do so. The regulations are essentially unchanged from when the cars originally competed, but the scrutineering is a lot better these days and the view is that anything that constituted cheating back then also would do now."



Photos: Chris Pickering

ABOVE The front strut assembly with two stub axles (current on left, old offset item on right)

One of the most spectacular pieces of gamesmanship in Ford's apparently liberal interpretation of the Group 2 rules was the rear springs. The regulations at the time stated that all cars had to retain the standard spring configuration – which in the case of the Mk1 Capri is a pair of very ordinary steel leaf springs. However, some bright spark hit upon the idea of introducing 'additional springs' to the telescopic dampers, turning them into coilover units.

A pair of plastic leaf springs – adding little or nothing to the overall suspension stiffness – was then stuck on for the sake of legality. Amazingly, the organisers allowed it, and since this is a well-documented period mod it continues to be used today. By now the teams have abandoned the pretence of the plastic springs, however, simply running a coilover setup.

THE BICEP BUILDER

On paper, the Group 2 Capris share their MacPherson strut front suspension layout with the road cars, but there are virtually no carryover parts. Lighter, tougher struts are used, filled with racing damper cartridges. These were Bilstein in-period, although the Raceworks car now uses Konis, paired with Faulkner springs; the same goes for the rear coilovers.

The uprights, meanwhile, are aluminium castings, modelled on the magnesium items used on the original ▶

ABOVE The interior is a no-nonsense affair, much like the car itself

ABOVE The oil tank filler hidden in the petrol cap is a neat touch

ABOVE The rear axle is relatively standard apart from uprated diff and driveshafts

ABOVE The original hub and top mount designs made the steering a real workout

works cars. At the bottom they're secured by a cast aluminium control arm and an additional tubular steel rod, which provide far better location than the road car's rather spindly single link.

Apparently the Capri is every bit as physical to drive as its steroidally-enhanced looks imply. "If you look at drivers who raced these things – people like Jochen Mass – they were built like wrestlers. And of course they were paid to do it," comments Purse. "We find it needs two people to turn the steering if we're manoeuvring it."

> **"Engineers pushed everything as far as they could. And in some cases somewhat further"**

Some teams have experimented with bolt-on power steering systems, but recently the organisers have clamped down on these, pointing out that they were never fitted in-period. Without that option, Raceworks has spent a substantial amount of time trying to engineer a more manageable steering setup without compromising the handling.

"We've probably halved the steering weight over the time we've had it," comments Purse. "It was originally built with works-spec components on the front suspension, which included offset stub axles that effectively increased the castor angle. The original top mounts also moved the top of the damper forwards and inwards to increase camber and castor. In total it was running about 10 degrees of castor, which you might get away with if you didn't have a great big chunk of engine sitting over the front wheels as well."

The Raceworks engineers have reverted to a more conventional hub design that removes the offset from the stub axle. They've also designed new top mounts, which reduce the camber and castor. All in all, it's helping to make the car more comfortable to drive for full race distances, but it remains a very physical experience.

"We knew roughly what lap times the car would do with the original geometry, so we were able to ensure that the changes weren't costing us too much in terms of performance," says Purse. "But you can still see the exertion on the drivers when they get out."

The other great challenge on the Cologne Capri is getting the braking right. Not only is it relatively heavy at circa 1,250 kg, but the vast majority of this weight lies close to the front wheels. A number of different disc and calliper designs were tried in-period, including a heavily finned 8-pot calliper nicknamed The Armadillo, which covered approximately half the disc.

Another novel feature rumoured to have been used on the original works car was an electro-hydraulic brake servo. Ironically, brake manufacturer ATE is thought to have co-developed the system with BMW for a road car application. While there's plenty of anecdotal evidence to support this, there's nothing in the original homologation to confirm it. Faced with a potential minefield when it comes to scrutineering, Purse has elected to go with an unservoed system.

The current setup uses an AP Racing ▶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closed-back calliper, similar to that found on a lot of sports racing cars of the period, with grooved and vented AP discs, plus CL Brakes pads. Raceworks has been experimenting with ways of improving heat dissipation, including a range of different materials for the backing plates and pistons, plus a variety of air scoop designs.

A switch to Castrol React SRF brake fluid helped to improve matters, as did a new Tilton 900-Series pedal box, but it remains an uphill struggle, says Purse: "You're trying to stop something that's got the same weight and rather more power than a modern touring car with brakes that are half the size. The airflow to the brakes isn't great, either. We have to retain the homologated front bumper, which means we can't enlarge the vents, and we're limited on the size of the ducting due to the wheel clearance."

This is very much an on-going challenge. The car retired from its first three rounds in 2016 due to brake temperature issues, having set or come within a few tenths of pole in every single case. Since then it has won virtually every event it's finished.

"We've been trying to push the brake bias back to help matters. We're trying to get as much temperature as possible into the rears, but there's so little load on them that they just end up locking," notes Purse.

LOOKING SERIOUS

The RS3100 emerged at a time when aerodynamics was starting to trickle down from Formula 1 into other areas of motorsport. Period photographs show that Ford experimented with various different aerodynamic devices, including a variety of rear wings and front splitters.

For the first few rounds of 1974 the radiators were mounted right at the back in an attempt to counterbalance some of the weight of the engine. There was even a primitive rear diffuser. Neither concept proved robust enough for the rough and tumble world of touring car racing, however, so the radiators were moved forwards to the front of the rear arches and the diffuser quietly abandoned.

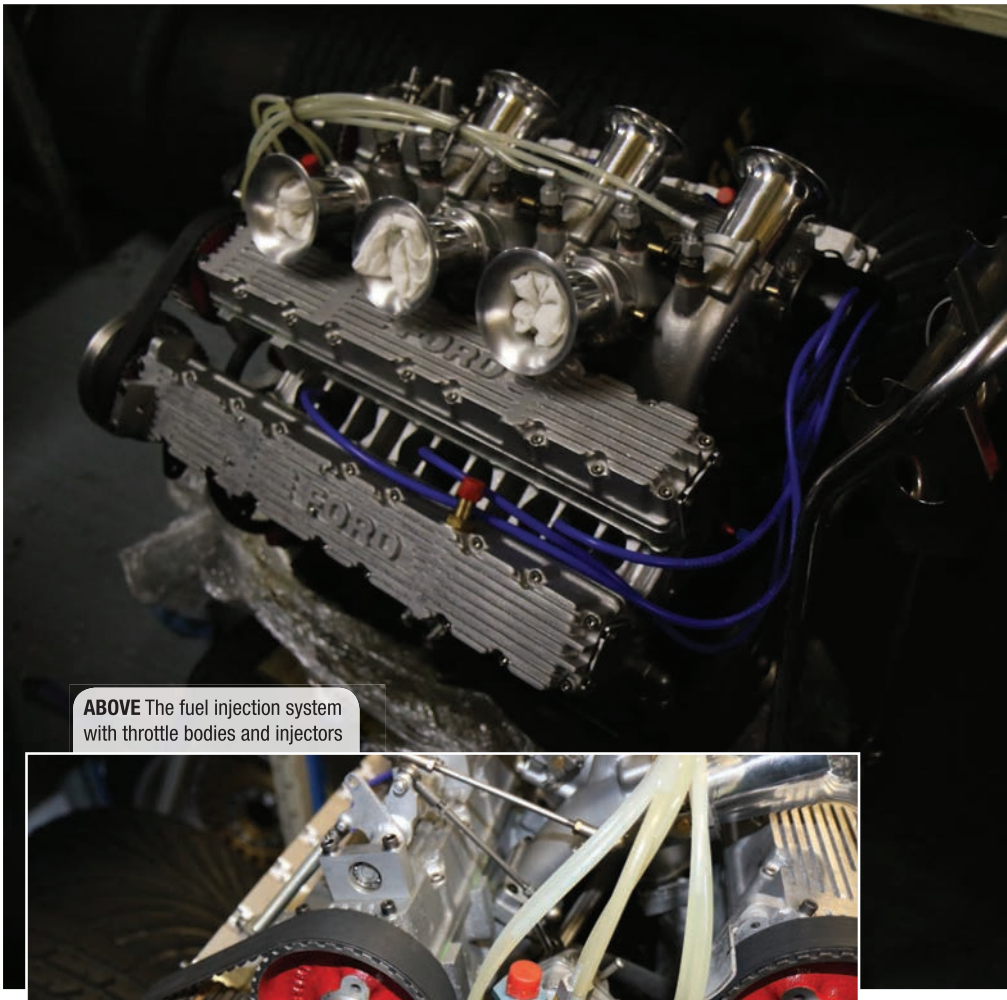
This being the seventies, even the Capri was wearing flares, so much of the steel in the road car's front wings was removed to make way for those giant fibreglass arches. "The rules state that you have to run steel wings with fibreglass extensions bonded on," says Purse. "Legend has it Ford was actually using fibreglass wings with a small strip of steel bonded in where the scrutineers checked. That wasn't cheating as such; nobody really specified how much of the panel needed to be steel and how much could be fibreglass, but for 2017 the FIA has said that it needs to be halfway down the flat section of the panel. Ours was pretty close already, but we've got some acid dipped steel wings ready to be bonded onto the fibreglass section for next season." ▶

Jeff Bloxham

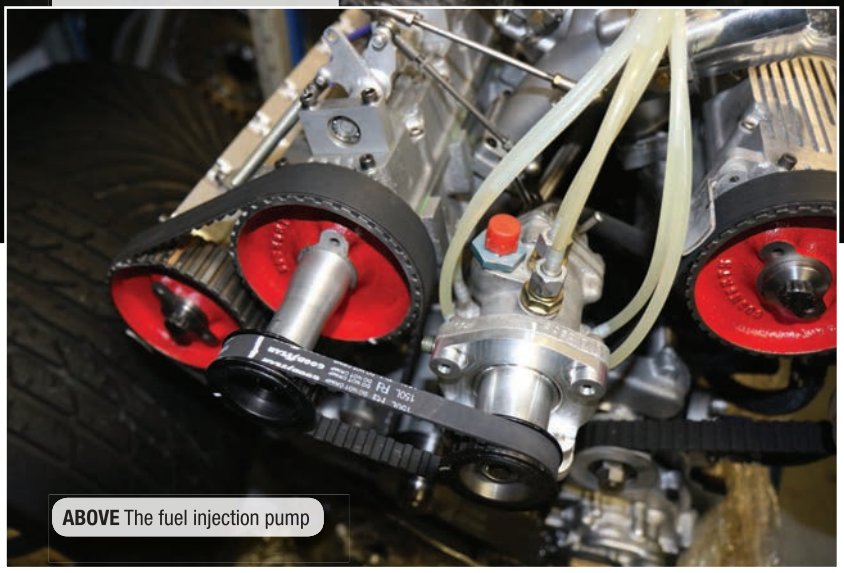
ABOVE Ford moved the radiators to the rear arches to improve weight distribution

Believe it or not, the RS body panels can be found as off-the-shelf components. Care needs to be taken, however, as some of the parts in circulation were reputedly moulding off a non-homologated car. Again, with the recent clampdown the FIA has picked a definitive specification for things like spoiler height and wheel arch width.

"There's a more active interest in scrutineering these cars now the values are going up," notes Purse. "Until recently you noticed quite a wide range of different rear spoiler heights, for instance, if you walked up and down the grid; the same with size of the side skirts and the front apron."



ABOVE The fuel injection system with throttle bodies and injectors



ABOVE The fuel injection pump

THE BUSINESS END

The heart of the RS3100 is undoubtedly its engine. Its predecessor, the RS2600, used a Weslake-built development of the 2.6-litre Ford Cologne V6, stretched to nearly three litres in its ultimate incarnation. The RS3100 competition engine, on the other hand, was engineered by Cosworth, based on the Ford Essex V6 produced in Dagenham. Quite why the same manufacturer had two such similar engines competing against each other in its range is anyone's guess, but Ford continued this policy for well over a decade.

The Essex V6 was bored out to 3.1 litres for the road-going RS3100 to enable the competition car to compete in the Over 3-Litre class. Cosworth then took the engine and squeezed as much additional capacity out of it as the ETCC rules would allow to create a 3,412 cc unit known as the GAA. Officially it used the same block as the Essex-engined road cars, but in reality little other than the bore spacing remains. In place of the two-valve-per-cylinder, cam-in-block configuration of the production engine, the GAA has four belt-driven overhead camshafts operating 24 valves in a pair of bespoke aluminium alloy cylinder heads.

Initially, Lucas mechanical fuel injection was used, with a set of six individual butterfly-valve throttle bodies (in contrast to the slide throttle layout that Cosworth favoured for its F1 engines at the time). This was used in conjunction with a transistor-based Lucas Rita crankshaft-triggered ignition system. Later Ford switched to Kugelfischer mechanical injection, which means both are now eligible in historic racing.

The engine in the Raceworks car was prepared by original builder Ric Wood, who's one of the acknowledged experts on Ford Essex race engines. Aside from minor changes to the reciprocating components to improve reliability, it's an exact copy of a works GAA. For the 2016 season it ran on the Lucas system, but Purse and his colleagues are currently in the process of swapping over to Kugelfischer in search of better drivability.

"It's an absolutely mighty engine," comments Purse. "In comparison to something like a DFV or a DFC the GAA only had minimal development, so goodness knows what they'd have ended up with if they'd continued developing it into 1975 and beyond. In its current incarnation it's good for about 470 bhp, but I'm told the Lucas system makes it feel a little bit like driving a two-stroke at the moment. You have nothing for the first 7,500 rpm and then 1,000 rpm of sheer terror!"

One of the benefits of the Kugelfischer system is that it offers far greater tuneability. Inside the pump there's a rotating camshaft, which controls the fuel flow to each injector via a set of plungers. The clever bit is the inclusion of a second '3D' camshaft, roughly conical in shape, which limits the travel of the plungers (and hence the quantity of fuel

> **“You have nothing for the first 7,500 rpm and then 1,000 rpm of sheer terror!”**

that’s delivered). This camshaft doesn’t rotate continuously, but its axial position is controlled by the throttle linkage, while its rotational position is controlled by the engine speed. As a result, the engine can – in a very literal sense – be re-mapped by changing the contours of the cone.

Kugelfischer specialist Lucas Developments has been tasked with creating the new cone. The company has developed a ‘drive-by-wire’ injection pump, which it uses as a development tool during calibration. Here, the plunger positions are controlled by a set of stepper motors, allowing them to be modified quickly and easily. Once the ideal fuelling map has been identified it’s reverse engineered to create a 3D CAD model of the required cam, which is then CNC machined from solid and fitted to the original mechanical pump.

OLD RIVALRIES

Top of the Raceworks to-do list for 2017 is continued development of the brakes and suspension. Purse is also keen to shift the weight further back if possible.

“We’re trying to do what Ford was doing in period,” he says. “Ballasting is not really an option; the car has a lot of fibreglass on it already, so we can’t make the front end any lighter, and we’re about to add more steel in exactly the wrong place. We’re not allowed to move major chunks such as the engine and gearbox either, so we’re having to look at other things.”

Part of the plan is to fit a redesigned fuel cell from Advanced Fuel Systems further back in the chassis, while the oil tank for the dry sump system is being relocated to the boot.

Setup development is also an on-going process, with extensive computer simulation used to find a baseline. This may sound rather extravagant, but it’s actually a very cost-effective way of doing things, says Purse: “Going through this route we can generate a theoretically optimal setup before we even get to the track. We then use that – or as close as we can get once you throw in practical issues like wheel arch clearance – as the baseline for real-world testing. It saves us hours and hours of experimentation.”

This season the car will be returning to the Heritage Touring Cup (HTC), organised by French promoter Peter Auto. It’s very much an international series, with rounds right across Europe – many of which are held on the same circuits that the cars visited in their heyday. It competes in the top-spec TC2 category, which is turning into a formidable class with some very serious machines. To put things in perspective, this Capri is around 20 seconds a lap faster at Spa than the quickest of the Lotus Cortinas in the Under 2-Litre Touring Car series.

Ford is one of the best supported makes in the HTC currently with several Capri RS2600s, a small army of Escorts and at least one very rapid Mustang. The last round of the 2016 season saw a strong showing from the BMW 3.0 CSL of Dominik Roschmann and Richard Shaw, however, and there are rumoured to be several other Batmobiles undergoing preparation for 2017. That raises the tantalising prospect of an RS3100-spec Capri once again going head-to-head with the cars it was designed to beat. And that promises to be quite a spectacle. HRT

ABOVE & BELOW Ford experimented with various different aerodynamic devices, including a variety of rear wings

ABOVE The WOSP range of brand new high output, lightweight, gear reduction starter motors are fully manufactured in-house and are completely adaptable to individual requirements

Hive of activity

Sebastian Scott

WOSPerformance (WOSP) has been manufacturing bespoke starter and charging systems since the 1980s. As well as an extensive and rapidly-growing range of replica starter motors, its latest innovations are being driven by the demands of race car manufacturers and engine designers that continue to push the boundaries in striving for a lower centre of gravity and higher revving engines.

In some cases, engines can be dry-sumped to the extent where they're being used to support crank bearings, while running a flywheel that's so small it doesn't exceed the lowest point of the power plant. WOSP is now witnessing growth in very complex drop gear starters that are capable of cranking a ring gear far narrower than the width of the engine block.

Catering for a vast range of cars including the MG Metro 6R4, Bugatti Brescia, Cooper Maserati, Ferrari 312B3, Honda Accord Super Touring Car, Jaguar XJR11 and Matra 650, WOSP continues to be a leader in the world of bespoke starter and charging systems.

With the racer in mind, it has designed and developed a wide range of starter motors, alternators, dynators – alternators disguised as dynamos, distributors and electric cooling fans. Housing a fully-equipped CNC machine shop, WOSP boasts large stocks and short lead times and continues to attract the attention of customers such as Aston Martin, Cosworth, Dallara, McLaren, Jaguar and Renault Sport, while also supplying to the leading names in the classic car restoration and race preparation market.

WOSP continues to charge ahead with its range of dynators with more than 120 models available in both 6V and 12V positive and negative earth, nor does it require modified wiring other than bypassing or using an existing external regulator as a junction box. Claimed as the most "authentic and reliable" on the market, and supplied with correct drive and period pulley in most cases, they can be considered as an ideal upgrade for boasting outputs up to 175A.

Complementing the dynator is WOSP's regulator box that is internally switched and fused so that it can continue to run with original wiring without the need to change any positioning to retain the correct appearance. In the eventuality of needing to bypass the ammeter, because of powerful outputs relative to the original items they are replacing, WOSP also has a special 52 mm classic ammeter reading from -25A to +25A. The charge is in fact four times the dial face reading so the passengers can be fooled as well as the mechanics. HRT

Autosport Bearings and Components

Autosport Bearings and Components (ABC) prides itself on exceptional service thanks to its enriched technical knowledge. **Seb Scott** reports

THE UK-based company is known for its expansive stock of rod ends and spherical bearings claiming that it has unrivalled expertise on these products.

Time is a commodity that ABC places a great value on, with the bearing specialist aiming to assist a customer with their respective project and with the least amount of fuss possible. Full expert technical advice is available over the telephone, keeping in line with its "least possible fuss" ethos.

"We had a project on a Lancia LC2 Group C race car," explains sales manager Lee Sinclair. "The original bearings for the car just didn't exist at all. Every bearing on the car was a special case - we reproduced the bearings and were able to increase the life of the originals that they were still running.

"We have also worked on various projects with old Formula 1 cars. For instance, Brabhams, Marchs and McLarens have always had special bearings on them. Everything was always a special on them, and an off-the-shelf bearing was never used – we've had times where we have had to make specials for those as well.

ABOVE A special OLD rose bearing from a 1977 McLaren M24 Indy Race Car – the rod end in question had a 11/16 UNEF thread with nothing similar being produced for nearly 30 years

"As long as we get the correct information over the phone then we can create a bearing specification to produce a bearing for a customer. Thankfully a rod end is quite a simple object as it consists of a threaded shaft with a hole on the end. However, an over-the-phone order is dependent on the correct specification being provided. If we can't produce it, if there's not enough information available or a customer is not confident in what they're telling us we just require a sample to use as a pattern to then reproduce the bearing or improve it."

ABC offers like-for- like replacements on historic racing bearings as it maintains a variety of bearings in production where they have original manufacture has been ceased for a long time.

"If there is a rod end bearing from the 1960s with a BSF thread, we are now producing that rod end bearing so that it looks and performs the same but it is made by ourselves," adds Sinclair. "Where we can't do that or the cost doesn't make it viable, we can provide a better specification than what was originally available too."

Sinclair details that a common trend with historic cars is that a metal-to-metal type bearing liner is used, he recommends moving to a higher strength, self-lubricating liner. It can upgrade the material of the rod end if the original is carbon steel. The company uses stainless steel instead and, depending on the age of the car and the original manufacturer, ABC usually upgrades most to NMB bearings which produces a lot of bearings for the Formula 1, LMP and WRC market. HRT

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Pre-War Lagonda Water Pumps

Sebastian Scott

VINTAGE Parts Supply specialises in the preparation, component supply and restorations of Bentley, Invicta and Lagonda cars. However, as there's a depleted availability of serviceable pre-war Lagonda water pumps and a lack of spare stock available, the solution has been to turn to re-manufacturing, which led the company to Performance Projects.

The quality of information available for producing constituent parts varied considerably, from worn or damaged components through to full drawings. Even castings and drawings didn't prove sufficient for use with modern manufacturing methods such as CNC machining or additive manufacturing, because of the lack of CAD models needed before manufacturing could commence.

With a number of customers requiring Lagonda water pumps and having a range of used units as the basis for reverse engineering, Vintage Parts Supply worked with design and engineering specialist Performance Projects to resolve the original pumps and supply designs in a format suitable for efficient manufacture.

The brief was clear: design replacement Lagonda water pump assemblies that look and perform exactly like the original units, while allowing owners to enjoy their cars without the leakage and durability issues. The design had to use a body, cover and impeller derived from the original casting, but incorporate a new shaft, seal and bearing pack arrangement.

Performance Projects re-engineered the pump to include a modern mechanical water seal, replacing the greased plain bearing/bush arrangement with sealed ball bearings located on the 'dry' side of the assembly. The original brass impeller is now fitted on a stainless steel pump shaft for corrosion resistance, assembled with a gland nut profiled to maintain historic aesthetics. Meanwhile the external threads on the pump maintained the original specification and use of the pre-war family of fasteners.

A set of computer models, detail drawings and assembly drawings, including the bill of material and assembly instructions to ISO standards have been issued for each variant of pump. Supply of comprehensive computer models and drawings in electronic format has enabled quotation and supply from the widest range of high quality and cost-effective manufacturers without high overheads. The process also means that the designs can be re-used with the minimum of support once new stock has depleted and the next batch is required.

As a result of the work, Vintage Parts Supply is able to provide high quality pumps that resolve the leakage and corrosion concerns of the originals, but with the period look and performance expected by discerning customers. HRT

BELOW A set of computer models, detail drawings and assembly drawings to ISO standards have been issued for each variant of pump

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HB Bearings keep Group B rally cars running

Sebastian Scott

THE MG Metro 6R4 Group B rally car, and the Ford RS200 were both outstanding rally cars of the 1980s and remaining examples are keenly collected today. As with many historic cars even of this late age, finding replacement parts is becoming increasingly difficult.

Wheel bearings are a typical example where existing stocks are drying up or have become obsolete altogether.

Both the MG Metro 6R4 and the Ford RS2000 were originally fitted with a SKF bearing reference 449133E which has long since been out of production and is hard to obtain. However, an HB Bearings replacement (ref, HB103693) has been available, ex-stock for some time.

The quality of bearing steel has come a long way since the 1970s when the originals were first manufactured and much cleaner steels are now employed in the HB version. In addition, the nylon cage has been replaced with a much stronger one-piece machined bronze cage. The bearing benefits from being manufactured on highly accurate Swiss CNC grinding machines and with quality control inspection on a CNC coordinate measuring machine.

Bespoke bearing designs can incorporate non-standard sizes, clamping flanges, anti-rotation holes, ceramic rolling elements, and material upgrades, which means these bearings can be designed to deal with high levels of performance. Features such as these means that HB's bearings are used at the highest levels of motorsport such as in Formula 1, MotoGP, the World Rally Championship and various touring car championships. An example of this, is the special bearing made for Padgetts Racing Team's 1993 classic Honda, winner of the 2016 Isle of Man Classic 250cc TT. HRT

LEFT An HB Bearing replacement for the original SKF bearing has made it easier to keep cars like the MG Metro 6R4 on the road

Think outside the Box

Sebastian Scott

GR-BOX was formed in 2014, born out of Davide Cesarini's and Maurizio Colonna's 15 years of experience in motorsport. Labelled as industry leaders in supplying historic and competition parts, the company builds historic rally, race and road car transmissions, specialising in ZF S5-18/3 gearboxes that are predominantly used on most Group 1,2,4,5 works cars.

GR-Box's first gearbox was created by Cesarini and Colonna in 2011 for the latter's Ford Escort RS1600. Every part was carefully selected and tested to ensure maximum reliability, resulting in an overall win for the car's first outing.

BELOW The first GR-Box transmission was seen in company co-founder Maurizio Colonna's Ford Escort RS1600

The company is highly recommended for Ford Escort Mk1 and Mk2 preparation in Italy, from supplying complete transmission kits to a Pinto engine to preparing full-spec rally cars.

The Italian company produces FIA homologated gearboxes due to adhering to the same rules used in the 1970s. The company is also capable of building ZF gearboxes without needing to use a customer's existing transmission and it can supply a full range of spare parts to enable the customer to maintain their transmissions.

With GR-Box's vast catalogue of spare parts, it's no surprise that many items are original and highly sought after. Therefore, where stocks of original parts have more or less depleted, GR-Box carefully rebuilds original parts, always respecting traditional processes. In some cases, the company is able to improve original parts through the use of developed manufacturing techniques. HRT

ABOVE Aurora Bearings has started to produce a rod end that went out of production almost half a century ago but which is back in demand by historic racers

Coming to a head

William Kimberley

IN US motorsport, the only company from the 1950s to the early '70s that made a commercially available rod end with a heat treated steel body, and a one-piece steel raceway was a company called Sealmaster which marketed its product under the name Spherco. In 1970 it stopped making the part itself and subcontracted the wok out. In that transition the unique head geometry of the part changed and the Spherco part no longer had its well known crown undercut.

"Over the years we've had enquiries from people who were looking for this style part for restoration and so we figured out how to make them," says John McCrory, Aurora Bearing's racecar product manager. "This really came to a head, parden the pun, at the PRI show in 2014 when we displayed a Gerhardt Indy car that used this type of rod end. We got together with some of our restoration partners and decided to produce a run in 1/2, 5/8, and 3/4 inch size, in left and right hand thread. In addition, the parts feature a PTFE liner. Truthfully, there's really no reason to use them nowadays other than the fact that you want it to look right on an historic car."

Part numbers are AM-8T-46 (1/2" rh hole and thread) and AB-8T-46 (lh thread), AM and AB-10T-46 (5/8" size), and AM/AB-12T-46.

Aurora Bearings has also recently produced two new products – high missalignment spherical bearings and rod ends with a three sixteenths bore or hole size, and 5/16 - 24 thread on the rod ends. "The typical product range for most people goes down to a quarter inch, but we've had demand for the three sixteenths size for small cars, universities, schools and so on, so we now have the spherical bearings in the chamfered version and the stake version and rod ends as well. It's now a stock item," says McCrory.

Part numbers for the rod ends are HXAM-3T (right hand thread), HXAB-3T (LH thread), and for the spherical bearings, HAB-3TG (with staking groove) and HAB-3T (chamfered race). Drawings of the parts are available thru the CAD drawing utility at www.aurorabearing.com HRT

Camouflaged as carbs

William Kimberley

JENVEY Dynamics, which has established itself as a leading manufacturer of fuel injection throttle body and induction systems, has developed the Heritage throttle body with Aston Martin specialist GTC Engineering. It boasts all the plus points associated with Individual Throttle Bodies, yet manages to marry these with the subtle, understated looks of a period carburettor so that it does not look out of place in the engine bays of classic and retro vehicles.

The collaboration with GTC Engineering saw the throttle body extensively road and dyno tested on GTC's Aston Martin DB5, with the resulting data ploughed right back into the project. The end result is a throttle body that looks perfectly at home under the Aston bonnet alongside the straight-six, yet still manages to function in a manner until now reserved for more modern induction setups. It's been proven to provide notable increases in power across the rev range, and sounds simply amazing.

While it has been developed for Aston Martins, the Heritage throttle body is an entirely homogenous replacement for traditional twin-carb setups that will fit any vehicle currently running any DCOE carburettor model, Jenvey offering it in four of the sizes most commonly used by classic car owners; 40, 42, 45 and 48 mm.

"While superior to carburettors in every quantifiable way, many owners have been put off throttle bodies due to an unwillingness to compromise the overall aesthetic of their treasured choice," says managing director Mike Jenvey. "With the increase in the classics market and demand for the benefits of an electronic fuel injected intake system, we have addressed the visual element with our Heritage throttle body design." HRT

ABOVE Disguised as DCOE carburettors, Jenvey's new Heritage throttle body retains the period look while offering enhanced all-round performance

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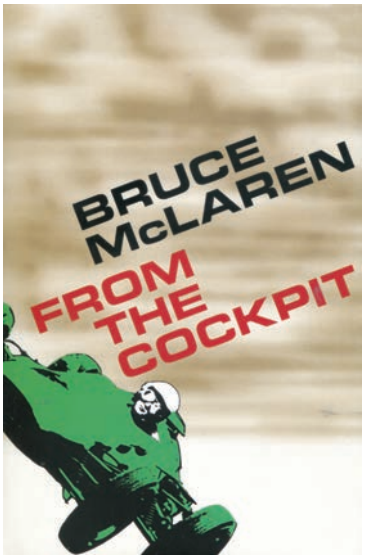
Bruce McLaren

From the Cockpit
Philip Porter
Published by Evro Publishing
ISBN 978-1-910505-14-4
278 pages
£19.99/$29.95



THIS is a reprint of Bruce McLaren's autobiography that was first published in 1964 by Frederick Muller and as such it retains the look and feel of a book of that time. It's all text and a number of inserts with monochrome pictures, but that is not to criticise it because it is the written word that is the jewel here.

It could be said that Bruce McLaren was far too young to be writing such a book; after all, he was only 27 at the time of publication and in a sense he hadn't really achieved anything. He hadn't formed the Formula 1 team bearing his own name and his Le Mans win was still two years away. For all that, though, it is compelling reading because we know that just six years after publication he was killed in a testing accident at Goodwood.

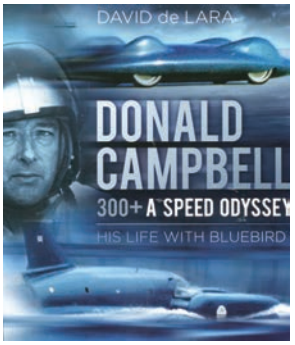
At a time when the McLaren organisation is going through something of a management turmoil with Ron Dennis, who took Bruce's legacy and created a mighty race team and a fabulous automotive business bearing the founder's name, it is perhaps most opportune that this book should be republished just to set a marker as to where and how it all began.

As to be expected, it is full of great anecdotes but perhaps it is the final paragraph in the book that is the most emotive when he touches upon the death of Timmy Mayer, his team-mate in the Tasman series in 1964. As McLaren wrote, "but who is to say that he had not seen more, done more, and learned more, in his twenty-six years than many people do in a lifetime. To do something well is so worthwhile that to die trying to do it better cannot be foolhardy. It would be a waste of life to do nothing with one's ability, for I feel that life is measured in achievement, not in years alone."

I think he had just written his own obituary without knowing it. HRT

Donald Campbell

300+ A Speed Odyssey
His Life with Bluebird
David de Lara
The History Press
ISBN 978 07509 7008 2
234 pages)
£30.00



FOR those of you who may not know Donald Campbell, he was the only son of the legendary Sir Malcolm Campbell but then became a legend in his own right with his various record-breaking exploits. In the inter-war years he was the ultimate record breaker with nine land and four water speed records in his Bluebirds.

This is a book that is sumptuously illustrated with absolutely magnificent pictures, many of which have never been seen before. In fact, the text really does take second place. There is no linear narrative but a series of "soundbites" throughout the book which makes it very easy to pick up and put down again.

The first section deals quite a bit with Donald Campbell's achievements with some wonderfully evocative pictures. They show him signing some papers at his desk smoking a pipe, mooring one of his boats while smoking a cigarette in a cigarette holder, a number of family photos and so on. At the same time they are accompanied by some very informative narrative.

At least half of the book is devoted to the boats, which is interesting enough, but it is when the author turns his attention to the cars that the real meat can be found. Again, there are some truly superb pictures, many of which are deservedly double page spreads.

Many of the record-breaking machines, both water and land, are gone into in great detail, explaining the various sub-systems, controls and instruments, accompanied by photographs and line drawings.

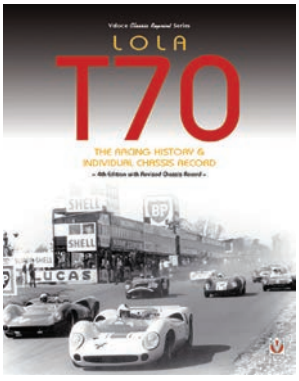
The Utah 1960 accident is covered in detail. This was when Campbell took CN7 to the salt flats in that state. It was there that he met Craig Breedlove, the US record breaker and national hero, the two immediately befriending each other and entering a friendly rivalry. There is a good description from Ken Norris, who was following in a support vehicle, about how Bluebird had gone a quarter of a mile off-track losing its wheels and suspension on the way and when you look at the remains of the car, which is given a full page, you do wonder how on earth Campbell survived.

The final section of the book focuses on the fatal final run on Coniston Water, complete with the pictures that are now well known to any who followed what happened.

This is a lovely book and a fitting tribute to a past national treasure. HRT

Lola T70

The Racing History &
Individual Chassis Record
4th edition with revised chassis record
John Starkey
Veloce Publishing
ISBN 978-1-787110-51-9
192 pages
£35.00/$60.00



FOR all fans of this great sports car this has to be the definitive book, which is now in its fourth edition and reprinted following a long absence after first being published in 1993. Author John Starkey has amassed an amazing collection of contemporary pictures in both colour and black and white while also telling the story of the car's development and racing history. What could have been a dull race-by-race narrative is enlivened by loads of anecdotes about the cars themselves and more pertinently, the drivers who raced them.

There is also a chapter devoted to the Lola T70 in historic racing, but as this part of the book remains unchanged from when it was first published it is now rather outdated. Nevertheless, the pictures of different cars in pieces are pretty good.

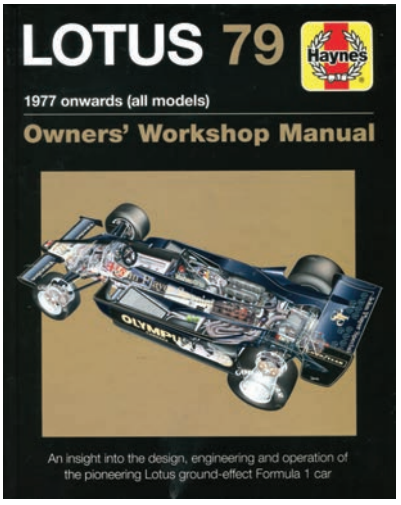
The meat of the book for those who like such things is the highly detailed history and record of the individual T70, T160 and T165 chassis. As the author admits, though, this has been quite a task as the records of John Mecom and Carl Haas, the two US Lola agents, have been lost. It has meant that the author has had to employ sheer detective work to sift through the contemporary race reports and factory records in order to identify individual cars.

It was not helped, he writes, by quite a few race mechanics in the US clipping off the chassis plates at the end of each Can-Am season to fix to their tool boxes. He emphasises at the end that the information he has provided cannot be regarded as a safe provenance for any car and the rule must be to check out the car's history through documentation and with expert help.

In his introduction, the author sums up his love for the model by writing that while it was powered by what was basically a "road car" engine, it could still be counted on to give a hard time to the likes of the Fords and Ferraris in short races. Sadly, there is just no place for the likes of such cars today, which is a real shame. HRT

Lotus 79

1977 onwards (all models)
Owners' Workshop Manual
Andrew Cotton
Haynes Publishing
ISBN 978 1 78521 079 2
156 pages
£22.99



BEFORE I commence this review, I have to hold my hand up and say that I am biased. I am a great fan of Andrew Cotton's work and knowing that this book was coming, I just couldn't wait to read it – and it was absolutely worth it. He also writes about a car that I fell in love with thanks to the likes of Mario Andretti and Ronnie Peterson.

As the author quite rightly points out, the Lotus 79 was not just an iconic car, but a ground-breaking one that delivered Andretti his World Championship in 1978. While one thinks of Colin Chapman as the engineering genius, that he undoubtedly was, he also had a brilliant design team behind him that helped him deliver his vision. Part of that was Peter Wright, who led the aerodynamic development programme and was instrumental in perfecting the ground effect concept in racing cars.

For me, the heart of the book is the second chapter on the 79's design and development, to the point that I couldn't put it down. The fine words are accompanied by some superb illustrations, including pictures of the handwritten test reports which are fascinating.

Another brilliant chapter is on the anatomy of the 79 showing reproductions of various design drawings, a cutaway of the car over two pages and many of the car being built, all accompanied by clear and concise text dealing with topics like the suspension, gearbox, brakes, weight distribution and of course the engine. The final chapter is on the five chassis that were built, their individual racing history and where they are now.

We have often commented on just what a great series the Haynes Owners' Workshop Manuals is and Andrew Cotton's book is a very fine addition to it. HRT

ABOVE Ferrari GTOs battle at the Goodwood Revival

REAL RACERS

It's no longer about the race for the win; it's about the race for the future, says **Sophie Williamson-Stothert** through gritted teeth. But could the historic hierarchy be the saviours of the internal combustion engine? We certainly think so

"**THE** future of motor racing is electric." That's according to CEO of Electric GT Mark Gemmell, speaking at the *Race Tech* World Motorsport Symposium 2016, and many other engineering geniuses for that matter.

Fair point; perhaps all racing cars of the future will be powered by electrified drivetrains, meaning the internal combustion engine, as we know it, will begin to fade into the history books. In any case, Formula E is growing at such a rapid rate, the industry is already gearing itself up for the first ever championship to be contested by autonomous cars – the ROBO RACE.

So, that's it for historics and modern classics then? Are they destined to be locked away in museums for all eternity? My answer to that (and I truly hope I'm right) is no. Let's take a moment to look at the bigger picture here. Motorsport is more than just a sport; it's a child's dream, a family hobby, an escape road, and a remarkable talent, made possible through the birth of the cars of the past. What's more, they still play a vital role in automotive pioneering. Rather than destroy an engineering marvel in its own right, we should be looking at ways of preserving it.

Now, I'm not saying I'm intending to become the leader of anti-electric rebellion. But I will say that, while I can certainly appreciate and admire the engineering excellence and sheer brainpower behind the development of electric technology, I never seem to find myself getting excited about it. For me, motor racing is, and always will be, about the sound of whining superchargers and roaring V8s, the overpowering smell of petrol mixed with Castrol R, and the notion of car and driver working as one.

Protecting our planet's environment is crucial, there's no doubt about it, and I fully support the introduction of hybrid and electric powertrains on our roads. But must it come at the cost of losing a sport that ultimately shaped the automotive industry we know in the first place? Not to mention one that continues to unite generations of drivers, engineers and spectators in sharing a mutual passion.

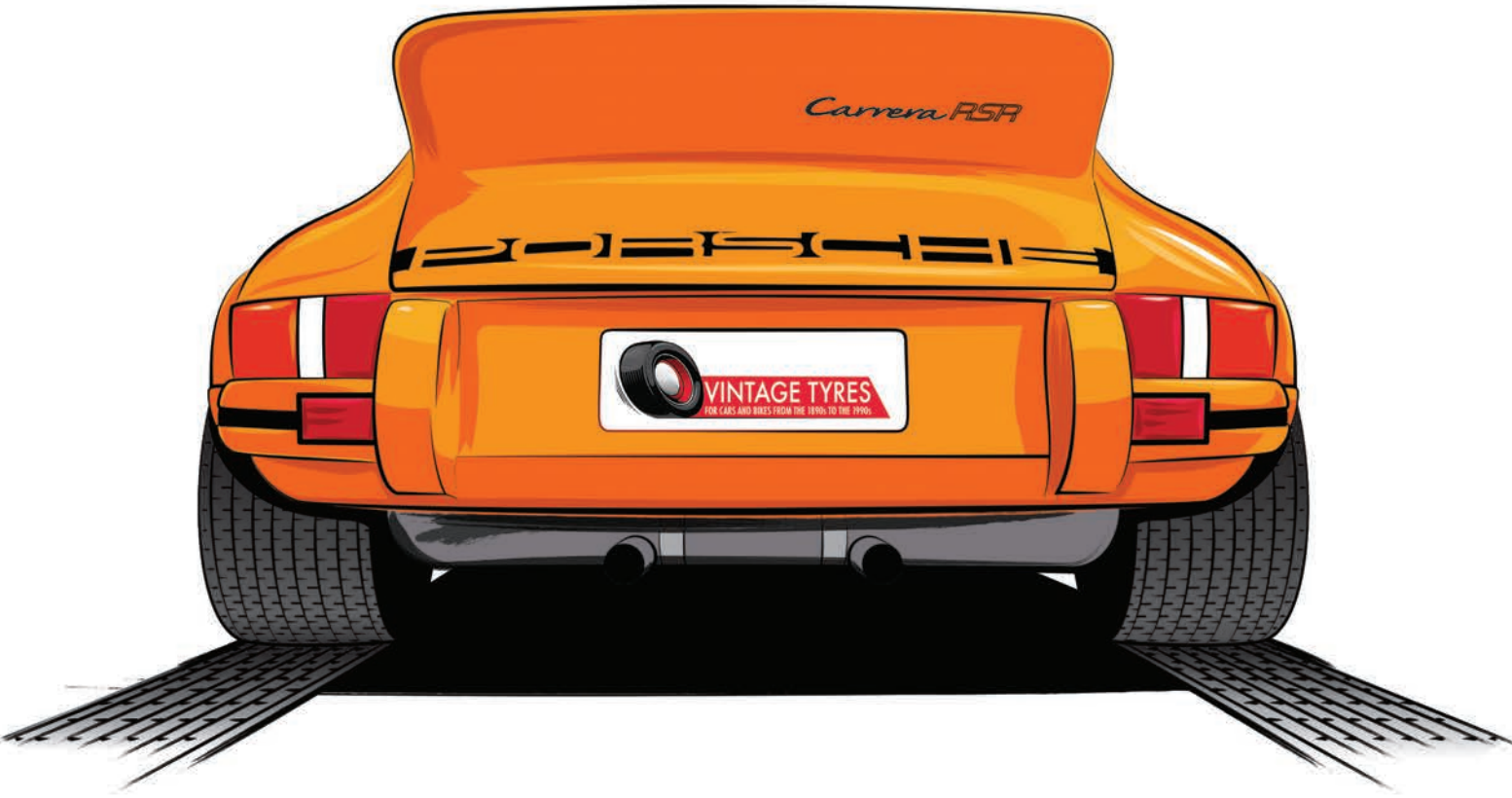
Then there's the argument of health and safety. Is driver instinct not more trustworthy than robotic software? Is a technological failure really safer than a driver fault? What's more, is electric power really as environmentally-friendly as we believe? Forgive me but, while you don't need to be a scientist to realise that petrol and diesel cars produce harmful gases such as carbon monoxide and nitrogen oxide, I believe there is a danger that (scarily) consumers are beginning to believe that electricity arrives in our plug sockets as if by magic! So for all the purists out there who argue that historic racing cars are solely responsible for polluting our planet, allow me to enlighten you: producing and sourcing electricity in itself is an environmental nightmare – fossil fuel power plants release air pollution, require large amounts of cooling, and can destroy large tracts of land during the mining process. Let's not forget that the human body itself is a conductor of electricity.

Touching on another point raised at the World Motorsport Symposium, one of the key reasons fans take an interest in our sport is because of the emotional bond they form with the drivers and the conflicts they witness between rivals. Take Niki Lauda and James Hunt, or Ayrton Senna and Alain Prost, for example. These days, Formula 1 coverage struggles to match the views of BBC's Great British Bake Off and, as Professor David Greenwood at WMG, the University of Warwick, said, "If we can't make cars more exciting than cakes, then we have a real problem."

That's why I firmly believe that historic motor racing is not only the one sure way of preserving the internal combustion engine's presence in motorsport, but will also help us to encourage and inspire a new generation of historic enthusiasts, drivers and engineers.

Let's embrace the future, while honouring our past. HRT

Michelin TB - The road-legal high



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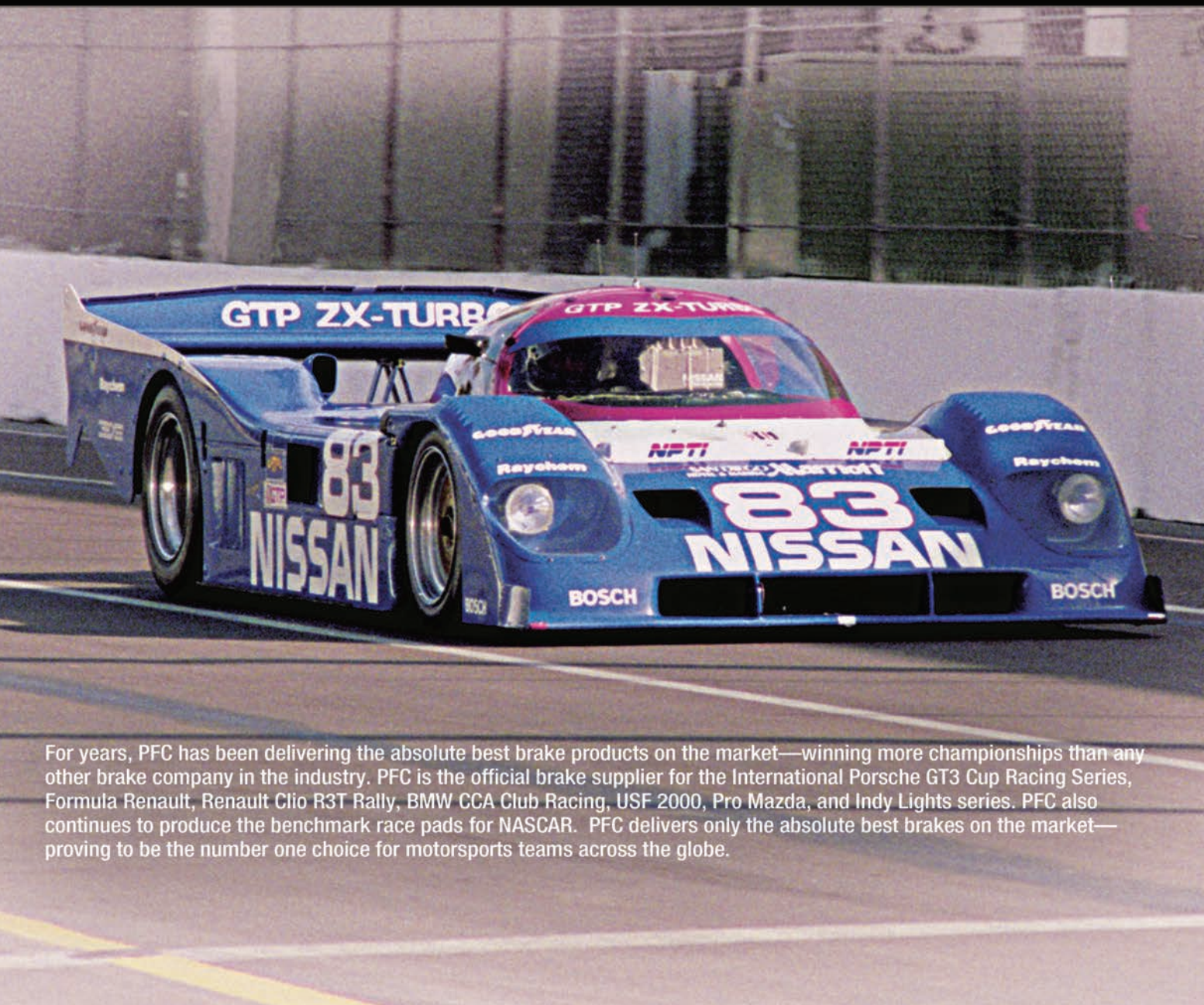

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