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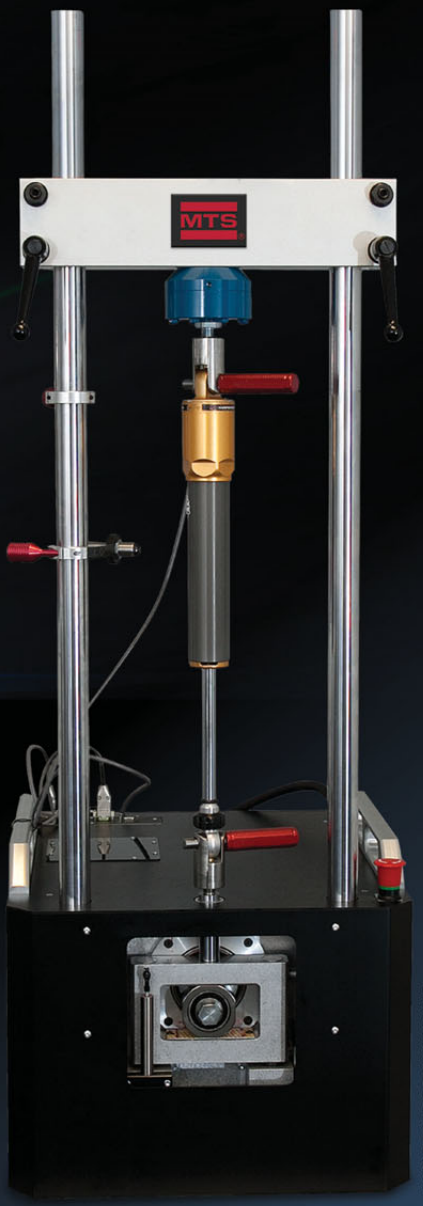
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# UNDER ATTACK

**IN THE** last issue I wrote how the Environmental Protection Agency (EPA) in the US has taken it upon itself to regulate the conversion of street cars into race cars, arguing that they fell under its mandate. It contended that to do so was "tampering" and that a vehicle is forever a "motor vehicle" subject to the Clean Air Act, even if it is unregistered, the licence plates have been removed and the vehicle is never driven on the highway. In other words, the EPA stated that it was illegal to convert street vehicles into race-only vehicles. However, under the Clean Air Act, Congress never intended that the EPA should regulate vehicles built or modified for competition use only. It's therefore seen by some that the agency is attempting to circumvent Congressional intent without proper statutory authority.

A consequence of this is that a Bill called The Recognizing the Protection of Motorsports Act of 2016 (RPM Act) has been introduced by five Congressmen, the outline of which was that it had always been Congress' intent that race cars were not included in the Clean Air Act's definition of "motor vehicle" and making it clear that it has always been legal to modify a street vehicle into a race car used exclusively at the track. It also sought to confirm that modifying these vehicles for exclusive track use would not be considered tampering.

Fortunately this has now been resolved, albeit only partially, because while the EPA has to decided to withdraw problematic language concerning racing vehicles from an ongoing, unrelated rulemaking, its position against street-to-race conversions has not changed. So while it has withdrawn the proposal, it is continuing to assert authority under the Clean Air Act to regulate the modification of vehicles used for competition. It means that there is still a great deal of work to be done to safeguard the right of people to modify cars, including historics, to go motor racing.

Then there was the news from Paris in June that it was going to ban cars registered before 1997 from the city between 8am and 8pm on weekdays as from 1 July. According to French media reports, these restrictions are set to become progressively tighter over the rest of this decade until 2020, when the only private vehicles allowed to drive in central Paris will be cars registered after 2011 and motorcycles registered after July 2015. However, there is a concession to classic cars as those registered 30 years or more ago will still be allowed to drive.

Then there is the news from Norway which is planning to ban the internal combustion engine from 2025 and will only allow zero-emission vehicles to be sold in the country. In this case there are no exemptions for classic cars. What's remarkable about this proposal, apart from the shock of outlawing the internal combustion engine, is that the country is currently one of the world's largest oil exporters.

The Dutch government is discussing the possibility of banning fossil-fuelled car sales and only allow electric vehicles sales starting in 2025 although it is not yet a done deal as its parliament is divided on the issue. However, India has confirmed that it is evaluating a scheme for all its fleet to be electric by 2030.

There is no doubt that the car is under attack and there is every chance that the vehicles we love and drive have every chance of being outlawed in a number of countries over time. It's possible that the only place they will be allowed to be driven is at tracks where they will have to be transported to and from rather than driven there.

Actually, I find the whole thing a little bit depressing knowing that the things that have been a major part of my life all my life may not be enjoyed by my grandchildren. I know there's the argument about exhausts and pollution but the one thing that still has not been properly explained to me is that while you can plug in your electric car and recharge it in an environmentally friendly way, what about the power stations that are out of sight creating the energy to allow this? In many cases around the world they are still coal fired, one of the major emitters of carbon dioxide. A microcosm of this for me is Formula E where I have been told that in some event locations the all-electric racing cars have been charged up behind the scenes by diesel generators. Not sure if this is true or not, but if it is it comes across as a little hypocritical in my view.

Historic racing is going through a boom and the Doomsday scenario of such cars being outlawed seems far away, but we must be vigilant and respond to any threats that appear on the horizon.

**William Kimberley**
**Editor**

Lister Motor Co



**ABOVE** Big cat: The Lister Jaguar Knobbly Stirling Moss Edition is correct in every detail to the 1958 original

# Moss's magnesium 'Knobbly' set for race return

## Andrew Charman

**THE** Lister Motor Company is to make a second 10-strong edition of its Lister Jaguar Knobbly continuation model, celebrating F1 driver Stirling Moss.

The first 10 cars, based on the original works racing Knobblys built by Brian Lister in the 1950s and featuring magnesium bodies, were launched in 2014 and have now all sold out, resulting in the second edition which will be built to the same specification as the car raced by Moss to victory at Silverstone in 1958. As well as the magnesium shell with its distinctive low-drag long front wing design, the sump, clutch and differential will also be made from magnesium, encased within a tubular steel chassis. While Lister Jaguar Knobblys are raced in historic events today, none of the magnesium-bodied works cars have survived.

Each car will be finished in the green and yellow colour scheme of Moss's 1958 race car, and include a solid silver plaque bearing its edition number and Moss's engraved signature. Lister says the cars will be able to be supplied in either road or full race specification with an FIA HTP passport. Prices will start from £1 million.

Laurence Whittaker, who acquired the Lister Motor Co in 2013 with his father Andrew, said that those who get to own a Stirling Moss edition will be getting a period-correct continuation 'works' Lister made using the same techniques as the original.

"As magnesium is such a difficult-to-source material and requires incredible skill and craftsmanship to form, the Lister Jaguar Knobbly Stirling Moss edition will be the only magnesium-bodied car you can buy – either as a road or racing car – anywhere in the world," he added. HRT

# Jaguar builds XKSS, races Lightweight and moves home

## Andrew Charman

**JAGUAR** Classic has followed up its build of the six missing Lightweight E-Type race cars with a programme to create nine versions of the XKSS, a road-going version of the racing D-Type.

As with the Lightweight E-Type programme, the programme is filling missing production numbers in Jaguar's inventory, in this case nine cars lost to a fire at the marque's Browns Lane, Coventry works in 1957. All nine cars have already been sold.

Meanwhile the recreated Lightweight E-Type was due to make its race debut on 9th July during the Le Mans Classic, driven by journalist and BBC Top Gear presenter Chris Harris.

All six 'missing' Lightweights were built as period competition vehicles, fully compliant with FIA homologation, though their existence caused some controversy, with Goodwood Revival organisers quoted on a TV programme following the build as suggesting they would not be eligible to race at the renowned meeting.

All of Jaguar Classic's operations, including services for historic racing, will move in early 2017 to a new £7.5m centre located close to the new Jaguar Land Rover Special Vehicle Operations hub near Coventry, which itself is an investment of £20m by JLR.

From the new premises Jaguar Land Rover Classic will offer an extensive range of cars, services, parts and experiences for Jaguar and Land Rover owners and enthusiasts, while the Jaguar Land Rover Classic collection of vehicles will be stored and maintained in new facility. HRT

# HRDC launches new Jaguar race series

**THE** Historic Racing Drivers Club is to launch a race series for Jaguar touring cars built between 1950 and 1966. The new series, which will contest its first events in 2017, is being planned as a 'Senior' companion championship to the entry-level Austin A30/A35 Academy Series launched by the HRDC for this season. Eligible cars, which will include such vehicles as the Mk1, MkII and the enormous MkVII, will compete on an 'invitation only' basis to period regulations and on mandatory Dunlop CR65 historic racing tyres.

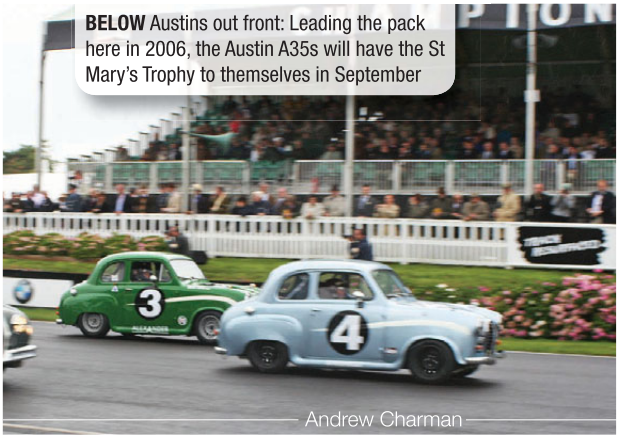
HRDC founder and race director Julius Thurgood sees the new Jaguar championship as a natural evolution from the A35 series."From the very beginning of my plans to create an entry-level series into historic racing, I knew that there had to be a logical path to follow on from the HRDC Academy that would be aspirational to both those drivers who were graduating through this grassroots series and to those already experienced competitors who were seeking to race in a high-end but fair-play 'Senior Series'," he said.

"Choosing Jaguar as the favoured marque was a no-brainer; its evocative stance in the historic racing arena is legendary and I was keen to keep the series restricted to Touring Car models, as I am passionately of the belief that this genre holds the greatest appeal to both competitors and spectators alike, for sheer close-racing and amazing spectacle." HRT



**BELOW** The HRDC's invitational Jaguar series will form a natural follow-on from the club's successful Academy series for Austin A35s

Andrew Charman



**BELOW** Austins out front: Leading the pack here in 2006, the Austin A35s will have the St Mary's Trophy to themselves in September

Andrew Charman

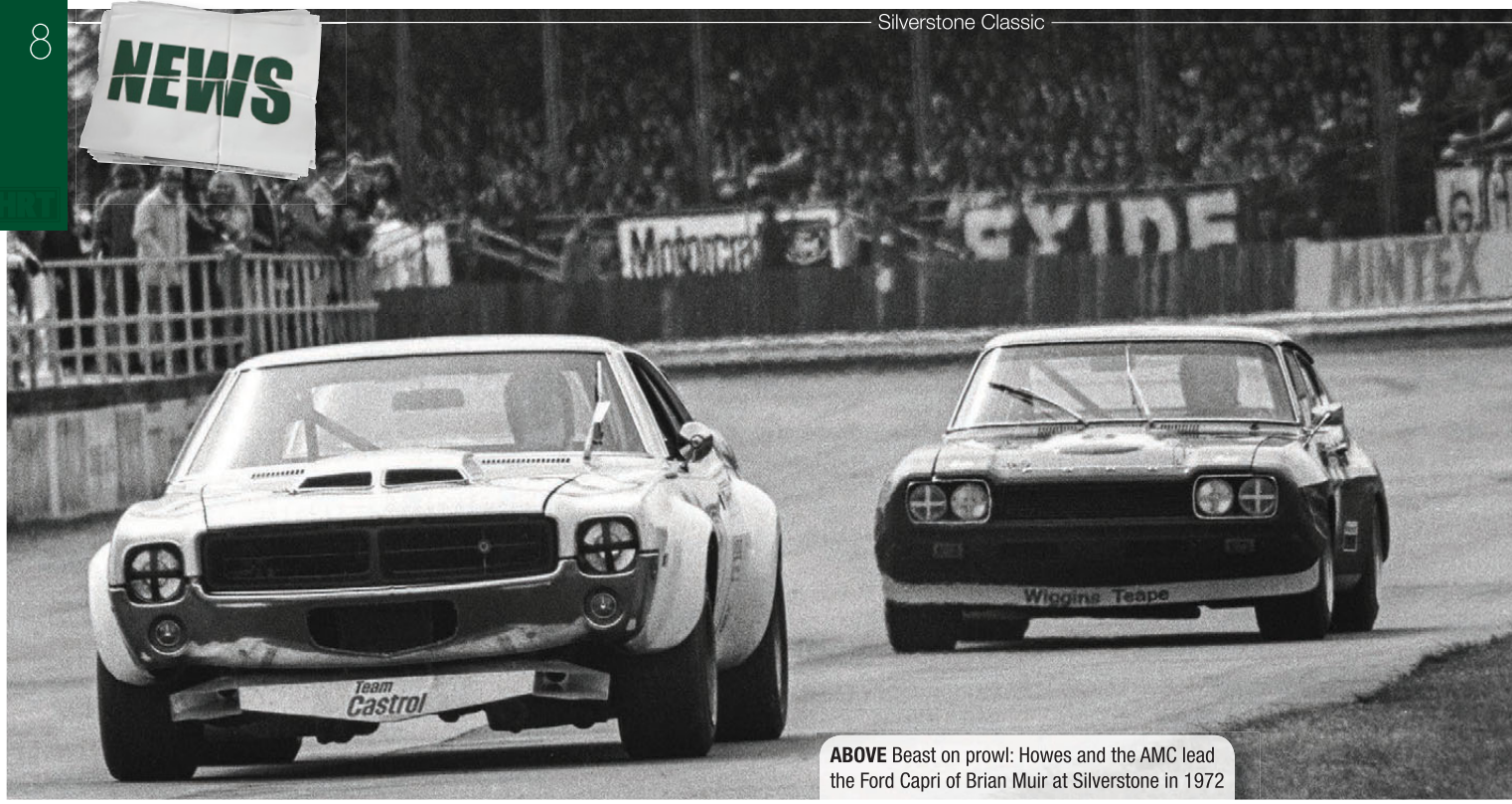
# Goodwood to host 1950s one-make race

## Andrew Charman

**ONE** of the Goodwood Revival meeting's most popular races will take on a new look this year when it is contested by a full grid of identical cars. The 2016 version of the St Mary's Trophy on 10th-11th September will feature 30 Austin A35s all built to the Historic Racing Drivers' Club's Academy regulations, somewhat akin to the modern British Touring Car Championship by running a number of specification components including engine, transmission, brakes, fuel tank, dampers, springs, interior and body panels.

Race organisers believe that the resultant evenly-matched cars will ensure that the race is decided purely by the skill of their drivers, which as previously will feature owner drivers on the Saturday and celebrities on Sunday.

* This year's Goodwood Revival programme also sees the addition of the Kinrara Trophy, a race for early 60s GT cars running into the dusk on Friday evening, and the Lavant Cup, run for 1930s-50s BMW-engined sports cars to celebrate the German manufacturer's centenary. HRT




**ABOVE** Beast on prowl: Howes and the AMC lead the Ford Capri of Brian Muir at Silverstone in 1972

# Beast is back at Silverstone

## Andrew Charman

**THE** AMC Javelin 'muscle car' campaigned in 1970s British and Special Saloon Car races and known as .The Beast' was expected to compete for the first time in more than four decades in July.

The 6.4-litre car had been kept in spotless condition by owner Dave Howes ever since his motor racing career was ended by a badly broken leg in a road accident – shortly after the Javelin had taken a win at Silverstone in August 1975. He had built the AMC up to Group 2 specification in 1971 having bought it as a road car from a US serviceman based in Britain.

Scoring several top ten finishes in the British Saloon Car Championship and taking two Special Saloon victories in 1972, Howes attracted some factory support from American Motors in Detroit for the 1973 season, his best BSCC finish a runner-up spot to Frank Gardner's Chevrolet Camaro in the British GP support event. However, when the BSCC regulations changed to Group One in 1974 the car was relegated to running in Special Saloon events until the accident to Howes ended its outings.

Not until the end of 2015 was Howes persuaded to sell the car to Belgian historic collector and racer Marc Devis, who immediately aimed for a return to competition at the venue of the car's last victory, in the Historic Touring Car Challenge Race at the Silverstone Classic meeting on 29th-31st July.

According to Devis the car came with a wide assortment of spares, original parts and documents, and he put historic racing specialist WDK Motorsport in charge of the restoration, with an emphasis on originality.

"Having been laid up for so long, both the engine and mechanicals were in need of a full rebuild and overhaul, but I was adamant those now overseeing the project at WDK Motorsport were sympathetic and didn't do anything to change the appearance of the original car – it must look exactly like it did before being parked in the garage in the mid-seventies," Devis said.

Rebuilding the car included sourcing replacement AMC engine components from the US but the team was confident of making the Silverstone date and having Howes present to see his car race again. HRT




**ABOVE** Beast's Lair: New owner Marc Devis and Dave Howes with the AMC

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NEWS

# Monthlery return for record-setting Voisin

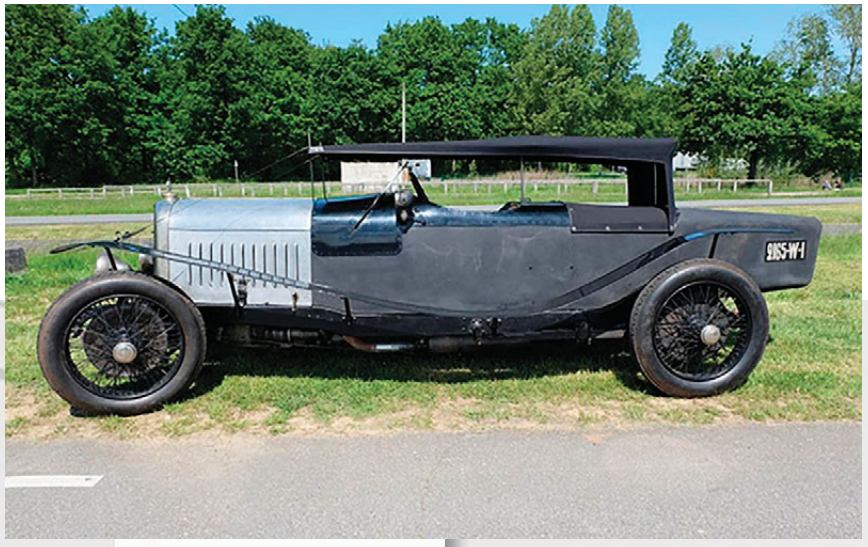
**THE** second 'Les Grandes Heures Automobiles' (LGHA) historic meeting at the famed French banked speedway of Montlhéry in September will see the return to action of a car that set 17 speed records at the circuit almost 90 years ago.

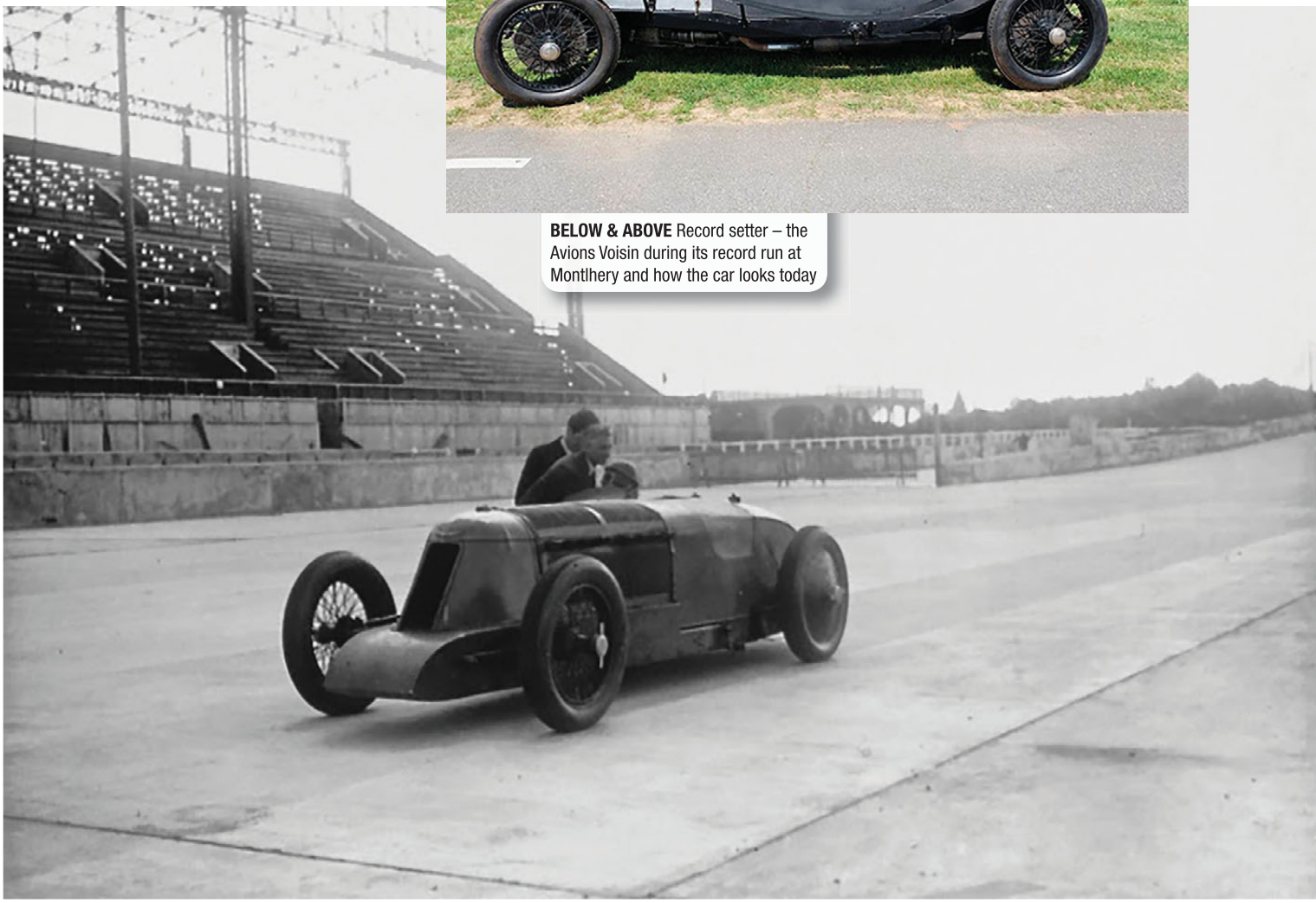
The 1927 Speed Record Voisin will be among a quartet of 1920s race cars from the pre-war French luxury brand of Avions Voisin to appear at the meeting on the Autodrome de Linas-Montlhéry, 20 miles south of Paris, on 24th-25th September.

The 210 bhp Voisin, created by aviation and automotive engineer Gabriel Voisin, took a clutch of speed records on the steeply-banked circuit in 1927, including a 24 hour record which it raised to 114.2 mph. At the end of the 24 hours it kept going for a further three hours, capturing 3,000 mile and 5,000 km records in the process.

The record car will be joined at the LGHA meeting by one of only two C1 Competition models, built in 1921, along with an example of the C3, which took the top three places in the 1922 Strasbourg Grand Prix, and the monocoque-based aircraft-inspired 1923 C6 Laboratoire which most recently ran at the Goodwood Festival of Speed. All four have been provided by Peter Mullin, owner of the Mullin Automotive Museum in Oxnard, California, where they now reside.

The LGHA meeting expects to attract around 200 competition cars and motorcycles, along with a large number of historic club vehicles which will all be permitted to drive on the track at the close of the meeting on 25th September. HRT





**BELOW & ABOVE** Record setter – the Avions Voisin during its record run at Montlhery and how the car looks today

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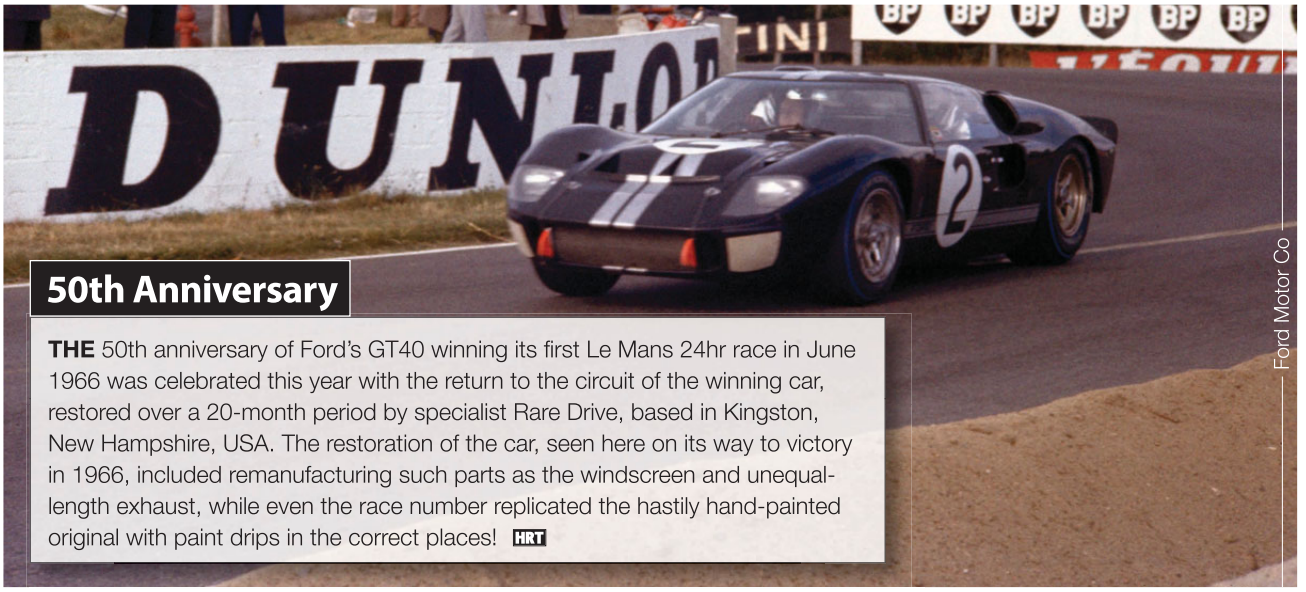
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NEWS

# MSA tightens licence requirements

**COMPETITORS** in historic cars could be affected by forthcoming MSA licence rule changes. From 1st January 2017 drivers competing in circuit racing with cars of more than 0.34 bhp/kg (excluding driver weight) will be required as a minimum to hold a Race National A licence, with the exception of single-seaters detailed in the RAC's 'blue book' regulations.

New licence requirements will extend to speed events from 1st January 1918 – anyone campaigning a racing or Sports Libre car of more than 1100cc in sprints, hillclimbs or drag races will require a Speed National A or Race National A licence unless the car is licensed for public road use and competes in road-legal condition. Pre-94 historic Formula Fords complying with the period Ford regulations are excluded from the rule. HRT




Ford Motor Co

## 50th Anniversary

**THE** 50th anniversary of Ford's GT40 winning its first Le Mans 24hr race in June 1966 was celebrated this year with the return to the circuit of the winning car, restored over a 20-month period by specialist Rare Drive, based in Kingston, New Hampshire, USA. The restoration of the car, seen here on its way to victory in 1966, included remanufacturing such parts as the windscreen and unequal-length exhaust, while even the race number replicated the hastily hand-painted original with paint drips in the correct places! HRT

## IN BRIEF

The Equipe GTS Series, which caters for smaller-engined pre-66 sports cars running to the FIA's Appendix K regulations, produced a record 58-car grid at Silverstone on 4th-5th June, competing over two races as part of the circuit's MG Live event. The wide-ranging grids included many examples from MG, Triumph, TVR, Healey, Lotus and Morgan among others.

Britain's MSA has reminded competitors that rain lights must be mounted on the rear of competition vehicles within 10 cm of the centreline, or as two lights equally about the centreline on vehicles with full-width bodywork. In the latest MSA Bulletin photos of compliant and non-compliant setups on historic Austin A35 saloons were used to illustrate the issue.

The Roger Albert Clark Rally, established in 2004 as a historic version of the RAC Rally, will not run for the second year in 2016, though organisers are working on a new biennial format starting in 2017. Low entries caused the cancellation of the 2015 event, costing organisers £16,000, but they hope to run a 200-225 stage-mile event taking in long forest stages in the classic RAC Rally venues in Wales, Yorkshire, Kielder Forest and the Scottish Borders, provisionally on 9th-12th November 2017 with a follow-up event in 2019.



Britain's MSA has published an update to the safety requirements for organisers of UK stage and multi-venue rallies, which includes historic rallying. Produced as part of the ongoing RallyFuture campaign, which is implementing recommendations from the Motorsport Event Safety Review set up by the Scottish Government in the wake of spectator fatalities at the 2014 Jim Clark Rally, the update includes such areas as personnel and radio requirements and safety car procedures. More details can be found at www.msauk.org/the-sport/rally-future HRT



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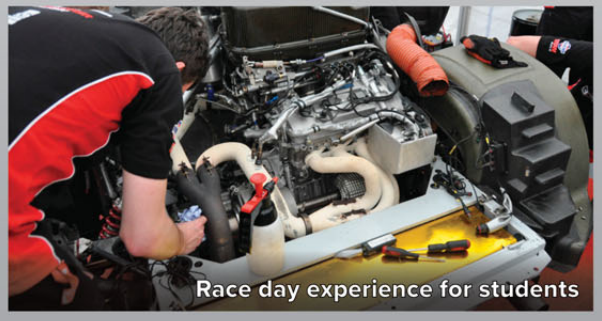
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# The cat that bared its claws

Initially used on the road, this unique Jaguar Mk1 went on to compete under the banner of one of the greatest names in sports car racing. **Chris Pickering** finds out more

**IT'S** hard not to stop and stare the first time you see the immaculate Jaguar Mk1 saloon owned by Simon Lewis and Guy Connew. Gleaming in its distinctive light green paintwork, it looks like it could have rolled out of the factory yesterday. In some respects that's not so far from the truth, but the story behind this unique racing car is as complex as it is fascinating.

Several years ago Lewis and Connew, both experienced XJ6 racers, enlisted the help of Carl Gannon from Xtreme Jaguar Restorations to help them find a Mk1. The plan was to prepare a car on a modest budget for some relatively affordable fun.

As it happened, Gannon knew of a potential candidate. A few months beforehand he'd been to investigate another Mk1 that was for sale, the so-called Cadbury Boost car (named because of the sponsorship it ran in the Eighties). In a shed on the same premises was a somewhat rusty green example – far from immaculate, but potentially salvageable for the right price.

A deal was struck and the new owners began looking out for any signs of the car's history while they planned the restoration. It didn't take long to track down former owner Chris Wood, who explained there was far more to this car than meets the eye.

Manufactured in 1958, MCH 178 had rolled off the production line at Browns Lane as a standard 3.4-litre Jaguar saloon. Wood acquired the car in the mid-Seventies, just as the concept of historic racing was starting to take off. At the time, the only suitable championship had a cut-off date of 1957, but he found he could enter the car if he converted it to the earlier 2.4-litre specification. Wood raced the car on and off for the next few years with modest success, during which time it was looked after by Ron Beaty of Forward Engineering.

This is where the plot thickens. Beaty had become friends with Brian Lister and the two of them hatched a plan to revive the Lister name, which had been so synonymous with racing Jaguars in the Fifties. Initially Wood was interested in purchasing one of the company's wild 7-litre wide-arched XJS conversions, but when the cost proved prohibitive he was offered an alternative: why not let Lister prepare his Mk1?

Wood leapt at the chance and MCH 178 was to become the only compact Jaguar saloon ever to race under the Lister banner. It picked up numerous class wins and became a well-known car in Jaguar circles, before being sold and eventually put into storage.

## CHANGE OF PLAN

When the new owners learned of the car's true significance, it prompted a bit of a rethink on the restoration plans. "At that point Simon and Guy decided to pull out all the stops," recalls Gannon. "They didn't want it to be just another racecar. The decision was taken to make it the ultimate Mk1 and we were effectively given carte blanche to build the car as we saw fit."

The shell was sent to CL Classics to be stripped and prepared, where the yellow ring was added around the nose in a nod to the Lister racers of the Fifties. Aesthetically, it still looks more or less standard, with a full interior including a back seat, headlining and door panels. However, an additional stiffening rib has been added down the centre of the floorpan, while the spare wheel well –



> **“Everybody builds engines for power but when you’re pushing a brick-shaped saloon through the air, it’s torque you need”**

which also helps to accommodate an enlarged fuel tank – has been filled with expanded foam.

To keep the weight down, every surplus fixture and bracket has been removed, while the glass windows have been replaced with Perspex. The bumper irons – originally made in steel – have been replicated to the exact dimensions in aluminium, while the bumpers themselves are now plastic, treated with Hydrochrome. This relatively simple spray-on process results in an incredibly realistic chrome mirror finish.

Under the skin, the transformation is equally thorough. Built to race in the Jaguar Enthusiast Club’s (JEC) Pre-1966 Championship, there’s a little more leeway in the details than there would be for an FIA Appendix K car, although the fundamentals are still very faithful to the original recipe. Wishbones and uprights, for instance, have to be standard Jaguar production parts.

Even running on authentic Dunlop L-Section crossplies, the rigours of competition still put far more stress on these 58-year-old components than they were originally designed to withstand. Suspension failures are not unknown on racing Mk1s, so the first job was to have all the components crack tested and shot peened.

Launched in 1955, the Mk1 – as it became known following the introduction of the Jaguar Mk2 in 1959 – was in many ways ahead of its time. ▶




Jeff Bloxham

**ABOVE** The ambition for the project was to make this the ultimate Mk1





**ABOVE & BELOW** The shell was stripped and prepared at CL Classics

Alongside the innovative monocoque construction it used independent front suspension, with optional disc brakes available by 1957, just four years after they first appeared on the Le Mans-winning C-Type.

At the front, the wishbones are mounted on a subframe consisting of two damper turrets joined by a lower box section. Over the years this box section has a habit of bowing, so having found a straight example, Gannon set about stiffening it to ensure it would retain the correct geometry.

"We actually took the idea from Jaguar," he remarks. "The XJ6s had a similar problem and all they did was drill through the box section and weld in a set of solid bars. Now instead of having the loads acting on a great long lever, there's only four inches between each bar."

Next, he set about replacing all the rubber bushes with his own phosphor bronze items. Made in-house, these consist of a phosphor bronze top hat section, which houses a stainless steel sleeve liner, scrolled and fitted with a grease nipple to provide lubrication. It means there's no unwanted compliance in the joints themselves.

At the front, the original anti-roll bar has been replaced with an upgraded item. The springs – semi-elliptic on the back and coils on the front – were made by Rob Beere Racing to Xtreme's own specifications. They're combined with a rather special set of Koni dampers, Gannon explains: "We thought Konis were the best in terms of performance, but the design we wanted to use is not adjustable on the car. What we've done is replace the original solid shaft with a hollow rod that has an adjuster running down the middle."

The JEC rules state that all teams must use solid discs, so the Mk1 uses heat-treated EBC discs with three-pot callipers from a later Jaguar 420 saloon. These are combined with EBC pads and Castrol SRF brake fluid, using Aeroquip hoses.

"The car still weighs 1,300 kg, so we've gone as large as we can go on the brakes, but that brings an issue with cooling," explains Gannon. "We now run brake cooling scoops hidden under the car, with ducting through to the wheel arches."

A modern twin-cylinder Tilton pedal box is now used with an adjustable bias ▶

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valve – and that's by no means the last trick up this car's sleeve. While most Mk1s race without a servo, they are notoriously physical cars to drive as a result. "In longer races you often see Mk1 drivers slowing down two-thirds of the way through because their legs are getting tired," notes Gannon.

With the car now eligible for longer races and both co-owners running it alongside more modern servo-equipped XJ6s, the decision was taken to fit a pair of 4:1 servos to provide a small amount of assistance.

The next question was where to take the vacuum for the servos. Typically this would come from the intake manifold, but Gannon was reluctant to follow this method, pointing out that it can rob pressure from the carburettor nearest the take-off point and disturb the balance within the manifold.

> **"If you can reduce transmission losses by 10 per cent that's the equivalent of getting an extra 30 bhp from the engine, which would cost thousands"**

His solution – inspired by modern diesel cars – was to use an electric pump. This also means it's now possible to adjust the vacuum in the car mid-race. "Servos are free in the rules," he comments. "This way, you can start a race on a hot, dry day when you want maximum brake boost, but if it starts raining you can turn the servo right down to give you more modulation."

## UNDER THE BONNET

In its Lister heyday, MCH 178 ran a 3.8-litre engine, but that has long since been lost to the sands of time and current regulations restrict it to 3.4 litres. The new unit is built around a standard factory block from the later 340 engine, which features an expanded water jacket for better cooling. It's a useful benefit in a full race engine, but Gannon believes the Jaguar engine's cooling requirements are sometimes overstated.

"You often hear people complaining about Jaguars – particularly E-Types – ▶



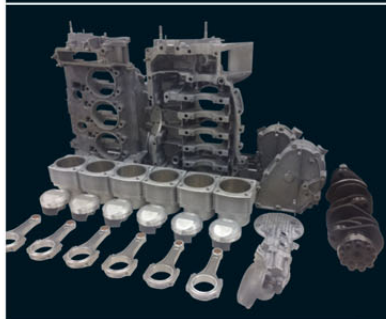



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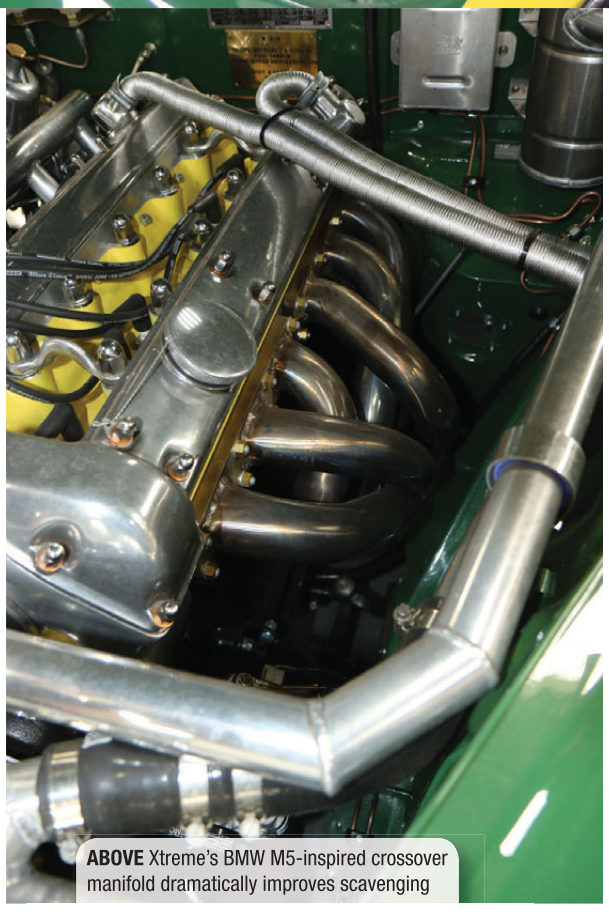

**ABOVE** Under the bonnet. Note the triple SU carburettor setup. The middle one stands slightly proud of the others

overheating, but they never did it in period and it has nothing to do with modern fuels or higher traffic densities," he says. "Over time you get a build-up of sediment in the block, which compacts down into a concrete-like sludge that can be over two inches deep. That's robbing the engine of its water capacity and causing hot spots due to heat retention. The only way to get that out is to acid dip the block, so we do that on all our engines, even for the road cars."

One of the inherent problems with all the XK engines is that the spark plugs are offset to accommodate the valve layout. Over the years many solutions have been tried, such as twin spark heads, but Gannon believes the best way to do it is to re-position the centre of the combustion chamber. He's done this with a bespoke piston design, developed in-house but manufactured in the US by JE Pistons.

Another trademark characteristic of the six-cylinder Jaguar engines is a comparatively long stroke. They are all virtually oversquare, so they can be reluctant to rev in standard form. In order to reduce friction and get the reciprocating mass down, Gannon uses Arrow Precision connecting rods that are somewhat longer than the stock items. These allow the gudgeon pin to be moved higher up within the piston for the same stroke, which means the pistons can be run with a shorter skirt. It's a relatively common mod, but a very effective one.

A harmonic damper and a much lightened flywheel with a competition clutch completed the rotating ▶



**ABOVE** Xtreme's BMW M5-inspired crossover manifold dramatically improves scavenging

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assembly. The whole thing was then sent to a local company that specialises in jet engine rebuilds, where it was placed in an oil bath, instrumented up with accelerometers and very carefully balanced. As a result, the engine is now quite happy revving to 7,400 rpm, while the standard red line is just 5,500 rpm.

Peak power is now 298 bhp delivered at 6,900 rpm, but of more interest to Gannon is the torque figure: 279 lb/ft, of which 220 lb/ft is available right from 2,500 rpm. "Everybody builds engines for power," he says, "but when you're pushing a brick-shaped saloon that weighs 1.3 tonnes through the air, it's torque that you need. This engine has a torque curve to die for, so it's very tractable. The only downside is that it's going to be a bit of a handful in the wet."

Part of the secret to this tractability lies with the porting. While some engine builders try to open the ports out as far as possible to increase the volumetric flow, Gannon prefers to keep them relatively small to increase the gas velocity. Competition valves with a 3-angle cut and a back cut are used, but the main difference lies in the manifolds, he says.

## CROSSOVER MANIFOLD

Each of the primary pipes has been individually designed to give exactly the same tuned length – not from the face of the manifold, but from the valve itself, which means there's a 2.25-inch difference across the set. Crucially, the primaries for cylinders two and five are crossed over, as in the early BMW M5 engines – cylinders one, five and three now feed into one collector, while six, two and four share another.

As the pulses from the cylinders merge in the two collectors, they're positioned to create a swirl effect. This vortex allows the air to travel faster down the pipe, sucking the exhaust gases out and resulting in a distinctive whistle when the car is worked hard. Again, this is not unheard of on Jaguar engines, but the level of work that's gone into engineering a bespoke solution is deeply impressive. Gannon carried out all the design work in-house, with fabrication provided by local firm Fast Road Conversions.

A similar philosophy has been applied to the intake side. Originally the Mk1 was fitted with a pair of two-inch SU carburettors, each feeding three cylinders. The problem with this layout is that the two central cylinders inevitably get fed better than those at the extremities, which means they run richer. The new engine uses a triple 1¾-inch SU setup, but again this distance has to be measured to the valves, which means the length of the intake runners has to be longer on the two central cylinders. Look carefully in the Lister's



**ABOVE** The dashboard is hard to reach once strapped in, so Xtreme has added this remote switch panel

**ABOVE** Aesthetically, the interior looks standard, but every surplus fixture and bracket has been removed to keep the weight down




**ABOVE** The yellow ring on the nose is a recent addition, but the characteristic light green paint was Brian Lister's doing in the Seventies

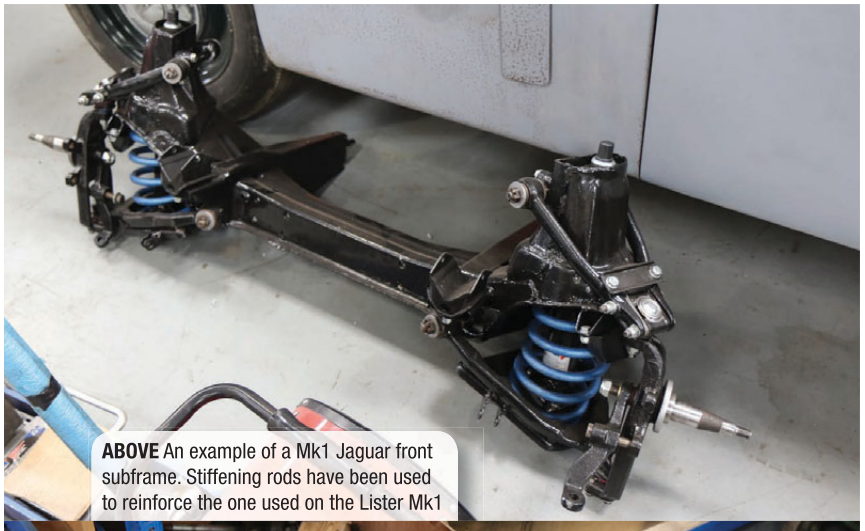
engine bay and you'll see that the middle carburettor stands slightly proud of the others, which has necessitated a somewhat complex linkage mechanism.

Again, the devil is in the detail. All SU carbs were mass produced, Gannon explains, so they tend to come with excess casting material and flash marks. He removes all this material, then seals the carburettors off and fills them with liquid to measure their volume and ensure they are all completely balanced. Other tricks include waisting the spindles down and sharpening the butterfly valves to a knife-edge point to impede the flow as little as possible.

Another unusual feature is the use of a constantly-recirculating fuel system. Unlike a normal fuel pump, which cuts off when it reaches the desired pressure, here it runs continuously to ensure the carburettors are always fed with fresh, cold fuel.

"Fuel works best at low temperatures," Gannon points out. "I deliberately wait until the last minute before fuelling the cars at a race – particularly in the summer – because it tends to heat up while it's sat in the tank. Plus, all Jags suffer from vapour lock to a certain extent, so if you stall the car on track or have to turn it off for some reason it can be a nightmare to restart. A constant supply of fresh fuel solves that issue."

Ignition comes from a mappable electronic distributor produced by Dutch firm 123. At first glance it looks a lot like a traditional points setup, but it can store up to 16 different advance curves.



**ABOVE** An example of a Mk1 Jaguar front subframe. Stiffening rods have been used to reinforce the one used on the Lister Mk1



**ABOVE** The back axle is a standard Jaguar item with a Power Lock differential

## POWER TO THE ROAD

Power is sent to the rear wheels via a standard Jaguar gearbox taken from a V12 E-Type. This has a much longer first gear than the original Mk1 gearbox, which is said to make the car much easier to get off the line. First gear is now good for the best part of 60 mph, while the ratios thereafter are quite evenly spaced.

Gannon's obsessive attention to detail is perhaps best witnessed by the fact that he blends his own gearbox oil. "Transmission loss can be a big killer. If you can reduce the losses by 10 per cent that's the equivalent of getting an extra 30 bhp from the engine, which would cost thousands," he comments. "I blend my own base oils to create a fluid which protects the bearings but is low enough in viscosity to minimise drag."

Other little tweaks such as removing the speedo drive all contribute incremental differences to the overall transmission efficiency. Elsewhere, the original propshaft has been replaced with a two-piece item, which minimises the articulation on the universal joint going into the axle (again with the aim of reducing friction).

The Mk1 uses a standard Power Lock-type differential, which locks completely ▶

## “Body roll can be disconcerting. I’ve known drivers to get out and be sick”

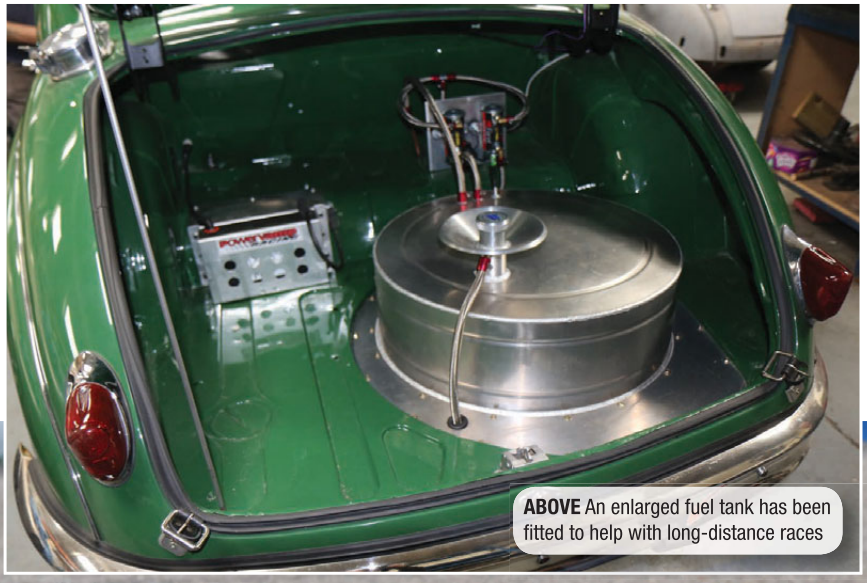
under drive, effectively turning the rear end into a solid back axle. This can lead to problems with understeer on corner entry and it contributes to the Mk1’s rather unusual handling traits.

“You have to drive Mk1s and Mk2s in a permanent four-wheel drift, otherwise it’s virtually impossible to get them to go round a corner at any sort of speed,” explains Gannon. “They don’t feel like any other car. You have to provoke some lift-off oversteer or trail the brakes to get the back to slide and then catch it on the throttle. There’s also an awful lot of body roll, which can be quite disconcerting initially. I’ve known drivers to get out and be sick, particularly at circuits like Cadwell Park.”

The reaction to this particular Mk1 has been anything but nauseous, however. On its first competitive outing at the recent Donington Historic Festival, Jaguar Mk1 specialist Richard Butterfield took the car out for the second stint.

“On his first flying lap Richard posted a quicker time than he did in his own car,” comments Gannon. “Unfortunately on the following lap the diff broke, but his view was that he would have had the car two seconds a lap faster [than his own pole time] given more opportunity.”

Although the exact spec has evolved somewhat over the years, it seems entirely fitting that this remains a Mk1 like no other. Resplendent in its Lister colours once more, there’s something very special about MCH 178. Brian Lister, we suspect, would have approved. HRT



**ABOVE** An enlarged fuel tank has been fitted to help with long-distance races




Jeff Bloxham

**ABOVE** Body roll can take some getting used to

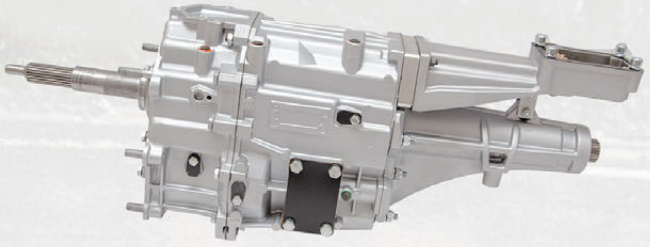
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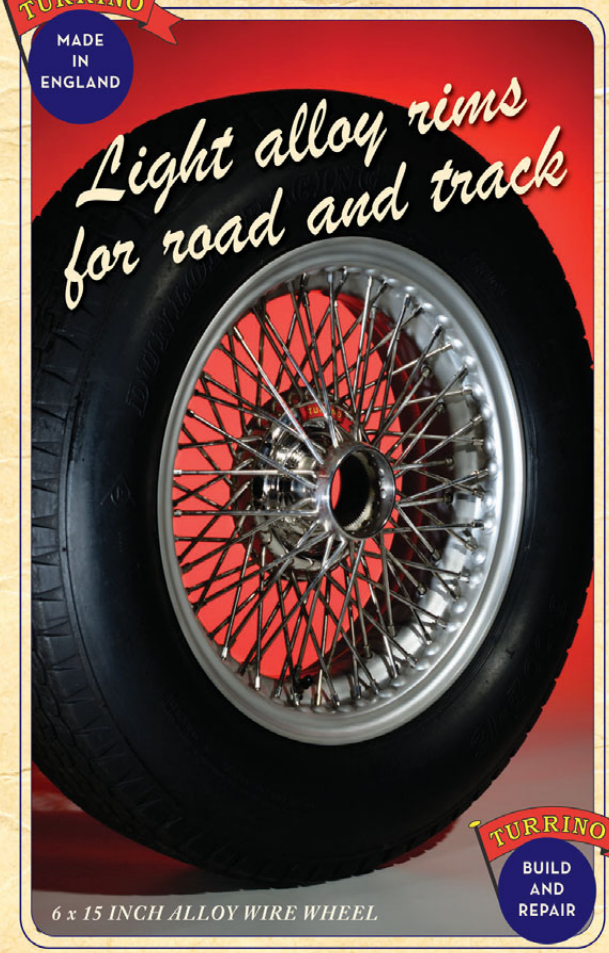

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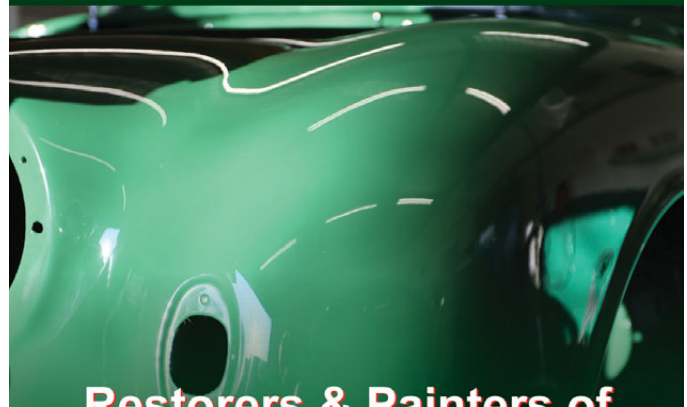
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# SUPERMEN

## You don't need superhero powers to run an iconic Super Touring car like the Williams Renault Laguna. But, as **Hal Ridge** discovers, they would certainly help

**THE** mid to late Nineties was home to arguably the greatest era of Britain's top racing series, the British Touring Car Championship. The Super Touring generation was broadcast live on mainstream BBC television, with high profile drivers and even higher profile manufacturers racing door-to-door in the tin-top saloon car series.

The Super Touring era remains legendary to this day. Cars were built with practically limitless budgets. Manufacturers and Formula 1 teams alike flocked to the category and developed the machinery at a rapid rate of knots. The racing was close, dramatic and exciting but the investment wasn't sustainable long-term and eventually started to dry up. As the manufacturers dropped away, the regulations were changed ahead of the 2001 season in a bid to get the sport and costs back under control.

Arguably the series didn't hit its next peak until recently under the latest NGTC (Next Generation Touring Car) regulations, which were phased in from 2011. ▶



Goodwood Road & Racing/Tom Shaxson




**ABOVE** Andrew Jordan raced the car on a PlayStation when he was a kid and the Laguna was in its pomp. Now grown up and a BTCC champion, he was impressed when he got his hands on the real deal

Two decades on from their heyday, the Super Tourers remain impressive feats of engineering. The notion of multiple manufacturers ploughing money into national-level motor racing programmes is a thing of the past and as such, cars of this kind are unlikely to be created again, certainly not en masse from a range of different marques at the same time.

Simon Garrad's Williams Renault Laguna is chassis 1999/04, one of four cars built by the touring car arm of the British Formula 1 team for the 1999 season. It was raced by former F1 driver Jean-Christophe Boullion, alongside team-mate Jason Plato. It is now campaigned by experienced racer Garrad in the Super Touring Car Championship, a series originally created off the back of a standalone event for Super Tourers in memory of David Leslie in 2009. At the Silverstone Classic, the category has achieved grids of over 30 cars since 2012 and from 2014 it transformed into a full championship, racing at the same circuits that the cars would have competed at in period.

The iconic machines are raced today without major adaption, but changes are required to combat the cost and general lack of existing bespoke components, along with a change of tyre supplier from period. Garrad's car is engineered by Gerald Nicholson, owner of 038 Engineering, tasked with keeping the Laguna as reliable as possible while honing it to deal with even minor changes from period.

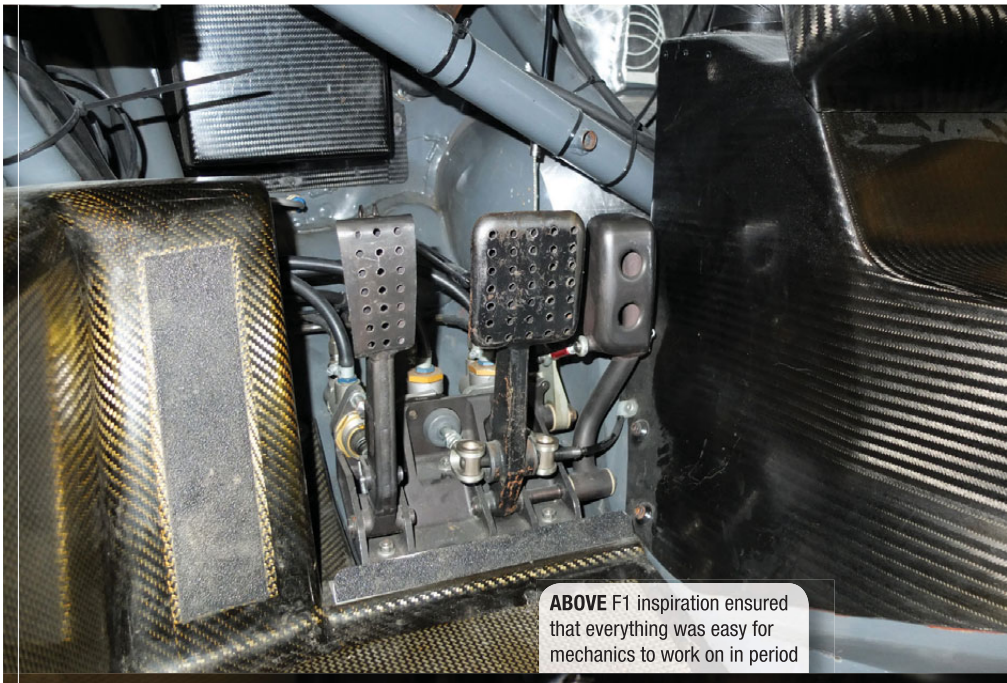
## FORMULA 1 STANDARDS

In a world where many motorsport disciplines are based around standard or strictly regulated components – the modern era of the British Touring Car Championship included – Nicholson enjoys the engineering imagination used in the original creation of the Laguna.

"On the production drawings for setting up the hubs and wheel bearings, everything is measured on a CMM (coordinate measuring machine), so all the bearing components have a tolerance of around 10 microns, if that. That's pretty much indicative of the whole car and the nature of these things coming from Formula 1 outfits," says Nicholson. "The whole car is designed so not only is each part optimised, but it's quite easy to work on, especially in the areas where you would have to on a race weekend. Race mechanics at a circuit would simply be bolting parts on and off in the simplest way possible, without really having to set things up. To me, that highlights how serious these programmes were and the amount of high level manufacturer involvement there was.

"For example, the throttle cable is a two-piece design. The engine would come from Sodemo with the cable already attached, so all the mechanics at Williams had to do was connect a spring and slide one joint together. The stop and everything was set back at Sodemo, ▶

> **"The bearing components have a tolerance of around 10 microns, if that"**



**ABOVE** F1 inspiration ensured that everything was easy for mechanics to work on in period




**ABOVE** Even F1 teams were enticed into the national tin-top series

Photos: Hal Ridge




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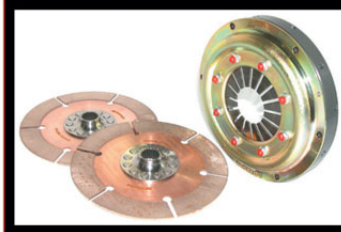
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so there was no room for error.

"It's similar with the steering rack. That's bolted to the front of the gearbox and engine. Once you have separated the rack from the corners, it has a quick-release mechanism from the column and it remains attached to the engine and 'box pretty much all the time. Getting it all out is straightforward: the whole front end of the car comes off, almost complete. The engine wiring harness is all on one plug and it's detached, aside from things like the fuel lines, which are attached by similar quick-release means. The loom is full military spec and would have been an absolute fortune in period. Obviously modern motorsport standards have superseded that now but the technology for the time is impressive."

The Laguna is raced today on a relatively small budget compared to how it would have been in period, and as such the engine is carefully monitored to ensure it remains as reliable as possible. "The engine is from Sodemo. It uses Mahle Motorsport pistons, but this one doesn't have a second compression ring. It's a two-piece, two-ring high intruder piston, with a 12/13:1 compression ratio," says Nicholson. "They were limited to 12.5:1 in period. Mahle did introduce what it called a U-Flex control ring and with anything over five microns of ovality on the bore they stopped working, such were the tolerances on these things.

"They used to simply feed engines into these cars, planning for around five engine changes a weekend. It's got DLC (Diamond Like Coating) followers, so there is very low friction in the head and re-entry finger followers are converted from standard. The valves are titanium Del West with 5 mm stems which are incredibly light. The poundage on the valve springs is very light and they have copper beryllium valve seats, which is a problem for us. We get a lot of seat regress so valve clearance is a bit of a headache. They need re-shimming after every other event. We're almost at the point where it needs new valve seats but they would have to be made from scratch and certainly wouldn't be cheap."

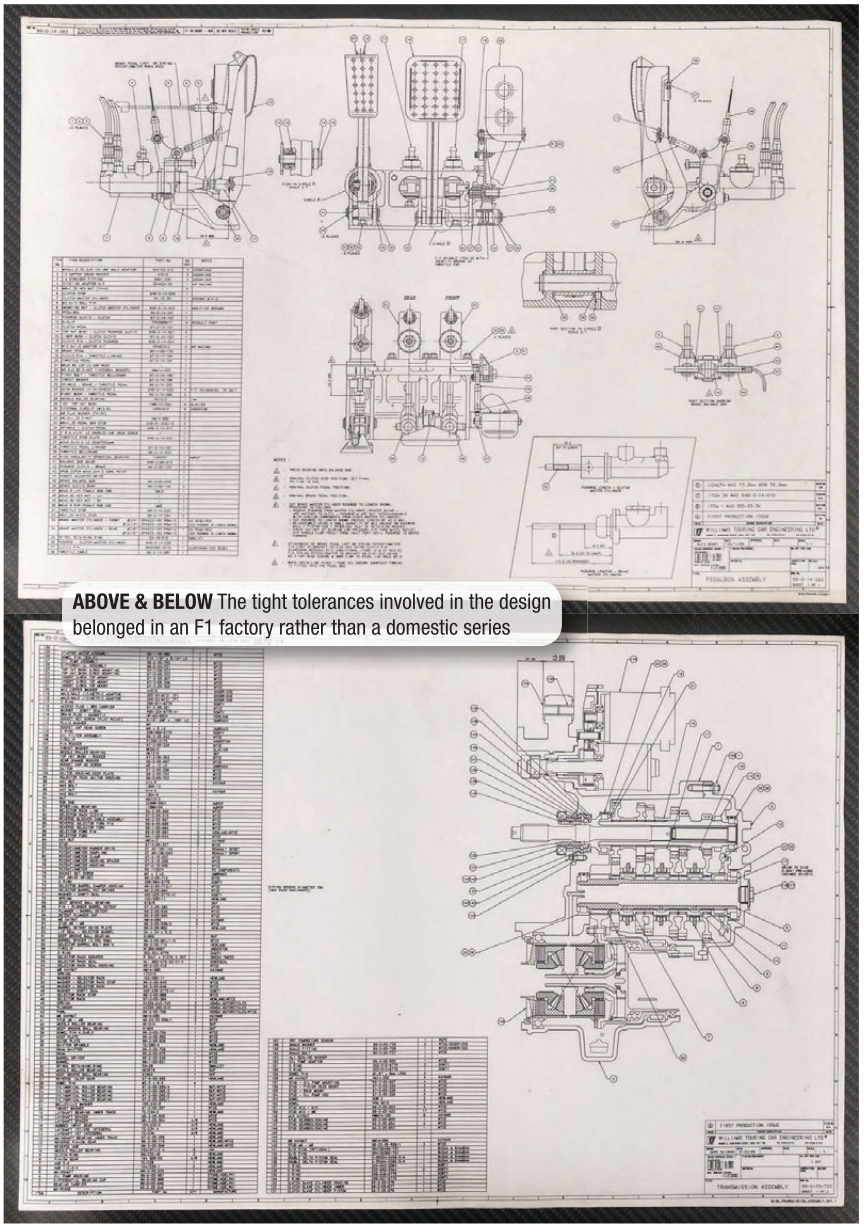
## BESPOKE COMPONENTS

The engine facilitates a long, curved inlet system from the airbox to the trumpets, but unlike many similar units this just features four injectors, not eight. "Sodemo played with eight injectors but they could never get the Magneti Marelli system to do a nice transition," explains Nicholson. "They did put a MoTeC M8 system on it to try and delete the hiccup – MoTeC wrote the code overnight but Sodemo would never come away from Marelli, so it ended up on a four-injector outboard system, using OE Bosch




Hal Ridge

**ABOVE** The car actually ran two dashes in period



**ABOVE & BELOW** The tight tolerances involved in the design belonged in an F1 factory rather than a domestic series

injectors, but to be fair it didn't suffer from lack of torque in period or now, and the response is good."

The car revs to 8,500 as per the Super Touring regulations and although Nicholson doesn't know the exact figures, it produces approximately 295 bhp and 190 ft/lb torque. He says one of the biggest challenges with running the car is the high-end bespoke nature of components that are either too expensive or not available: "Williams won't help with anything really. We've managed to source people who made stuff in period and thankfully with this car we had some spares, and Simon has avoided any big issues so far. Really the next step would be to convert it to modern electronics so you can use it properly. It's all in period, so we're very limited on what data we can retrieve. I've got no real idea where he's revving it to, where he's using the power, whether the thing is running at 200 degrees or if it has no oil pressure, but we set up a camera to try and look at the dash as best we can.

"We have another Super Tourer, an Opel, which we have put on modern electronics for that very reason. We had to rebuild the engine and needed to dyno it, but we can't run it on someone else's fuel map from 15 years ago, so we made the decision to change the harness and the ECU and now we know what's going on. That will probably happen with this. For instance, we're not sure what the coils in the car have come from. Just sourcing the coils themselves would be a problem and if you can't replace them like-for-like, how do you adjust the mapping to suit for new coils? You can't.

"Interestingly, they actually ran two dashes in the car: the standard issue Marelli dash and then a Williams satellite dash which was all fed separately to the Sodemo electronics. That dealt with wheel speeds, damper position, driver inputs as well as engine stuff. The key information was all displayed back to the driver above the main dash, in a red LED panel. We've got the Marelli software but not the Williams."

Attached to the low-mounted dry-sumped engine is a six-speed ▶

## Spec: Williams Renault Laguna

| | |
|---|---|
| **Bodyshell** | Williams |
| **Weight** | 975 kg |
| **Power** | 295 bhp |
| **Torque** | 190 ft/lb |
| **Engine** | 1998 cc Renault/Sodemo |
| **Engine Management** | Magneti Marelli |
| **Transmission** | Williams Hewland (6-speed) |
| **Clutch** | AP Racing |
| **Brakes** | AP Racing |
| **Pedal Box** | Williams |
| **Dampers** | Penske |
| **Springs** | Williams/Eibach |
| **Wheels** | OZ Racing 19" |
| **Tyres** | Hoosier (Michelin in period) |
| **Radiators** | Secan core (end tanks made by Williams) |
| **Fuel** | Petrochem Carless 102 |
| **Fuel Tank** | ATL |
| **Seat** | Recaro |
| **Harness** | Takata |




**ABOVE** It's fantastic to watch, incredible to drive but a real handful to maintain!

sequential Hewland gearbox, developed in conjunction with Williams. The differential is higher than in a normal transverse application, so the driveshafts run just below the cylinder head, mounted to the block. "The clutch is 140 mm diameter triple-plate carbon, with a tiny flywheel. It was advanced technology in its day, but a pretty standard affair these days," notes Nicholson. "The most interesting thing about the transmission is the combi diff. It runs a viscous and a plated diff together so there's no preload on the plated diff at all; it lets the combi take up the slack. After the viscous takes up the initial bite, it drops onto the ramps of the plated diff. It has negative preload on the plated diff, very mild positive preload on the viscous, but nothing like just running a plate diff by itself."

## DRIVESHAFT ISSUES

Nicholson explains that incorrect setup has caused a number of Super Tourers in the series problems of late: "In period, the engineers were very wary of high-speed vibrations from the driveshafts, so they basically let them float in between two joints. A lot of the cars have had driveshaft failures recently, where the geometry is wrong on the car and the shaft either drops out of or into the joint. Different teams had slightly different approaches to that: some just packed the end of the joint with sponge, others used sprung plungers."

> **"There's a lot of fabrication that's not immediately obvious, even to the trained eye"**

The Laguna's suspension is a MacPherson setup on the front, using elliptical arms that wouldn't look out of place on an F1 car. "There's not a lot of adjustment," surmises Nicholson. "There are rose joints on the inner end of the arms but they're fixed at the outer. There's not even any adjustment on the track rod ends for the steering; the only way to adjust the tracking is with shims on the rack, which is not a quick process. Everything was set to spec when it left the factory and it would just change very mildly for driver preference at the track."

The front anti-roll bar is another work of art on the car, attached to each corner by a central pivot position. Using a pushrod and bellcrank system and a central blade, it is adjustable using a lever inside the car, allowing the driver to change the stiffness.

The Laguna's uprights are bespoke fabricated steel units, while the car uses Penske dampers with Williams springs. "They are three-way adjustable dampers: high speed, low speed and rebound; as much as you would expect from a racing damper nowadays," he says. "There were a lot of different specs of dampers throughout each year then though. The valving changed from track to track and everything was a constant evolution. There's a difference in anti-roll bar from this car to chassis #3, even though they were sisters.

"Some of the cars had carbon fibre seals in the dampers. This one does. I contacted Penske about rebuilding ▶

# Masters HISTORIC RACING




# 2016 EVENT CALENDAR

| | | | |
|---|---|---|---|
| APRIL | 09 – 10 | Zolder, Belgium | Masters Festival |
| MAY | 28 – 29 | Brands Hatch GP, UK | Masters Historic Festival |
| JULY | 02 – 03 | Donington Park GP, UK | Masters Festival |
| | 29 – 31 | Silverstone GP, UK | Silverstone Classic |
| AUGUST | 12 – 14 | Nürburgring, Germany | Oldtimer Grand Prix |
| SEPTEMBER | 02 – 04 | Zandvoort, Holland | Historic Grand Prix |
| | 16 – 18 | Spa-Francorchamps, Belgium | Spa Six Hours |
| OCTOBER | 15 – 16 | Jarama, Spain | Espiritu de Jarama |

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| | | | |
|---|---|---|---|
| NOVEMBER | 10 – 13 | Daytona International Speedway, USA | Daytona Historics |
| DECEMBER | 01 – 04 | Sebring International Speedway, USA | Sebring Historics |

Correct at time of going to press. Dates and venues may be subject to change.

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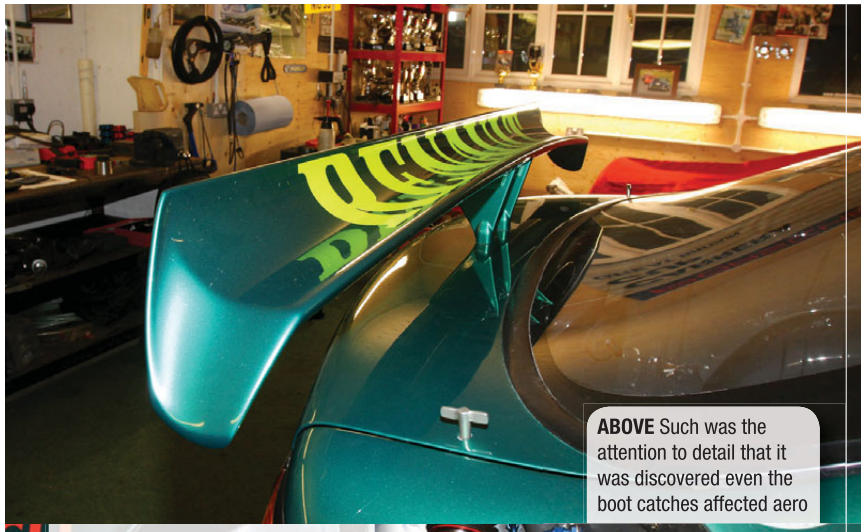
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them and the quote went from £75 to £600 per corner, depending on what seals they had to use. We've got the measurements for all the seals, like in the gearbox, and we can't buy replacements – we've got to remould everything. That's the same throughout the car."

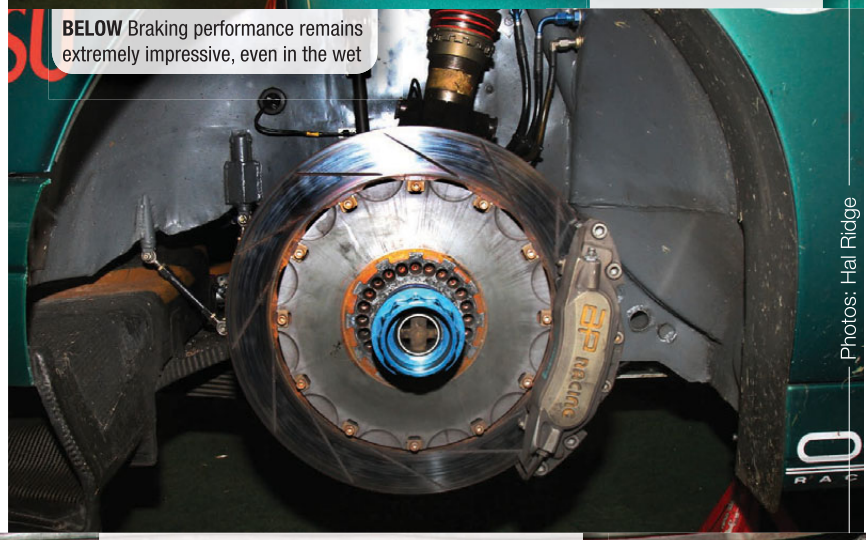
## EXTENDING LIFE

Nicholson works hard to extend the life of components beyond their originally intended use. "We've changed the wheel bearing grease for instance," he explains. "The hubs and wheel bearings were quite short life parts, which isn't an option now. They're quite vulnerable to dirt, weather and especially setup, so we use neo synthetic grease now as part of the service regime to make them last as long as we can. We've had to swap the driveshaft boots too, because we just can't get hold of the Williams moulded ones, so we're using a GKN fast boot now.

"Similarly, we've switched to Ferodo DS300 brake pads because they're a

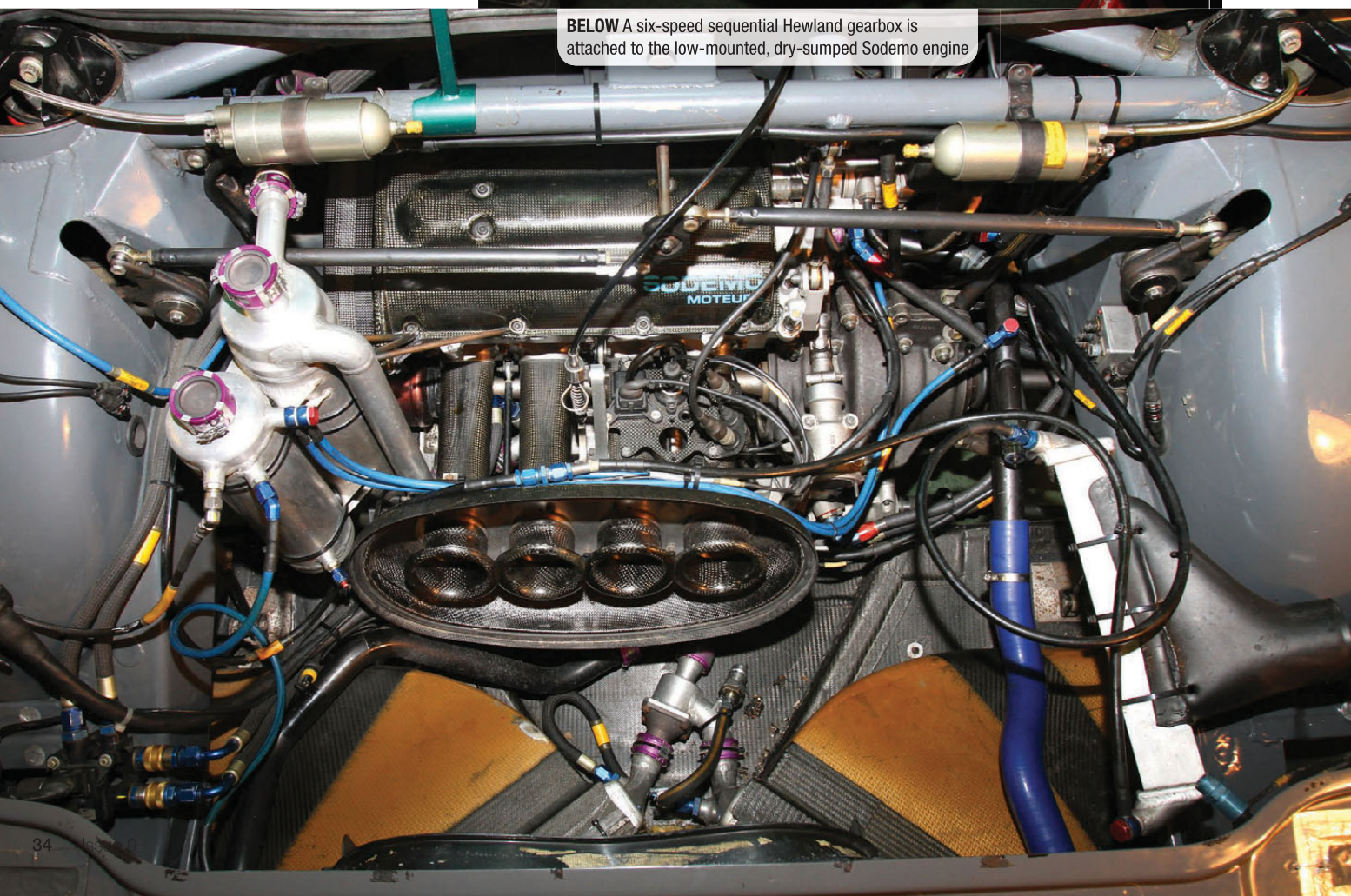


**ABOVE** Such was the attention to detail that it was discovered even the boot catches affected aero



**BELOW** Braking performance remains extremely impressive, even in the wet

Photos: Hal Ridge



**BELOW** A six-speed sequential Hewland gearbox is attached to the low-mounted, dry-sumped Sodemo engine

known quantity to us anyway, and we're not utilising the water cooling function on the AP Racing six-pot front callipers. For sure we have had to compromise a bit in some areas. The car uses a pre-heater, which is an external heater plumbed into the cooling system to heat the coolant around the engine to bring it up to operating temperature before starting, just like in Formula 1. The Priest dry-break fittings on the car were hugely expensive and not available, so we've had to change that too."

One of the great appeals of touring car racing is the fact that the cars on the circuit are relatable to those the consumer drives on the road every day. That is what makes the BTCC series attractive to manufacturers. As such, this really does look like a Renault Laguna, although there are obvious differences. "It all looks almost standard," says Nicholson. "The wheel arches are up, and everything is tubbed to bring the sub frames higher. It's got quite a special mid-mounted swing axle arrangement for the rear suspension to get the roll centre down low. The whole car is stressed on the roll cage – they pretty much started with the cage, mounted it to a floor pan and attached the panels around it.

## BTCC champ goes back in time

**ANDREW** Jordan, who won the British Touring Car Championship title in 2013 and is one of the leading lights in the sport, relished the chance to drive Garrad's Laguna. The opportunity was part of his role working with Goodwood Circuit to promote this year's 74th Members Meeting event, in which Garrad drove the Laguna in a Super Touring demonstration.

Jordan is relatively unique in that while he is one of the current breed of young stars, he is also partial to historic racing. He is a regular competitor in historic events, while also running the Jordan Racing Team with his father Mike, which builds and runs a range of historic racers for clients. As such, he has experience of driving a wide variety of machinery.

"Super Touring was for me the golden era of touring cars. This is what I grew up watching," says Jordan, who was 10 years old when Boullion raced Garrad's Laguna in 1999. "It was really cool to get the opportunity to drive the Williams Laguna. I would have played on these cars on the (TOCA 2) PlayStation game. It was everything I hoped it would be and more.

"Having grown up watching them I obviously hoped it was going to be lovely to drive, but I really could have driven that all day long. The grip and the feel it gave enticed you to go quicker, it gave you good confidence."

Jordan enjoyed the noise emitted by the naturally aspirated 2-litre engine: "It sounded wonderful, much better than any turbocharged engine and it's just asking to be revved and pushed hard. I drove the car in the wet but even then the brakes were impressive, and the car was responsive. It wasn't too difficult to drive, but unlike modern cars they are much more reliant on aerodynamics, so extracting the last bit of lap time would require big commitment. I'm pretty at home in the NGTC so I know what a top-level touring car is like, but these things are clearly no-expense spared and it was great to be able to have a go in one." HRT




**ABOVE** Jordan found the car's grip enticed him to push harder

Goodwood Road & Racing/Tom Shaxson

> **"The rear boot catches had an effect on the aero in the wind tunnel. Running them in line with the car does make a difference to the drag!"**

### IMPRESSIVE AERO

"These are bespoke race cars. There's a lot of fabrication that's not immediately obvious, even to the trained eye. There's very little carbon fibre externally, even the front wings are pressed steel and the front bumper is standard to an extent. It's got the diffuser and ducts for the radiators, which are mounted in a V arrangement for efficiency, all as one. Weight was only used where it was needed; there isn't a bonnet prop because it would be extra weight. The aerodynamics are impressive, even though it was strictly regulated. There's a lot of work gone into the front splitter and at the rear. An engineer who worked on the car in period told me that the rear boot catches, which rotate to lock the boot down, had an effect on the aero in the wind tunnel. Running them in line with the car does make a difference to the drag!"

While keeping the car running as close to how it was in period as they can, Garrad and Nicholson have had to alter the setup of the car to suit the tyres now used in the Super Touring series. Bolted to the 19" magnesium wheels is a ▶




**ABOVE** The supply of Hoosier tyres has helped the Super Touring series gather momentum

set of 210/650 R19 Hoosier tyres. "When the Super Tourers started again, Dunlop were doing tyres similar to the ones from period, but they couldn't offer full support so now we run Hoosiers," says Nicholson. These have a much stiffer sidewall, which has changed the setup of the car quite dramatically.

"Before we could run a lot of camber and still not overuse the tyre, but we've had to take a lot of camber and caster off. Now the setup has changed, the overall grip level is not massively different, but it has taken a while to get there. This is very different to period: back then they were changing the compounds numerous times throughout the year, for specific tracks and sessions in events."

The Hoosier tyres that have been mandatory in the series since last year – the Laguna originally ran Michelins in period – are provided by ProTyre. Jason Buckley is the firm's assistant motorsport manager and works as an engineer on events.

"Dunlop weren't in a position to supply the series any more so we went to Hoosier to see if they wanted to be part of the championship, and they've come on board. They are one of the world's biggest manufacturers of motorsport tyres and only make competition tyres. They had never done a 19" slick before, so it was all-new. They're developing the tyre and it's just gone from strength-to-strength," says Buckley. "The Super Tourers run one tyre that is in two different compounds, and a wet. We originally tested three compounds and went with the preferred choice. Some loved it, some thought it was a bit too hard, so Hoosier has now developed a softer option.

## MIXED COMPOUNDS

"In their heyday a lot of the cars ran two compounds at the same time. Some are running a mixture now and some are still running the harder tyre; it's down to driver choice. There's such a range of cars and setup, you're never going to get the perfect tyre to suit every car, you would just be producing tyres left, right and centre. Hoosier coming on board has kept these cars running, because a narrow 19" slick is not a common tyre now."

The final word on Williams' creation is left to Garrad, who explains that it requires to be driven on the limit to extract the most out of it. "The first time I sat in it, it was night and day compared to other things I've raced. It does everything you want it to do. Being on the limit is where it wants to be, it's just getting to that point, putting your trust in the car that it's going to do what you want it to do, and it does. It's fantastic," he says. "The Hoosiers are getting there now, they're spending money on development, which is fantastic and the Super Touring series is coming on."

Garrad says that owning and racing a competition car from an iconic period of motor racing is special: "It's great, I'm very biased, but I think it's one of the most special and best-looking cars on the grid. It gets a lot of attention. It's wonderful to own and it's just great to drive." HRT

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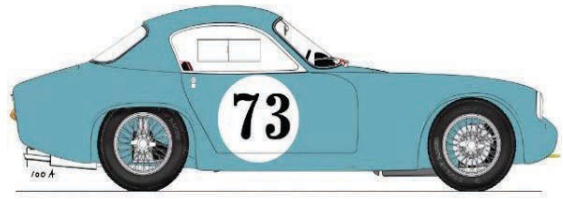
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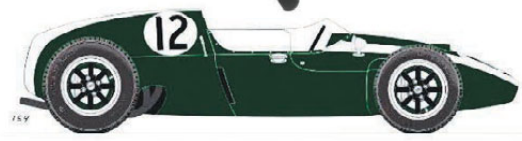
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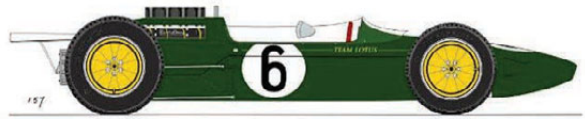
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# PORSCHE'S WOLF IN THE GT FOLD




Porsche 993 GT1-109 was one of just nine racing Porsche 911 GT1s built between 1996 and 1998. **Glen Smale** looks into what made this car so successful

**I**T surely comes as no surprise that when Norbert Singer, described as the architect of Porsche's sports car racing, spotted the Dauer 962 Le Mans GT at the 1993 Frankfurt Motor Show, the cogs of creativity began to turn in his mind.

At this time Porsche only had the 911 Carrera RSR 3.8 as a GT racing contender, but the Dauer 962 certainly offered the possibility of an overall win at Le Mans. It is now a matter of history that Porsche did in fact win the 1994 Le Mans 24 Hours race after Singer had worked his magic on the Dauer cars, but the focus was shifting more towards GT cars.

"The Le Mans people didn't really like the Dauer car, but it was to the letter of the regulations, and out of this we developed the GT1 car," said Singer. "The idea was to have it as close to the road car as possible, and so for the 1996 and 1997 seasons we took the steel bodyshell of the 911 and cut it behind the driver seat. We then made up a frame which we attached to the back of this, and by turning the engine and gearbox around, we had a mid-engined car."

The brief was that the GT1 should resemble the 911, and so under the watchful eye of Singer and Horst Reitter, the mid-engine concept, based around a standard 911 bodyshell, began to take shape. Tony Hatter, a Scottish designer at Porsche, was given the task in early July '95 of penning the shape. The car had to meet all the necessary criteria for motorsport as well as road use, but above all, it had to be instantly recognisable as a 911.

Later that same month, the Porsche Board gave its approval for the project to proceed and by November the design and all dimensions were finalised. Two months later, in January '96, the first chassis for the roadgoing car arrived, and this was followed by two racing chassis in March.

The GT1's first competitive race was the 1996 Le Mans 24 Hours. The two works cars came home first and second in the Le Mans GT-1 class, finishing second and third overall behind the TWR-Joest Porsche WSC95.

Our feature car, GT1-109, was built in early 1997 and was sold new to Konrad Motorsport as a 993 GT1. It made 11 appearances during that season, the first three outings in May of that year being the Le Mans test weekend, Silverstone where it finished 12th and Helsinki, finishing seventh in rounds of the FIA GT Championships. Wearing its green/blue Giesse/Warsteiner livery, GT1-109 recorded DNFs in the Le Mans 24 Hours, due to an accident, and at the Spa round of the FIA series.

The GT1 Evo version was introduced for the 1997 season, and improvements included a wider track with a reworked suspension, with the most distinguishable exterior feature being the new 996-like front end. The GT1 Evo also boasted another innovation, the 6-speed sequential gearbox actuation mechanism that had been developed by Porsche.

At the end of July 1997, our feature car returned to Porsche where it was converted to the new Evo spec whereupon it was sold to the French team, JB Racing. Now wearing the 996-nose, and finished in the Marlboro colours of its sponsors, GT1-109 participated in the Suzuka 1000 Km, Mugello 4 Hours, Sebring 3 Hours and the Laguna Seca three-hour race.

With GT1-109 ending the '97 season in the US, the car attracted the attention of Larbre Competition owner and founder, Jack Leconte, who purchased it. Prior to the 1998 Le Mans race, a new lightweight clutch was fitted to the car at the Porsche factory, but this component broke on its first lap during qualifying and the team did not have sufficient time to repair the unit and for the drivers to post a qualifying time. As a result, GT1-109 was not allowed to participate in the Le Mans race that year although it did compete in a number of other events. At the end of the season, though, it was retired by Larbre.



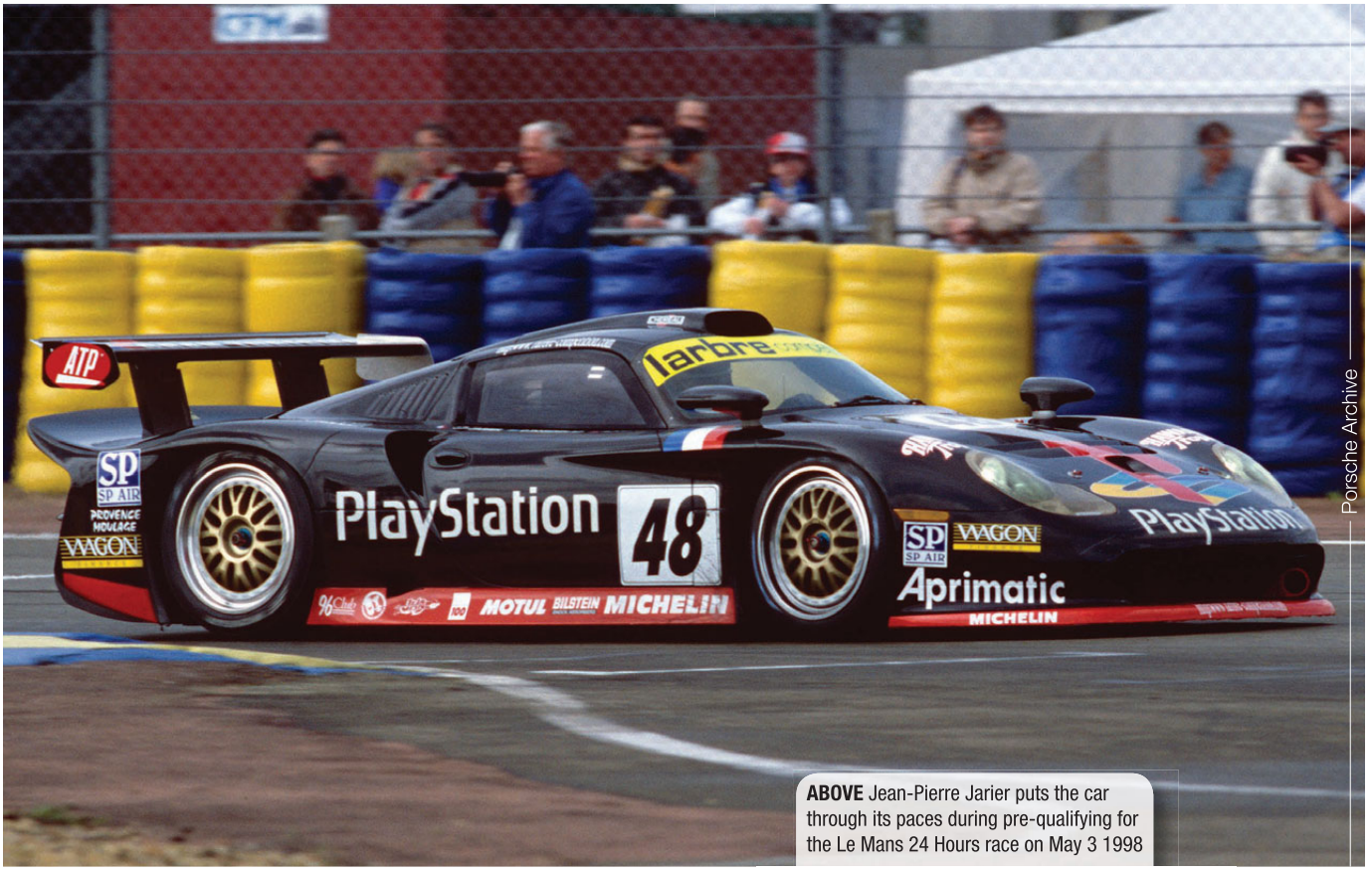

Photos: Glen Smale

## ENGINE AND GEARBOX

The GT1's 3.2-litre engine, which was semi-stressed, used a standard 911 6-cylinder aluminium crankcase with aluminium cylinder heads. The block and heads are all water-cooled and the engine was dry-sumped. The valve train consisted of four valves per cylinder, two inlet and two exhaust valves, which used rigid bucket tappets with valve play compensation. The engine was fitted with two KKK K27.2 exhaust gas turbochargers with 35.7 mm air restrictors (1996 models). Fuel injection was of the Multipoint, sequential type with Lambda control, with single plug ignition. When the GT1 was introduced, it was fitted with the TAG 3.8 engine management system.

Mated to the engine was a bespoke Porsche racing gearbox, a 6-speed fully synchronised unit in a conventional ▶

**"The Le Mans people didn't really like the car, but it was to the letter of the regulations"**




Porsche Archive

**ABOVE** Jean-Pierre Jarier puts the car through its paces during pre-qualifying for the Le Mans 24 Hours race on May 3 1998

H-pattern layout with a single-disc sinter metal racing clutch and a locking differential. Additional lubrication was by means of an oil pump with an oil-to-water heat exchanger.

## BODY AND CHASSIS

The body was fabricated from carbon fibre by Zakspeed and was built up using a Type 993 front end structure, which terminated at the B-pillar. The cockpit section was reinforced with a roll cage, and a bulkhead stretching the full width and height of the body was fixed behind the driver. To the bulkhead was attached the frame that carried the engine, gearbox and suspension mounting.

The body of the GT1 was extremely sleek and aerodynamic. The air inlet for the turbocharger was located on the roof, directing an airstream into the airbox sitting above the engine. Air passing over the car then flowed over the adjustable rear wing, which on the early cars was reasonably small. By comparison, the Evo model had a much bigger rear wing with side plates reaching almost down to the rear bodywork of the car.





**ABOVE & BELOW** The air inlet for the turbocharger directs air from the roof into the airbox sitting above the engine



**ABOVE** The scoop behind the door guides cool air down to the rear hubs and brake callipers

On the early GT1, the bodywork around the front was quite smooth with a small chin spoiler, while the Evo model boasted a more aggressive chin spoiler with front dive planes. The Evo also let more air out of the back of the wheel well, and the shape of the rear bodywork had a more pronounced lip which the 993 version does not have.

Centrally located on the front bonnet is an air scoop which directs cool air into the cockpit. Low down on the car's nose is a large radiator opening which feeds air to the centrally-mounted flat radiator for engine cooling, the air from this exits through two large vents on the bonnet. On each side, but still within the radiator opening, are two ducts which channel cool air to the front hubs and brake callipers. A fairly substantial air scoop just behind the door guides cool air down to the rear hubs and brake callipers. Located lower down on the rocker panel, and just ahead of the rear wheel, is a NACA duct which feeds air to cool the turbos. ▶

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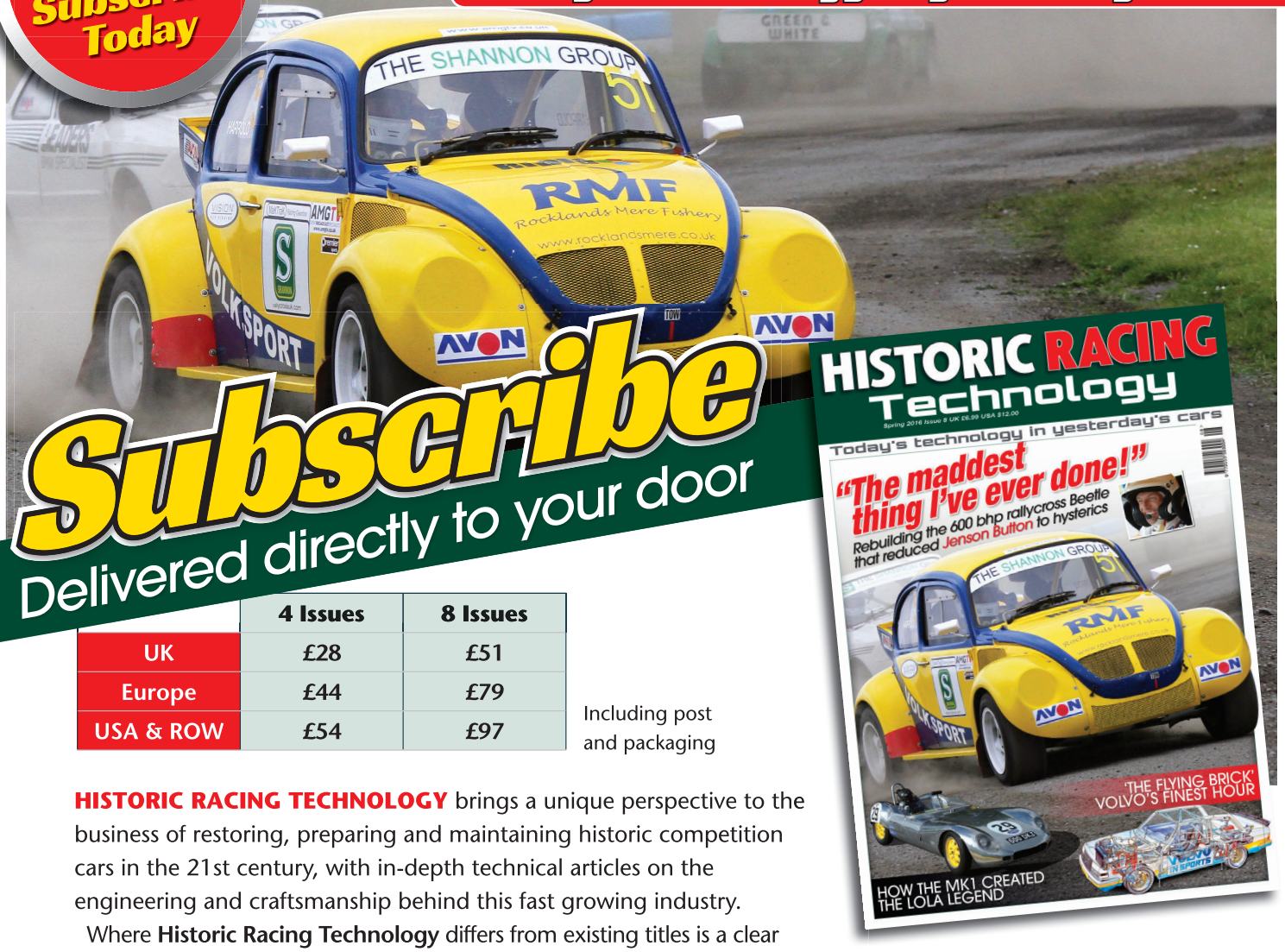
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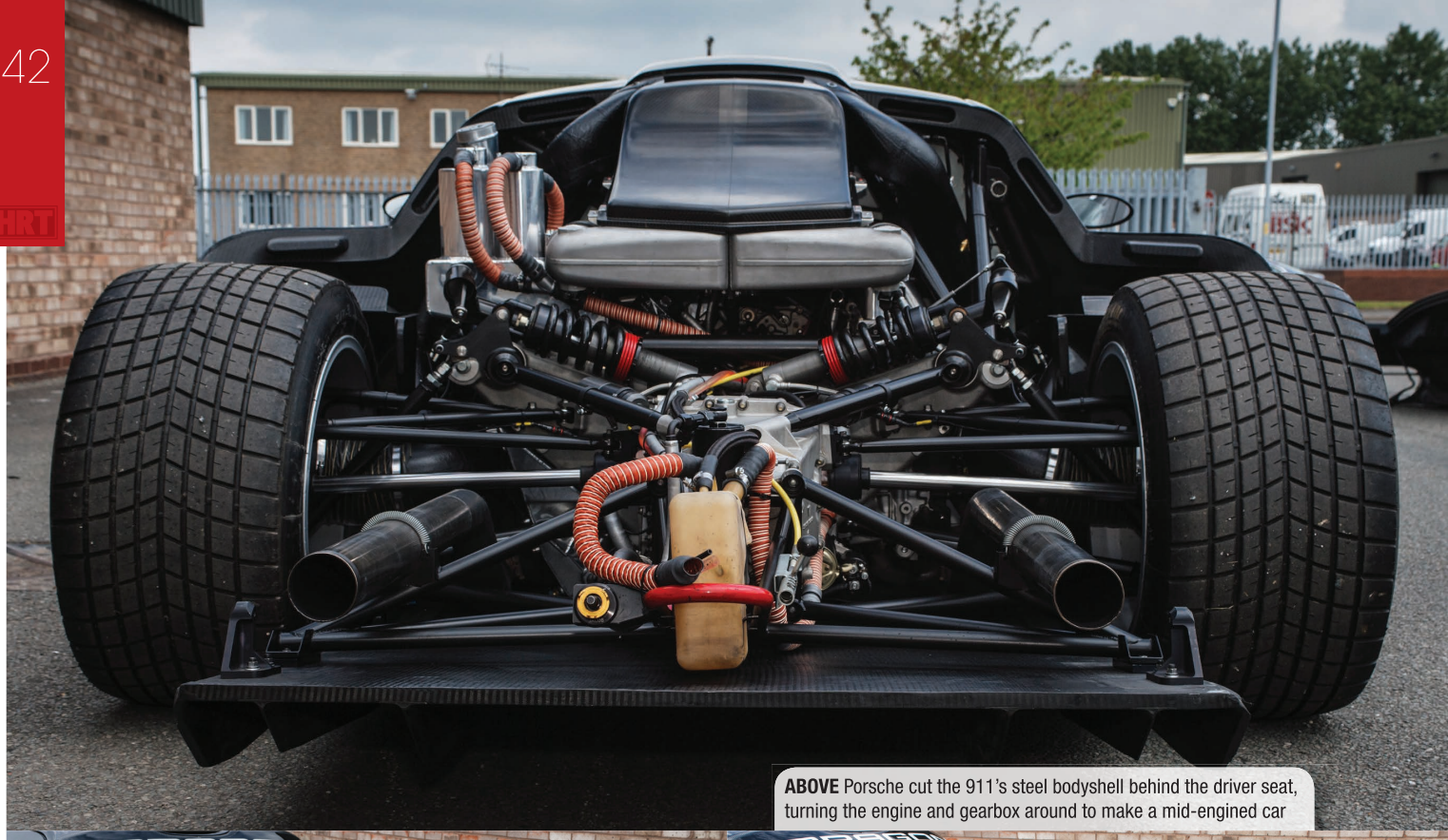
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**ABOVE** Porsche cut the 911's steel bodyshell behind the driver seat, turning the engine and gearbox around to make a mid-engined car






**LEFT & RIGHT** The front of the car, seen here clothed and unclothed, focuses on cooling for engine, brakes and driver alike

## SUSPENSION, WHEELS AND BRAKES

Due to underbody constraints, the original McPherson struts would not have allowed sufficient space for suspension adjustments. As a result, the front suspension was replaced with a double wishbone setup. As one technician put it, from the rear suspension mounting rearwards, it was 'all prototype', and consisted of the suspension components including an adjustable anti-roll bar and the racing gearbox. The rear suspension, which was attached to a sturdy frame that sat between the engine and gearbox, consisted of upper and lower A-arms with pushrod actuated spring/dampers. Both front and rear dampers were each fitted with their own reservoir to ensure that the pressure within each damper remained optimal.

The works GT1 cars were fitted with centre-lock BBS wheels, courtesy of a sponsorship deal Porsche had with the wheel supplier. They were comparatively heavy on the factory cars, which led some of the privateer teams to opt for the lighter monoblock OZ Racing wheels. These were 18-inch wheels, but the 1998 Le Mans-winning works cars had 19-inch wheels.

## REBUILD

In 2007, Mark Sumpter, of Paragon Porsche, purchased GT1-109 but unfortunately the engine had picked up a misfire while in the hands of one of its previous owners. The task of rebuilding GT1-109 was given to Paul Knapton of X-Tec and at first it was just the engine that was going to be done. However, Sumpter soon realised that this was a golden opportunity to restore the whole car, as he explains, "I didn't know the extent of the engine damage when I bought it, but just assumed the worst. I have been around enough racing cars to know that it wasn't going to be an easy fix."

Dismantling the engine revealed damage to the crankshaft, which meant all the internal parts would need to be replaced in a race car of this stature. A new crankshaft was sourced from Porsche, along with Mahle pistons, liners and titanium con rods, chains, valves and valve springs, resulting in a comprehensive rebuild.

The racing cams provide 385/1000 of an inch lift on both inlet and exhaust valves. Inlet valves are 37 mm in

diameter while the exhaust valves are 32 mm, with both having a 6 mm stem diameter. Inlet cam timing is 105° ATDC and the exhaust cam timing is 107° ATDC. Following the engine rebuild, Knapton puts the current output at 650 bhp at 7600 rpm.

GT1-109 received a new wiring loom during the rebuild, and although the GT1 was originally fitted with a TAG engine management system, this was replaced with a MoTeC unit. "Updating the electronics wasn't done so much as a performance issue, it was just to make it more user-friendly," says Knapton. "If anything, we have simplified it because we can access the data logging more easily so we can keep on top of any potential problems before they crop up."

When taking the paint down to bare carbon fibre, evidence of the Marlboro livery was found, but Sumpter wanted the car to be finished in its PlayStation livery. "That is the way I remember the car. People talk about the PlayStation generation, and I just think it is quite an iconic car. The other thing is that with cigarette advertising, it will possibly become harder to run those cars in the future. Although the Marlboro colours are cool, it is still cigarette advertising, and I just prefer the PlayStation livery."

New brake callipers were sourced which were still available, but new carbon discs had to be fabricated. "We still have the original discs and they looked fine, but they were just old, and it is better to fit new ones than to risk using the almost 20-year-old carbon discs," says Sumpter.

## DRIVING AND MAINTENANCE

The car starts with a traditional key, but GT1-109 has not raced since it has been in Sumpter's ownership, it has only done the odd track day and demonstration run. Even so, when preparing the car for an outing, it must still be checked over thoroughly, as Knapton explains: "Apart from basic spanner checking, it has got carbon brakes so we keep an eye on the brake wear and we do basic fluid changes in the engine, but other than that, the car is very good."

It has got heat exchangers from the water to the engine and to the gearbox, so to warm it up from cold might take 10 minutes. After starting it up, it will just be left to run at 1500 rpm for a minute or two, and as the temperature builds up, the revs will be increased to 2000 or 2500 rpm until all temperatures level out at around 75°C to 80°C. The team ensures that it uses a good quality, fully synthetic oil in the engine and gearbox.

GT1-109 has proved extremely reliable, but as Knapton admits, "We had a breather pipe split from the oil tank, but that's about the only thing. It made a bit of a mess, but apart from that, we've had no mechanical issues with the car at all." ▶

## Technical specifications (28 April 1996)

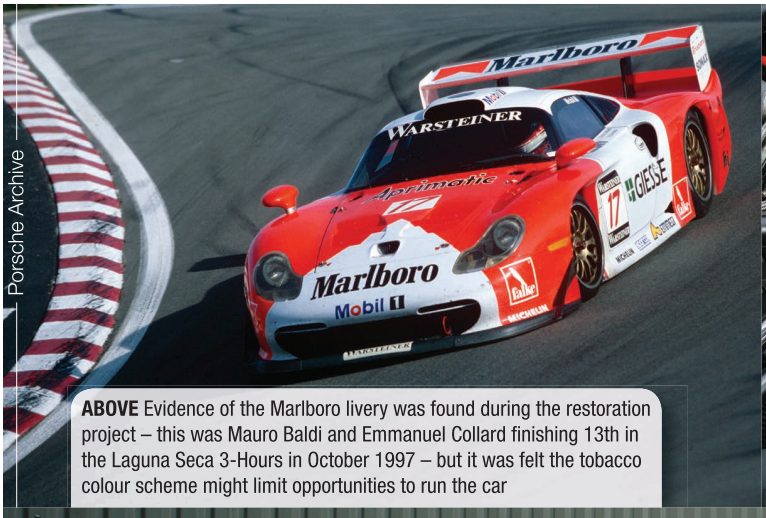
| | |
|---|---|
| **Engine** (M96/80) | 6-cylinder boxer |
| **Capacity** | 3200 cc |
| **Bore x stroke** | 95 mm x 74.4 mm |
| **Power output** | ca. 600 bhp @ 7200 rpm |
| **Torque** | 650 Nm @ 5500 rpm |
| **Valves** | 4x valves per cylinder |
| **Turbos** | 2x KKK K27.2 exhaust gas turbochargers |
| **Restrictors** | 2x 35.7 mm |
| **Intercoolers** | 2x charge-air intercoolers |
| **Lubrication** | Dry sump |
| **Engine management** | TAG 3.8 |
| **Fuel supply** | Multipoint, sequential fuel injection with Lambda control |
| **Gearbox** (G96/80) | 6-speed synchronised |
| **Gear ratios** | 1st gear 13/41; 2nd gear 20/40;<br>3rd gear 21/33; 4th gear 29/36;<br>5th gear 33/35; 6th gear 34/31 |
| **Clutch** | single-disc sinter metal racing clutch |
| **Lubrication** | Dedicated oil pump with oil-to-water heat exchanger |
| **Differential** | Locking differential |
| **Suspension** | Front: double wishbones<br>Rear: double wishbones with pushrods |
| **Shock absorbers** | Adjustable front and rear |
| **Anti-roll bar** | Adjustable front and rear |
| **Steering** | Power steering |
| **Wheels** | Front: 11.5 x 18" ET49<br>Rear: 13 x 18" ET66 |
| **Brakes** | carbon disc brakes front and rear, hydraulic servo unit |
| **Discs** | Front: 380 x 37mm<br>Rear: 380 x 37mm |
| **Callipers** | Front: 8 pistons (fixed)<br>Rear: 4 pistons (fixed) |
| **ABS** | Bosch ABS |
| **Electrics** | 55Ah battery<br>Main switch<br>2x main Litronic headlights<br>2x auxiliary headlights (Le Mans) |
| **Dimensions** | Weight: ca. 1000 kg<br>Length: 4683 mm<br>Width: 1946 mm<br>Height: 1173 mm |
| **Ancilliaries** | Air jacks<br>100-litre fuel tank with integrated catch tank<br>Rapid tank valves with reserve switch<br>Racing bucket seat with 6-point racing harness<br>Fire extinguisher system |

One small modification was made during the five-year rebuild, and that was to fit a passenger seat. “I have no plans to race the car at the moment and I don’t want to customise it, but we added the extra seat by moving the position of the battery. This was done subtly without affecting the car’s provenance, and it has been good to let other people have a ride in it,” says Sumpter.

Two years ago, he took the car to the Paul Ricard circuit in the south of France. “It’s a very open circuit and you can really push on a bit without risking anything,” he says. “The car is very different from the 962; it has far less aero but that actually makes the GT1 feel faster strangely, even though it has slightly less horsepower. With less aero, a 6-speed ‘box and bigger brakes, it’s quite a busy car to drive, but it’s also exciting because there’s a lot to do, especially with all that power, you are forever changing gear. With the seating position, you have a lot of space in the car and it feels so much more modern than the 962.

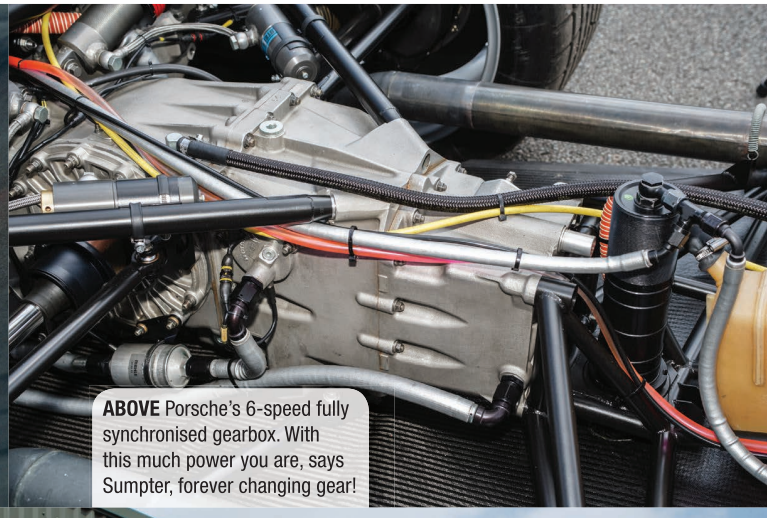
“The gear stick feels like it goes straight into the top of the gearbox; they really have sorted out the linkage problems because it just clicks in and out, you couldn’t get a gear wrong. We haven’t changed springs and dampers, it still feels like a typical factory-built Porsche, it all works properly and it is very well-balanced.”

Unfortunately, there isn’t a series where the GT1 can currently be raced in Europe, so for now we will just have to be content with watching the sleek PlayStation GT1 doing demonstration laps at various events. HRT

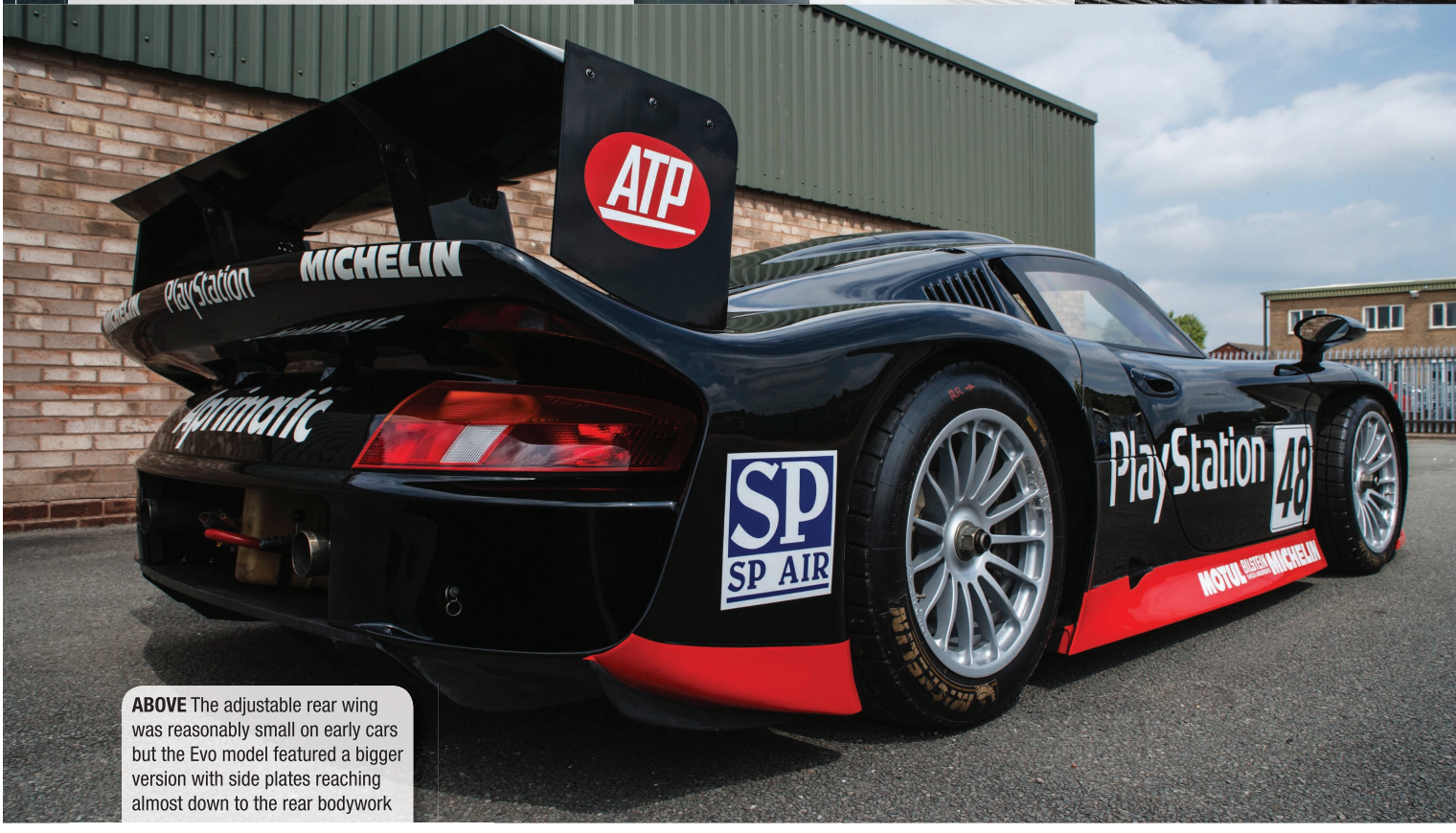



Porsche Archive

**ABOVE** Evidence of the Marlboro livery was found during the restoration project – this was Mauro Baldi and Emmanuel Collard finishing 13th in the Laguna Seca 3-Hours in October 1997 – but it was felt the tobacco colour scheme might limit opportunities to run the car



**ABOVE** Porsche’s 6-speed fully synchronised gearbox. With this much power you are, says Sumpter, forever changing gear!




**ABOVE** The adjustable rear wing was reasonably small on early cars but the Evo model featured a bigger version with side plates reaching almost down to the rear bodywork

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# THE DOMINATOR

## Introduced to the world in 1962, the Ferrari 250 GTO was a formidable racer, and came to dominate its class between 1962-1964. **Glen Smale** uncovers some of what made this car so successful

**I**n 1961, Jaguar introduced its revolutionary E-type fitted with a 3.8-litre engine, while at the same time, Aston Martin was busy developing its 4-litre DP212. Enzo Ferrari had his highly successful 250 SWB to offer privateers, but his concern was that this car was at the end of its developmental lifecycle, and with the opposition introducing their new models, his car would soon be uncompetitive. Although the 250 SWB was powered by a smaller capacity 3-litre engine, there was some scope to develop it further.

Giotto Bizzarrini, Ferrari's chief engineer from 1957 to 1961, was instrumental in creating the 250 SWB and was responsible for getting the GTO project off the ground. However, in 1961 after laying down the plans for the car, Enzo fired half a dozen of his key engineers in the famous 'palace revolt,' and Bizzarrini was one of them. The 250 GTO was in due course completed by Ing Mauro Forghieri.

In an attempt to improve the car's aerodynamics, the 250 GTO featured a more streamlined nose than the 250 SWB, which resulted in a smaller grille aperture. This in fact created another problem, that of getting sufficient air through the grille opening to cool the radiator. Despite having the same basic engine as the SWB, the GTO's engine produced more power which in turn generated additional heat in the engine bay. Getting more air in to cool the radiator was solved by cutting six additional openings in the nose, three just above the main aperture and three below. The top three openings have removable covers which are fixed in place by means of Dzus fasteners, while the bottom three openings have internal flaps which hinge back. These covers

could be left in place or hinged back/removed depending on track conditions on the day.

This cooling problem was highlighted on GT cars which also doubled as roadgoing vehicles, because when driven up steep Alpine passes, one would use a lot of power accelerating between the bends without actually reaching very high speeds. It was here that most of these high-powered cars would overheat, as insufficient air reached the radiator to cool the engine.

The GTO featured a longer front overhang than its predecessor, the SWB. The intention was to make the front end lower, and this necessitated making it longer in order to accommodate the engine height, even though the engine was located further back and lower in the chassis. The other most noticeable and profound change to the body can be seen at the rear of the car, where the Kamm tail of the GTO replaced the more rounded backend of the SWB.

The 250 GTO's first competitive outing was at the Daytona Continental 3-Hour race on 11 February 1962. As Ferrari had not yet received official homologation for the newcomer at this race, it had to compete as an Experimental car in the Grand Touring class. Once homologated, the GTO's official debut was the Sebring 12-Hours where, in the hands of Olivier Gendebien/Phil Hill, it won the GT class and finished second overall behind a prototype Ferrari 250 Testa Rossa.

## A STAR IS BORN

Ferrari 250 GTO (chassis 3757) was manufactured on 14 June 1962, and was sold new to the Belgian, Jacques Swaters of Ecurie Francorchamps. Its most notable achievement was a third place finish overall in that year's Le Mans 24 Hours in the hands of Léon Dernier/Jean Blaton. This was followed by another third place finish just three months later in the Tour de France where it was driven by Gerard Langlois van Ophem/Robert Darville, and a sixth place finish in the Angolan GP in Luanda in 1963. The car remained active until the end of the 1965 season after which it passed through the hands of three more owners before being purchased by Nick Mason in 1978. Today it is a well-known car, appearing in many events such as the two Goodwood events, the Festival of Speed and the Revival, and it takes part regularly in European tours.

It is understandable though, that in period a car such as the 250 GTO would have been raced hard, because that was the purpose for which it was built. However, with the market values for these cars having literally exploded in recent years, does one park it or race it? Most owners will tell you in no uncertain terms, that these cars are to be raced because if they get damaged, they can be fixed.

Apart from touring and the Festival of Speed, the Mason car is prepared for just one proper race per year, and that is the Tourist Trophy at the Goodwood Revival. Charles Knill-Jones, who looks after the Mason GTO at Ten Tenths leaves one with no doubt, "In the TT at Goodwood, its full race conditions, there are no holds barred."

Like all race cars, the 250 GTO has ▶




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**BELOW** The GTO utilised the same basic engine as its predecessor, the SWB, but produced more power



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**ABOVE** When the car competes, it is raced hard

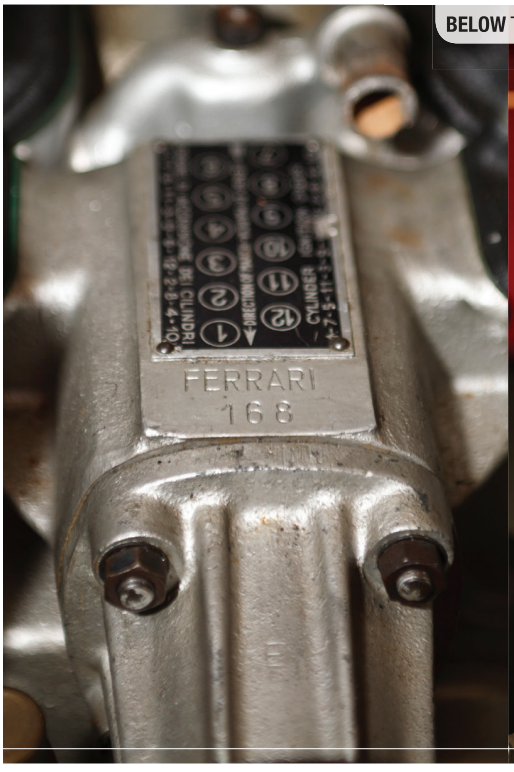
a life expectancy in terms of how long things will last. Subjecting some of the older components to the stresses and strains of regular racing throughout the season, would cause those components to wear more quickly in a 54-year old car, and the life expectancy of the car would be dramatically reduced. By selecting a single race meeting each year and preparing the car properly for that race, it means the car will continue racing for a lot longer.

Certainly, since the car has been in the care of Charles and his team, it has never been fully restored, rather, it has been maintained. Knill-Jones explains, "That is because every feature on it has a purpose. So it has been tailored towards a particular race meeting, but without trying to detract from what it is. Weighing in at just under 1200 kg with driver, fuels and oils, it is still a heavy old girl, and as a result it tends to understeer."

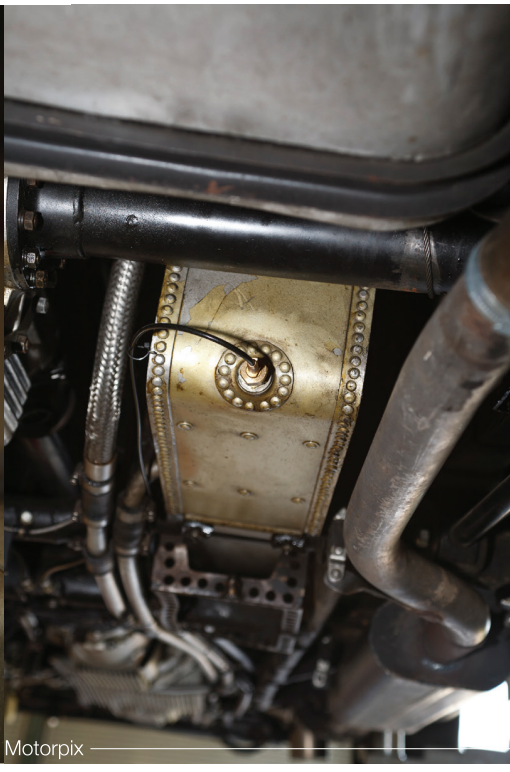
In order to maintain their position at the front of the TT grid, chassis 3757 has had to be continuously maintained and developed. The battery box, which sat behind the passenger seat, has been blanked off and the battery relocated to the engine bay, but the original battery box has been left in situ. Most of the original items that have had to be replaced for safety reasons, have been retained and could be put back on the car if necessary. This type of development has been carried out with the car's heritage and originality in mind, so for instance the heavy horns have been left in place, as has the original windscreen washer bladder. This car can boast an almost continuous racing history from new, and as Knill-Jones says, "For me, if a continuous history racing car can still be out there at the front end of the grid, whilst retaining most of its original guise, then our job is done."

Today it seems that the cars racing in the Goodwood TT are raced even harder than they were in period, and there are a few reasons for this.

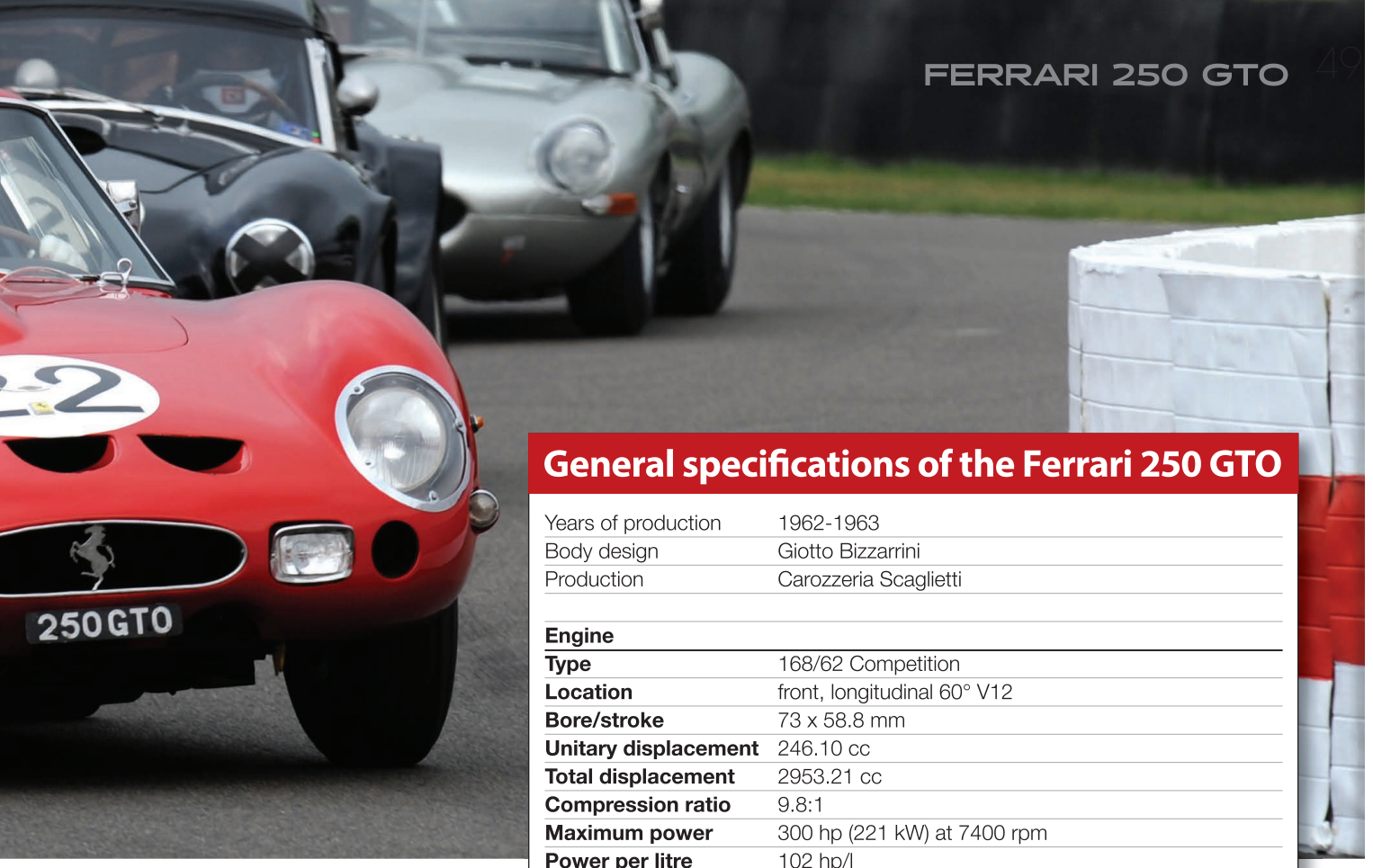
**BELOW** The car's heritage and originality drive each development





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To keep up with the pack in current historic racing, one generates forces not foreseen back in the 1960s. For instance, modern tyre technology and modern track surface technology all puts additional strain on the car because it grips harder and puts more lateral strain on the suspension. In recent years, the push to stay at the front of the grid at the TT has led to the addition of a number of small modifications, but the car has also lost a few small features. Although the Mason team still has the original engine and back axle, it competes in the TT with a newly fabricated racing engine and diff. They are all done to original spec drawings as it would make no sense to wear out the original engine or to wear down the crown wheel and pinion.

In the current day Tourist Trophy Celebration race, the GTO would be pulling in the region of 180 mph down the back straight at Goodwood. “You can do that today,” says Knill-Jones, “because the oil is better, and the tyres and brakes are also better. There are also other tweaks that we have added which don’t change the character of the car in any way, but which improve the cooling or the aero a bit, and so you can in fact go faster today than you could in period.”

Knill-Jones explains, “With Italian ▶

## General specifications of the Ferrari 250 GTO

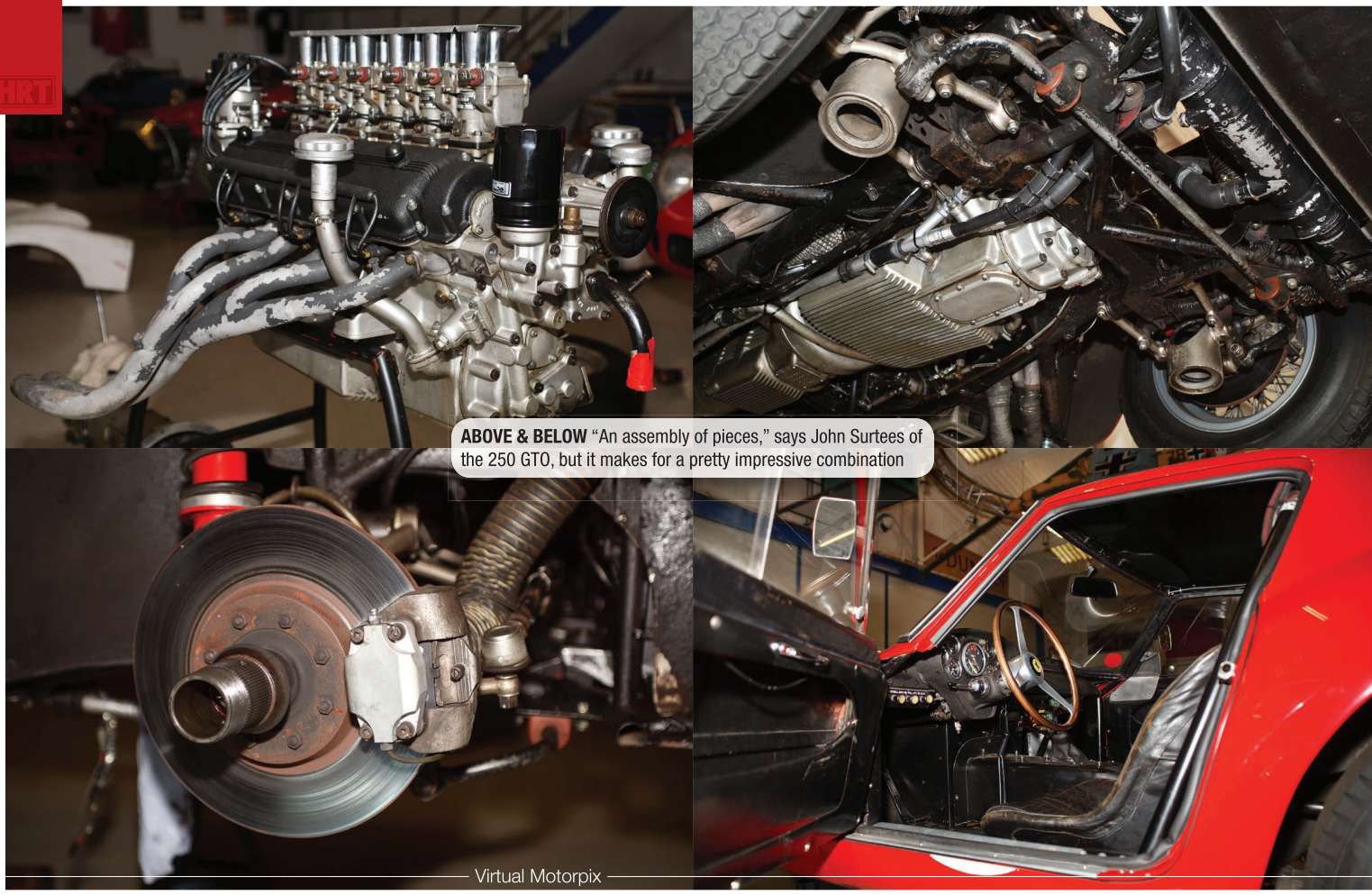
| | |
|---|---|
| Years of production | 1962-1963 |
| Body design | Giotto Bizzarrini |
| Production | Carozzeria Scaglietti |

| **Engine** | |
|---|---|
| **Type** | 168/62 Competition |
| **Location** | front, longitudinal 60° V12 |
| **Bore/stroke** | 73 x 58.8 mm |
| **Unitary displacement** | 246.10 cc |
| **Total displacement** | 2953.21 cc |
| **Compression ratio** | 9.8:1 |
| **Maximum power** | 300 hp (221 kW) at 7400 rpm |
| **Power per litre** | 102 hp/l |
| **Maximum torque** | 333 Nm / 246 ft lbs @ 5500 rpm |
| **Valve actuation** | SOHC per bank, two valves per cylinder |
| **Fuel feed** | 6x Weber 38 DCN carburettors |
| **Ignition** | single spark plug per cylinder, two coils (one per bank of cylinders) |
| **Lubrication** | dry sump |
| **Clutch** | single-plate |

| **Chassis** | |
|---|---|
| **Frame** | tubular steel |
| **Front suspension** | independent, unequal-length wishbones, co-axial coils and telescopic shock absorbers, anti-roll bar |
| **Rear suspension** | live axle, twin radius arms, semi-elliptic springs, co-axial coil springs and telescopic shock absorbers |
| **Brakes** | discs |
| **Transmission** | 5-speed + reverse |
| **Steering** | worm and roller |
| **Fuel tank capacity** | 133 litres |
| **Front tyres** | 6.00 x 15 |
| **Rear tyres** | 7.00 x 15 |

| **Bodywork*** | |
|---|---|
| **Type** | two-seater berlinetta |
| **Wheelbase** | 2400 mm |
| **Front track** | 1351 mm |
| **Rear track** | 1346 mm |
| **Overall length** | 4400 mm |
| **Overall width** | 1675 mm |
| **Overall height** | 1235 mm |
| **Dry weight** | 900 kg |
| **Top speed** | 280 km/h |

*It should be noted that as every 250 GTO was hand-made, the body dimensions could vary from car to car.



**ABOVE & BELOW** "An assembly of pieces," says John Surtees of the 250 GTO, but it makes for a pretty impressive combination

Virtual Motorpix

cars like Ferrari and Maserati, their engines were so good, they were actually at the limit of their development capacity when they went into the car in period. It has only been in the last 10 years that technology has caught up, and its rivals are now equal to and in some cases beating the GTO. When our race engine goes into the car, it really gets used, that's what it's designed for and that's why we don't race the original engine. When we go racing, we put the racing components in, they are exactly the same spec."

## WITHIN AN INCH OF ITS LIFE

By contrast, some British and American race cars were developed in period from standard production units, and often raced with little more than tuned production engines, which were typically over-engineered to ensure reliability in their roadgoing format. This left some considerable margin for potential development which has been exploited in recent times. Developments on the Mason GTO have, by contrast, largely been confined to chassis 'dynamics and tweaks.' When asked how well the Colombo-designed 3-litre engine performed against the opposition, Knill-Jones responds, "Brilliant, just brilliant when it is within its power range, we are pushing the race engine to within an inch of its life."

Reliability was one of the GTO's strong features, and most drivers and team personnel interviewed agreed that the engine did not have a weak point. "It can oil up plugs, and the distributors are reasonably sensitive to points, but today most GTOs don't do the same sort of mileage that they might have done in the '60s and '70s. What tends to happen is that clutches burn out because of the type of people that are driving them, and while they are not sensitive to heat, it would be much better to keep them cool," adds Knill-Jones.

John Surtees OBE drove the Ferrari 250 GTO on a number of occasions. "There were no new special components made for the 250 GTO really, it was an assembly of pieces that were already available," he says. "It had a lower Centre of Gravity and everything was a little more central. Frankly there was nothing special about the GTO, it was just a very nice, balanced type of car which is why most people can drive one."

Just 36 250 GTOs were produced, and when you factor in the 1964 upgrade, the number rises to 39 cars. It is regarded by many as the most beautiful sports car in the world, but while others may not elevate it to quite that level, there can be little doubt as to its success in competition. Since the World Sports Car Championship had begun in 1953, Ferrari had won the title on six of the eight occasions between 1953 and 1961, this being achieved by the 250 SWB and its predecessor the 250 GT. For the 1962 season, the WSC Championship was replaced with a championship for Grand Touring cars in three classes, and it was in the top class for cars between 2000-3000 cc that the 250 GTO competed. Ferrari won the new GT Manufacturers' Championship Div III in 1962, 1963 and 1964, the 250 GTO and GTO 64 being victorious in all three years. To call the Ferrari 250 GTO the dominator is perhaps not too strong a term; it is surely well deserved. HRT

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# Short Shift

Ferrari specialist GTO Engineering has teamed up with Quaife to produce a batch of gearboxes for one of the most sought-after GT cars of all time. **Chris Pickering** finds out more

**THREE** little letters are all it takes to send a shiver down the spine of Ferrari enthusiasts everywhere. Created in 1959 by chopping 7.9 inches (200 mm) from the existing 250 chassis, the Ferrari 250 GT Short Wheelbase – or SWB for short – is one of the most highly prized of all classic Ferraris.

More than half a century after the last 250 GT SWB rolled off the production line, the owners of these cars are finding themselves increasingly dependent on a small but thriving spare parts industry. For some time now GTO Engineering has been producing complete engines and back axles for the 250 series, and the latest addition to the parts catalogue is a faithful reproduction of the original gearbox, produced in collaboration with Quaife.

Traditionally, GTO Engineering has sourced original gearboxes and rebuilt them, but the supply is now drying up, explains managing director Mark Lyon: "Ferrari 250 gearboxes – and in particular the correct gearboxes for the Short Wheelbase and the Testarossa – are becoming very hard to come by. They were pretty much the last major component on the 250 that we didn't make, but a few months ago we decided that we would have to take the plunge."

The situation is made more complicated by a number of different gearboxes fitted to the 250 range. Cars like the 250 GTE and the 250 GT Lusso use a closely related gearbox with the integral oil pump moved to the back and various changes to the mountings. In contrast, the Short Wheelbase and the Testarossa use the earlier 'rear-pump' gearbox.

It's a relatively conventional four-speed design, which uses Porsche-style synchromesh with an elastic ring locking mechanism. This does have a tendency to wear on the synchronising ring, particularly with the uprated power and torque outputs of some of the healthier 250s now in circulation, but overall it's a good solid gearbox.

Partly for that reason, Lyon was adamant that the new units should be kept as original as possible. He also wanted to ensure that the individual components would be interchangeable with their 1950s and 1960s counterparts. That meant the modules, splines and bearing sizes would all have to be completely authentic.

The project began with a




Andy Swift

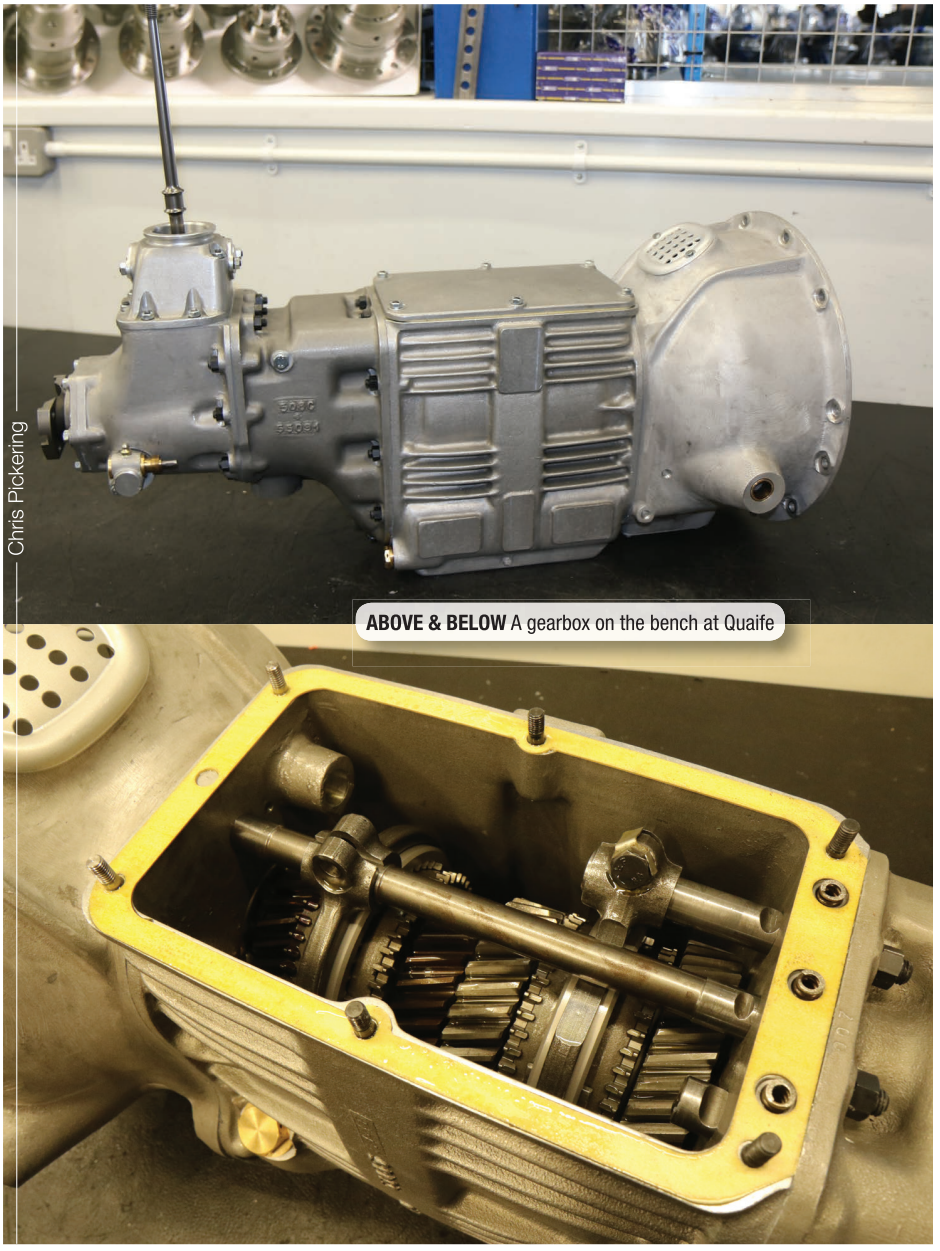
**ABOVE** The Ferrari 250 GT SWB is well represented in historic racing, but gearboxes are increasingly hard to come by

comprehensive reverse engineering exercise on an original gearbox, carried out by Quaife and GTO Engineering's own in-house technical team – in some cases by hand.

"Techniques like optical scanning are great for rapid prototyping where you want to get the general shape of models, but when it comes to detail jobs like this we've found in the past that we need to go back and measure the parts by hand. So for the 250 gearbox we used a mixture of manual measurements and co-ordinate measuring machines," explains Quaife's commercial manager, Mark Catterall.

On the face of it, simply drawing up a carbon copy of the original gearbox and re-making it with the benefit of more than half a century's additional expertise might not sound too taxing. In reality, it was to prove a somewhat unusual experience for the Quaife engineers.

"One of the trickiest things about this project was resisting the temptation to modernise," comments Catterall. "There are so many things you just wouldn't do these days. When you really look at the details, almost nothing on the gearbox is exactly the same as we would design it today, but keeping the components interchangeable was a key part of the brief."



Chris Pickering

**ABOVE & BELOW** A gearbox on the bench at Quaife

## ORIGINAL RECIPE

One example is the use of white metal bushes. Needle roller bearings have been the default choice for the best part of 30 years now, but the new gearboxes stick faithfully to the original recipe. Elsewhere, the exact material specifications for some parts have been changed – notably the gears themselves are now made from modern EN36 case-hardened steel – but this has been done largely for the sake of material availability. Lyon notes that Ferrari used high quality materials in-period, so wear is not generally an issue with the gears anyway.

Manufacturing techniques have also evolved dramatically since the 1950s, and with that, tolerances have become much finer. When it came to the Ferrari gearbox, however, the need for interchangeability between modern and original parts meant that Quaife couldn't simply shrink the tolerances to modern standards.

"We had to unlearn a lot of modern practices to appreciate the way that the components interact with each other in this gearbox. It's quite a complicated job – if you simply opened up all the tolerances you'd end up with massive variations when you stack everything together and that's not how they were designed," Catterall points out.

Armed with the appropriate tolerances, Quaife's state of the art CNC facilities produce parts that can be used virtually straight off the shelf. Modern tools also result in a more polished surface finish, which improves oil retention, increasing the longevity of the gearbox.

A batch of around 15 gearboxes is planned and GTO is currently testing the first two – one of which is installed in a car, while the other is running on a dynamometer. Both are periodically stripped and checked for signs of wear or other problems with no major issues reported so far.

With all the data held on CAD, it should be relatively easy to produce additional batches of 250 GT SWB gearbox parts should they be required, but GTO Engineering doesn't plan to stop there. The company already rebuilds transaxles for the Ferrari 275 and 365, but whole new assemblies could be on the cards. Lyon is also contemplating a batch of gearboxes for Aston Martin DB4s and DB5s, which are currently in short supply. Whatever happens, you can be sure it won't be the last we see from this partnership. HRT

# THE FORD PHOENIX

Built as one of the few road cars rather than a race car, Ford GT40 chassis 1070 is now vigorously campaigned in various historic events ranging from rallying to racing. However, were it not for some incredible salvage work, it could well have ended up in some skip as **William Kimberley** reports

**PAINTED** red with black road trim and powered by the 289 High Performance small-block engine with Weber carburettors, chassis 1070 was one of 31 road-equipped cars built by Ford Advanced Vehicles at Slough in England. Essentially a softened race car, the road version of the Mk1 GT40 differed in having softer suspension, less aggressive brakes, Borrani wire wheels, a silenced exhaust system, a heater and windscreen demister, twin luggage boxes housed in the tail, a fully trimmed cloth interior, fully working door locks, and "Ford" sill badges.

The car, shipped to Ford in Dearborn in March 1967, was sold to Roger West in Birmingham, Alabama, but it was only a short term ownership as it was then sold to fellow Birmingham resident Paul Higgenbottom less than a year later. In January, 1968 it was then sold again to Charles Schmitt at Classic Cars Ltd in St Louis, Missouri, and then 13 months later to Watts Hill Jnr, who at the time was on the SCCA competitions board, in Chapel Hill, North Carolina. At this stage it only had 2,000 miles on the clock. In May 1969, it came under the ownership of Dick Leppla in Cleveland, Ohio who owned it for a couple of months before selling it to Dick Bair of Akron, Ohio. It was under his ownership that near tragedy struck when the car caught fire, one of the Bair brothers driving the car back from the local filling station when the right filler cap flipped open spilling fuel that immediately caused a massive fire. The driver just managed to escape death but still sustained 63% burns, keeping him hospitalised for more than a year.

There were no salvageable or usable parts left of the car as it had burned to the ground before the fire truck arrived, the heat of the fire even warping the tub. It was later determined that the fuel cell had split, leaked into the metal retaining tank, which then leaked the fuel onto the right rear wheel. This threw neat fuel onto the exit which ignited the petrol back into the tank. A great deal was learned about the cause of the fire, the fuel bladders and the structure in which it was housed.










**ABOVE & BELOW** Hard work behind the scenes has kept chassis 1070 active

Fast forward many years and the car was then acquired by Fran Kress of Pittsburgh in 2003 but less than a year later it was sold as a pile of bits to the late John Etheridge of Ford Advanced Vehicles who bought it on behalf of Richard Meins in the UK. It needed a new tub and the majority of the car was beyond repair but was otherwise faithful to the original. Over a period of time, the car was completely restored and over the last 10 years it has been continually campaigned in various historic race and rally events such as the Classic Le Mans, Spa 6 Hours, Tours Auto and Goodwood Revival. It is now maintained by Dorset firm Wren Classics, which has been looking after it for the past two and a half to three years.

"Principally, our aim is to pre-empt problems before they arise," says Steve Farthing, Wren Classic's managing director. "It's a question of trying to identify what can go wrong, what went wrong if anything on the previous event and thoroughly checking everything. We also completely strip the car down to its component level after every event before it gets back onto the circuit even if it is just a two-week gap as it recently was between the Modena Centro Rally and Le Mans Classic. What was doubly challenging about this is that the car's setup such as the ride height is very different while various items we have to put on the car for the rally have to be removed."

The car still runs on the original brakes as per the regulations but which are re-sealed on a regular basis. "It's one of the things we life, and as and when they get damaged or worn, we replace them with new ones. The car suffers from rear wheel bearing problems so they are continually checked."

The car has three gearboxes, the original casing which is kept on the shelf but never used, and two reproduction ZF ones for competition – one for sprint racing and the other for long distance events. "We learnt our lesson when we went to Le Mans Classic with the car and found we had the wrong gearing and so had to change to the spare gearbox which had longer gearing to give us the speed down the straights," says Farthing. "However, it's not like a Hewland where the gear ratios can be changed as the unit itself needs to be changed. It means that we have one unit we use for sprint racing and a spare one we use for things like Le Mans."

A Mathwall Engineering engine powers the car, the Surrey-based engine preparation specialist looking after and maintaining it throughout the season. "We've got to take it out now after Le Mans Classic and get it rebuilt in time for the 6 Hours of Spa," says Farthing.

What started out as a road car, survived what should have been a catastrophic event and has been raced and rallied hard over the last few years, chassis 1070 has proved the resilience of the Ford GT40 backed, of course, by some tender loving care from the owner and specialist companies that keep it on the track. HRT



**ABOVE** The corroded engine cover was resurrected with modern technology. Here a finished casting is scanned for inspection purposes

# Re-animated Alfa

## How applying high-performance engineering has brought an Alfa Romeo Tipo back to life

**THE** Alfa Romeo Tipo 33/3 was one of only 12 cars made by the Italian manufacturer in the late Sixties to compete in the World Sportscar Championships. Run by Autodelta, the works team, the car initially struggled, but found major success in 1971 at races in Buenos Aires, Sebring and Brands Hatch. It went on to gain a faithful following, and even played a starring role in the Hollywood movie, *Le Mans*, alongside Steve McQueen.

One of the remaining Tipos is being run by UK-based Martin Stretton Racing, a leading historic racecar restoration specialist. Like many race teams and restorers, Stretton is faced with a challenge that will only get harder as historic cars get older – the replacement of original parts.

Emerging industrial technologies, such as additive manufacturing, often called 3D printing, are transforming the sector's response to the spare parts problem in the historic motorsport market, and when such know-how is used in conjunction with digital scanning techniques, this makes for a powerful mix. Employed by skilled engineers, these tools can be used to help re-manufacture one-off, original parts quickly and often at a fraction of the cost of traditional methods.

### THE ENGINEERING CHALLENGE

Faced with badly damaged parts that have kept its Alfa Romeo Tipo off the road for several seasons, Martin Stretton Racing turned to high-performance engineering business KWSP to bring its rare works 1971 Alfa Romeo Tipo back to the grid.

The car's original, naturally aspirated, 3.0-litre V8 engine was in good working order, apart from a problematic front engine cover, which had deteriorated significantly in recent years and had been subject to numerous running repairs. As an integral working part of the vehicle's powertrain, the poor condition of the front cover had become a major issue. The final straw came when the car failed to start.

Martin Stretton explains: "This is a rare car – only one of 12 that were made and run by Autodelta – so when we were searching for a replacement cover, the options were limited. We found several alternatives that were close, but none of them were exact matches for our Alfa Tipo 33/3. In the end, we had to explore other avenues.

"Having investigated the pattern making route, using skilled model makers, we realised that this would be a technically difficult project to deliver. It would also be prohibitively expensive. It was at this time that we began talking to the team at KWSP who invited us to visit its facility next to the Mercedes Petronas F1 factory in Brackley, Northamptonshire.

"Touring the KWSP facility was a real ▶



**BEFORE:** The Alfa's original engine cover and water pump were heavily corroded



**AFTER:** The final cast front cover

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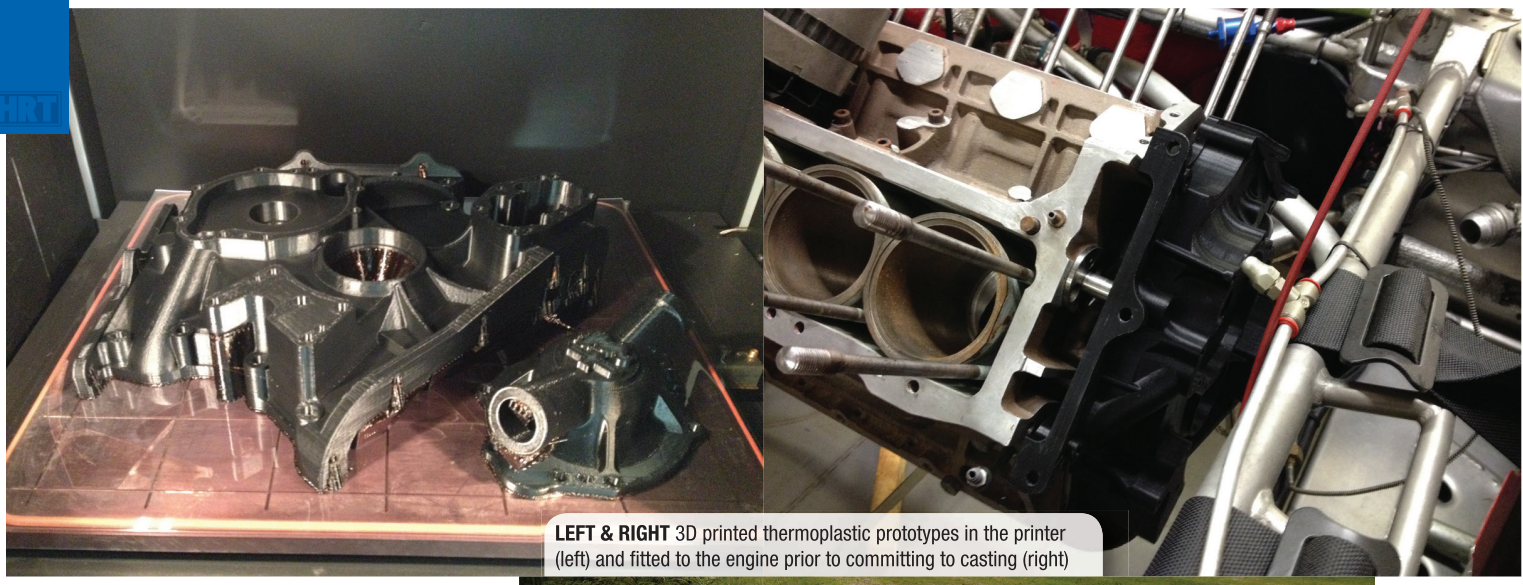
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**LEFT & RIGHT** 3D printed thermoplastic prototypes in the printer (left) and fitted to the engine prior to committing to casting (right)

eye-opener for me. It showed what could be done with skilled engineers using 3D printing. Components, body panels and complete structures can now be scanned, digitised, designed for manufacture and made within days using this approach. Previously, much of this would not have been possible – and if it was, it could have taken months."




**ABOVE** Back in business: Stretton's Alfa Romeo Tipo 33/3 is ready to race

## THE RIGHT SOLUTION

Originally cast in lightweight magnesium alloy, the Alfa's engine front cover had lost form and function. Unsightly welds were no longer keeping up with the number of cracks that now rendered the component redundant.

Having decided to remanufacture five new covers, the KWSP team set to work creating a digital CAD file of the component. This stage of the process involved scanning the badly corroded engine cover, along with the original water pump and housing. To give an indication of the poor condition of the cover, it was no longer possible to recognise the distinctive Alfa Romeo logo on the outside of the original casting.

However, meeting this challenge comprised more than simply scanning the original part. Stuart Banyard, head of advanced manufacturing at KWSP, explains: "While we had the original part to scan, undertaking a simple like-for-like photocopy operation would not solve the problem, as the original part we had was defective. This is where the real value of our consultancy comes in. We were able to create a digital scan of the part – and then crucially, make vital changes to the design to bring it back to its original geometry and functionality.

"Intelligent use of CAD data allowed us to use the scanned part as a reference, enhancing structural elements as required to re-create the component into its intended form. This part of the process requires a lot of decision making from our design team, examining draft angles and other integral geometries of the CAD."

Eventually, a finished digital asset was created. Before committing to the casting process, a 3D prototype was printed in a high-performance thermoplastic called PC ABS. Once printed overnight using one of KWSP's Stratasys machines, the cover prototype was fitted to the engine to confirm proof of concept.

"This is an important stage of the re-manufacturing process as it enables us to make any final changes to the design, without incurring significant cost," says Banyard. "On this occasion, the part fitted perfectly and we were able to move straight to the finished casting process."

With the new aluminium – not magnesium for reasons of corrosion resistance – engine cover now fitted, Stretton is happy with the result. "Without 3D printing, it would have been a lot more difficult to put this great Alfa on the road again. Of course, there are alternatives, but they would have been more than three times more costly – and less accurate. Thanks to this technology and the skills of the guys at KWSP we're now back on the grid with the knowledge that we also have spare parts should we need them in the future. Even better, we have our own digital asset in the CAD file, which can be enhanced and amended should we want to explore this option in future."

Scanned, re-designed and prototyped in just a few days, the Alfa's engine cover shows how quick the digital remanufacturing process can be. While still adhering to both the letter and spirit of FIA certification, the 3D process has huge potential in the historic motorsport market. HRT

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Photo: Remi Dargegen

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The business came into life in 1972 when Fred Draper, who had been the parts manager with the Donald Healey Motor Company for 18 years, was instructed to compile a list of all the Austin Healey parts it had in the stores with a view to selling them as the Healey factory's dealership was not renewed by BMC.

Knowing that this news would cause great concern among current owners and club members, to secure the future of Austin Healey parts supplies he requested that he be made redundant and with his redundancy money purchased all the parts that the Donald Healey Motor Company had in stock. Fortunately his proposal was accepted and with this ingenious deal, secured the future of Austin Healey by starting AH Spares, initially trading from his garage.

Three years later he invited Bob Hill, his nephew, to join him and a partnership was formed. This proved to bring further success and very soon the business was becoming more than the two of them could manage so they asked Gordon Barton, another former DHMC stores staff, to join them.

The two started investing heavily in tooling so that the continuity of parts was secured and the heritage of the Austin Healey remained intact, growing ever larger over the years. The company has also grown allowing them to stock more parts and develop an in-house trim shop and also establish AH Panels, a professional sheet metal manufacturer. Both have allowed AH Spares to focus solely on producing quality interiors and body panels.

It has always been important to the company that it relies on the old traditional skills, but it has not turned its back on modern processes and so incorporates the use of latest technology and equipment to fabricate practically anything to an extremely high quality at affordable prices.

Over the years, AH Spares realised that the supply of competition and race-spec parts was limited, so embarked on developing its own AH Performance Spares range, including engine, brakes, suspension and transmission parts. The suppliers and manufacturers it works with are experts in their fields, many of whom work in all forms of motorsport from Formula 1 to historic racing. They take their designs and ideas to these experts who then with their wealth of speciality knowledge help AH Spares supply the ultimate performance parts available.

It is still very much a family concern and can boast that it is now in its third family generation. Bob's son Jonathan now runs the business assisted by his sister Rebecca and John Lee as the sales manager. The new team has been busily building on the sound foundations put in place by Fred and Bob to continue offering a level of quality and service that these cars and their owners deserve. They are also investing heavily in exclusively designed tooling ensuring parts are improved upon and better than they were originally. Examples of this are their adjustable and non-adjustable steering boxes where they used CAD design, modern materials and CNC machining to ensure tighter tolerances giving a smoother operation. The company also gains exclusivities with suppliers so it can supply such items as competition head gaskets, Sprite dash cones and 4-pot calliper upgrade kits to its customers. HRT



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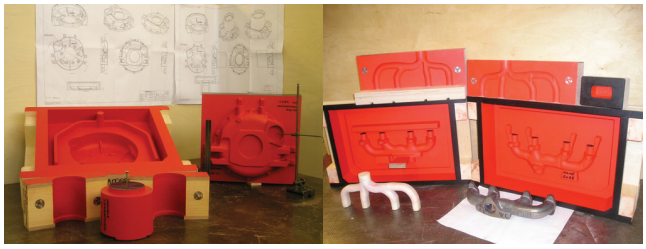
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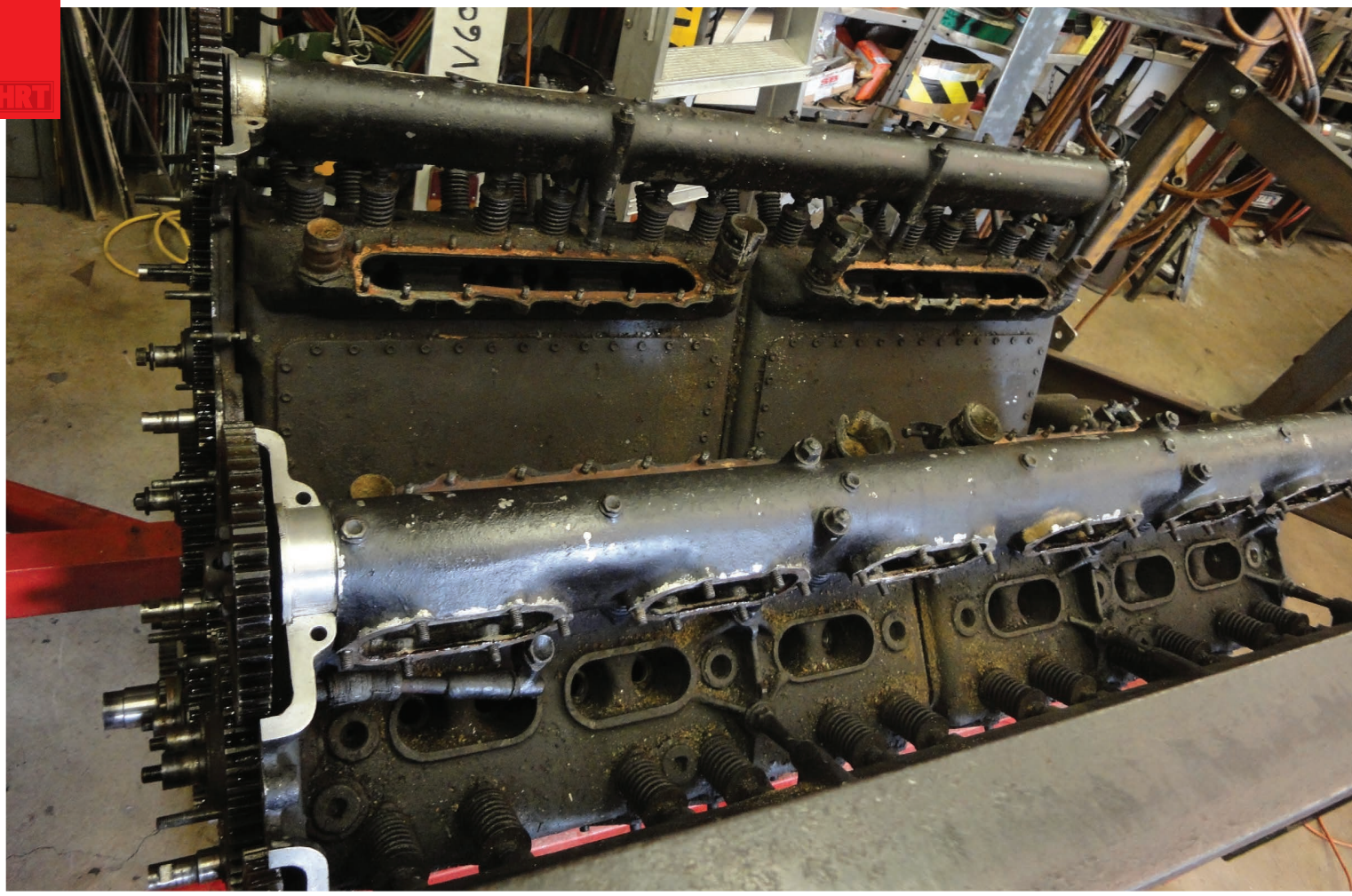
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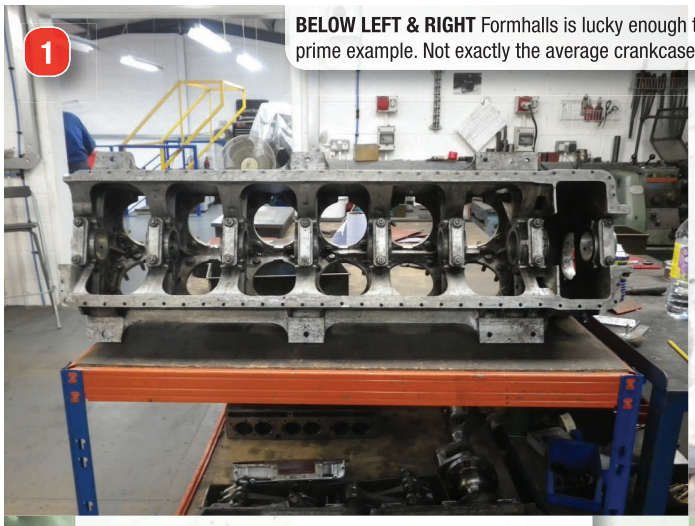
# WORLD'S FASTEST 'SLUG' BROUGHT BACK TO LIFE

## V12 Sunbeam Matabele engines powered the first car to exceed 200 mph. Here's how a 22.5-litre beast is being revived in the Formhalls workshop

**THE** 1000 HP Sunbeam, also known as The Slug due to its unique shape and appearance, was one of the first cars built for the sole purpose of breaking the world Land Speed Record and the first car to reach 200 mph (321.87 km/h).

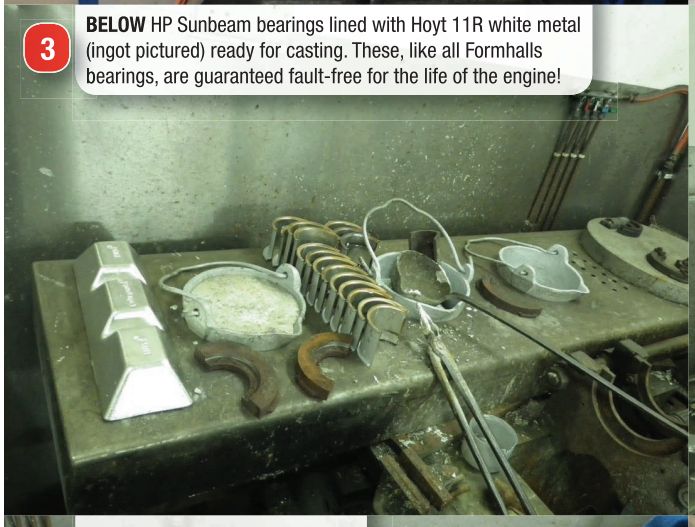
Driven by Major Henry Segrave, it made two runs at Daytona Beach in Florida on the morning of 29 March 1927 with an estimated crowd of 30,000 spectators watching from the nearby sand dunes. On the first run, the car got caught by the wind and skidded with the brakes melting from the heat of the engine, Segrave having to drive the car into the sea to slow down after exceeding the nine-mile track. The speeds achieved on the two runs were 200.668 mph/322.944 km/h and 207.015 mph/333.158 km/h, giving an average speed of 203.792 mph/327.972 km/h over the mile and a new Land Speed Record – the first over 200 mph/321.87 km/h.

The car was powered by two Louis Coatalen-designed 22.5-litre V12 Sunbeam Matabele aero engines, each rated at 435 bhp at 2,000 rpm, that were positioned in line with the driver's cockpit in between. The actual power output of the car was more in the region of 900 hp than the 1,000hp but the latter sounded better for marketing purposes. It is one of these engines that has been in the tender care of Formhalls Vintage and Racing in the UK and which can now be seen at the National Motor Museum in Beaulieu. ▶



**BELOW LEFT & RIGHT** Formhalls is lucky enough to see many rare and historic engines pass through its workshops and below is a prime example. Not exactly the average crankcase and cylinder block we're dealing with. Then again, it wasn't an average car either!





**BELOW** HP Sunbeam bearings lined with Hoyt 11R white metal (ingot pictured) ready for casting. These, like all Formhalls bearings, are guaranteed fault-free for the life of the engine!




**BELOW** Terry Formhalls preparing the bearings using the company's ultra-reliable triple tinning technique



**BELOW** Pouring the Hoyt 11R white metal onto the bearing shell



**BELOW** Completed, rough cast bearings



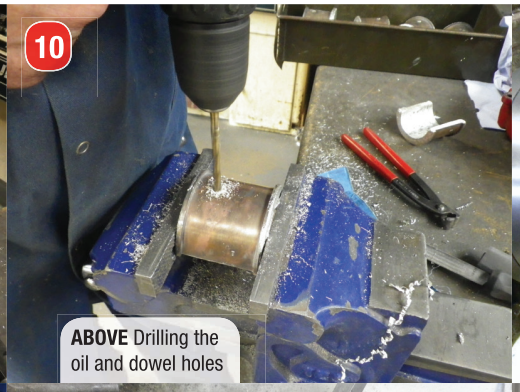
**BELOW** Scrubbing the bearing backs




**BELOW** Bearings have excess metal (flash) removed


9

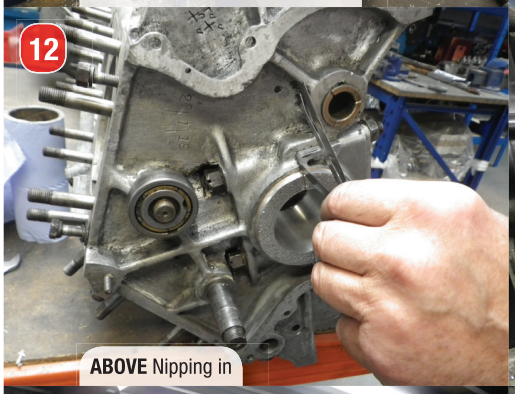
**ABOVE** Filing bearings, prepping for rough boring and oil grooving


10

**ABOVE** Drilling the oil and dowel holes


11

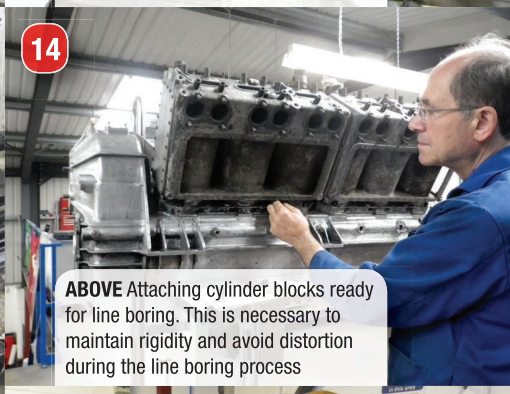
**ABOVE** Roughing through the bearings, prepping for nipping in and line boring


12

**ABOVE** Nipping in


13

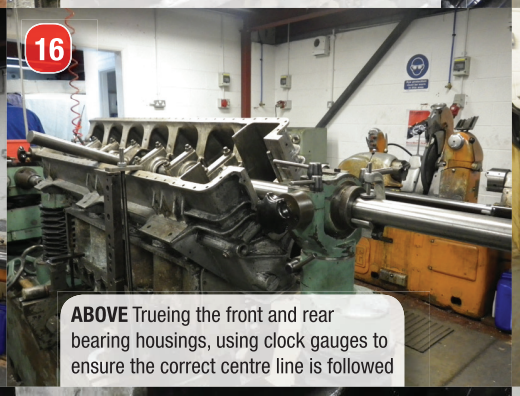
**ABOVE** Oil grooving. The oil grooves for this engine are unusual because they sit opposite each other and are linked by mud gulleys


14

**ABOVE** Attaching cylinder blocks ready for line boring. This is necessary to maintain rigidity and avoid distortion during the line boring process


15

**ABOVE** Keith Lockyer setting the engine up on the line borer


16

**ABOVE** Trueing the front and rear bearing housings, using clock gauges to ensure the correct centre line is followed


18

**ABOVE** Crank grinding


17

**ABOVE** Final line bore finish and radius. Sides are trued and ready for trial fit


19

## TO-DO LIST

There is work still to complete on the engine:

- To de-burr bearings and fit mud gulleys for lubrication.
- Re metalling and machining of conrods, the big end bearings of the V12 conrods (above) are now undergoing Formhalls' white metal process. HRT


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**BELOW** "The only way to learn how to do it, is to do it!"

# ADDRESSING THE SKILLS GAP

**Andy Swift** looks at an automotive course in the US that has set out to address the specific needs of a skills shortage in the historic car market

As the contemporary automotive and motor racing worlds continue to tread a path of aerodynamic sophistication, hybridisation and nanotechnology, we face the potential for a severe skills gap in the historic race sector.

Fewer engineers and mechanics will be exposed to, and familiar with, traditional materials, technologies and techniques. In coming years, encouraging a new generation to put down its iPad and pick up a spanner might become one of historic racing's next major challenges. McPherson College in Kansas, though, is endeavouring to buck this trend by offering the only historic automotive restoration Bachelor's degree in the US.

While McPherson College has been open since 1887, the institution initiated the automotive restoration degree in 1976 after local benefactor Gaines 'Smoky' Billue gifted the college almost 100 classic cars to help offer local pupils the opportunity to learn a trade. Today, the programme occupies a 33,000 sq ft facility comprising workshop and classroom space, producing around 30 graduates per annum.

The degree features a mix of academic study and hands-on 'shop' time – with six hours in the workshop for every classroom hour. Amanda Gutierrez is the vice president for the historic automotive restoration programme and elaborates on its approach: "The curriculum is designed to emphasise not only technical skills, but also historical context. Classes outside of the programme in business, fine arts and science create a full complement to the restoration classes."

The variety of roles sought by graduates is testament to the breadth of the course, with alumni following careers not only as technicians but curating museums and private collections, as well as less hands-on positions in marketing and historical research. Students come from all over North America, including Canada, pursuing interests in history, hot rods, racing or muscle cars.

This diversity is encouraged through the course; the social context – and importance – of the car is at the core of every module. This approach is intended to develop a deep respect for historic vehicles, something which will strike a chord with anyone who holds sacred the preservation of originality among machinery in the historic racing scene.

The backbone of the programme, though, is workshop time, with a set of core skills taught to all pupils. As Gutierrez quips, "The only way to learn how to do it, is to do it!"

Introductory classes are offered in trim, metal shaping, paint, machining, drive train/chassis, engines, automotive woodworking, casting, welding, and assembly – with advanced classes available as elective modules later in




**BELOW** The students turn their hands to many skills. This is a 1929 Model A 'Woodie' station wagon they built

the course. While the course itself might not focus on historic racing per se, it's apparent that a rigorous grounding in these skills, with the attention to detail and analytic approach encouraged in any automotive engineer, will be easily transferable to the race track.

The programme's focus is on vehicle technology up to the early 1970s. That means that working with carbon fibre isn't on the curriculum yet, but Gutierrez is quick to acknowledge that the programme will evolve in order to adapt to the movements in the collector car scene.

While the most modern of materials might not be handled in the McPherson College workshops, they do play host to a number of techniques which would be familiar to any modern race team. Students are taught to use everything from tree stumps to plasma cutters in working with traditional materials. That means 3D printing of components and CAD for designing patterns for castings, following the trends seen in the wider industry as teams seek an edge with ever more sophisticated approaches to preparing historic racers.

Encouragingly for the prospect of today's young people savouring old cars being used as intended, Gutierrez is unequivocal about the importance of exposing students to historic machines in action. "To engage people in the history of the automobile and make it come alive for them, they need to experience the automobile in a sensory manner beyond sight. When one can hear, smell, ride in or drive a vehicle the experience changes. Their appreciation grows. We endeavour to take as many students as we can to events around the U.S. so that their appreciation for history and these remarkable cars of their time is heightened."

Lance Butler is a graduate of the automotive restoration degree programme who enjoys a healthy respect for old cars. Still in his early 20s, he curates a private car collection of unmentionable value and quantity. At present he is overseeing the restoration of 13 racing cars and preparing for a further seven to attend the forthcoming Pebble Beach extravaganza in California. The collection includes Can-Am, Group C and Grand Prix cars among the machinery in his care.

Butler admits that he found out about the degree programme quite by chance but cites it as having been critical in his professional development: "The best part of the job is being at the race track. I just love to have a spanner in my hand, but I also took business classes at McPherson and I take an interest in that too."

With his boss working in the financial sector, being able to read a balance sheet helps in communicating accurately the position of the business.

It's within the true definition of 'restoration' where Butler is able to give an example of how his specific university training can bring huge benefits to his employer. By applying critical financial thinking to his hands-on experience restoring old cars, he is able to scrutinise the costs arising from the collection's restorations. He has brought a previously unseen level of rigour to this process, not being afraid to challenge the cost of items where he knows the level of work required.

He has become involved in the purchasing of vehicles and applies his hands-on skills to checking paint and trim for signs of age or rework. His engineer's ear has helped diagnose potentially costly mechanical issues at the first sighting of a potential purchase. His is a role with a wide remit.

Perhaps most telling are his reflections on his time at McPherson and the relationships he has built with his peers. "The other students came from all round the country and brought their car cultures with them; we had greasers from California, muscle car fanatics and even guys who restored tractors! We'd all get together in somebody's garage after class and work on each other's cars. We'd have a barbecue and drink a few beers. I learned so much from those days."

The chance to learn from a wide variety of automotive spheres has gifted Butler a wide skillset, which he has augmented with internships at modern race teams up to American Le Mans Series level. Beyond those hard skills, he has also created a professional network which is already reaping rewards with friends who run trimming shops, fabrication firms and curate other collections. He estimates this year's informal McPherson alumni photo at Pebble Beach will feature up to 20 graduates.

The old car movement in the US is evolving, with the Preservation class a fixture on the Pebble Beach Concours d'Elegance bill since 2001 and vintage racing becoming ever more competitive. Encouraging the preservation – and critically the maintained usage – of historic vehicles will enable fresh generations of enthusiasts to enjoy them in their thrilling, dynamic state.

This will only be possible through a generation of young people which embraces the challenges of researching and cherishing the historical importance of the cars and is capable of restoring and maintaining them in a fitting manner. If establishments like McPherson College can keep producing talented graduates like Lance Butler and his peers, the potential skills gap in the industry might never manifest itself. HRT

# ‘We can do this better!’

**William Kimberley** reports on a company whose founder believed he could produce better limited slip differentials than he was given – and proved it




**ABOVE** Drexler Motorsport makes a huge variety of limited slip diffs for cars across all forms of motorsport, including historic

**DREXLER** Motorsport is committed to the design and development of innovative drivetrain technology, its main business activity centring on the manufacture of limited slip differentials for various motorsport classes including production cars, historic cars and special one-off applications. Its considerable experience in this area can be traced back to the motorsport successes of company founder Herbert Drexler, an accomplished competitor in DTM, FIA GT and ADAC GT Cup racing.

In the 1980s, Herbert, along with his nephew Rainer, now technical director of the company, modified and re-developed existing limited slip differentials for use in their race cars. Coming to the conclusion that a differential of their own design and manufacture could perform better, they started work on developing their own product.

In 1986 the first run of 50 Drexler limited slip differential units was manufactured and delivered to the Wolf Racing Team for use in its Ford Sierra Cosworth touring cars. One year later Ford Motorsport won the manufacturers’ title in the World Touring Car Championship with differential parts developed by Drexler.

After finishing his racing career in 1998, Herbert decided to utilise the experience he had gained to develop performance driveline components further, and Drexler Motorsport was founded. Since its inception, all areas of the business have been continuously expanded. In 2005 the company was accredited with meeting DIN EN9001 and ISO 9001:2000 quality standards.

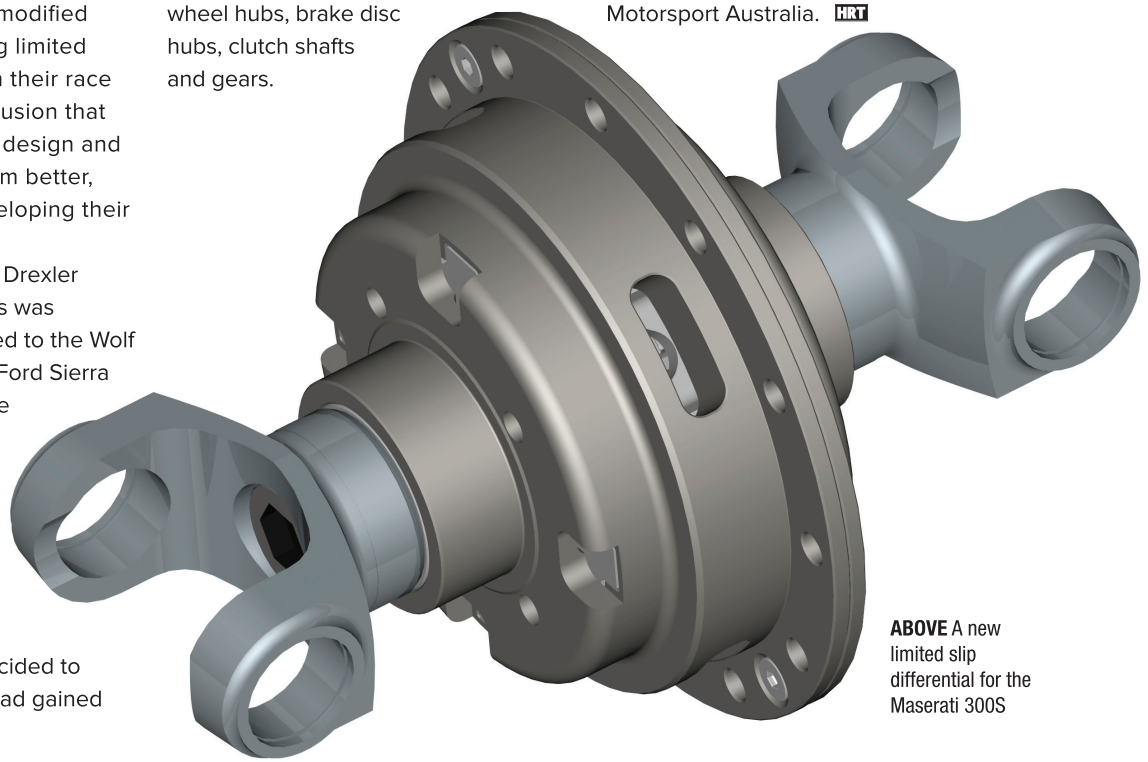
> “They concluded that a differential of their own design and manufacture could perform better”

In December 2006, a technical partnership with Pankl Racing Systems saw a newly designed and built gearbox released to the Formula 3 market, proving a success on the race track and winning numerous championships and countless races. Other products from Drexler include tripod driveshaft systems, wheel hubs, brake disc hubs, clutch shafts and gears.

When it comes to historic cars, most off-the-shelf limited slip differentials do not fit properly. Their assembly in such cars can often be difficult due to their special characteristics, which require them to be handled with sensitivity.

“We do not want to forget where we originally came from,” says Rainer Drexler. “This is the reason why Drexler Automotive offers a selected range of limited slip differentials for historic racing and wants to provide the proven technology of the Drexler limited slip differentials to these customers as well.”

Drexler’s limited slip differentials can be obtained direct from the factory in Lower Bavaria in Germany, CM Engineering in the UK, Autotech Driveline in California and Drexler Motorsport Australia. HRT



**ABOVE** A new limited slip differential for the Maserati 300S

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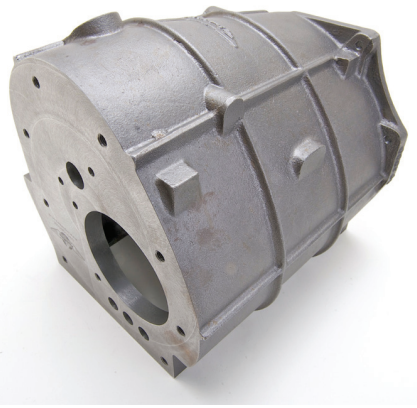


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# Putting a Lid on it



**DENIS** Welch Motorsport produces exclusive, new Austin Healey centre change gearbox lids, made to exact dimensions and tolerances.

Original gearbox lids for the Austin Healey centre change gearbox are becoming hard to find. Stocks of new old stock items have long been exhausted and many used examples have become damaged and worn after 50 plus years of use. This supply issue provided a dilemma for Denis Welch Motorsport – to accept the part is no longer available or to re-manufacture new ones? Enthusiast Healey owners and competitors require a fully functioning and reliable gearbox. With the growth in historic motorsport, there are many Healeys competing in road, race and rally competitions around the world, providing a significant number of potential customers.

Once the customer demand had been identified, work started on designing new gearbox lids for the first time. The Denis Welch Motorsport CAD team first analysed copies of the original factory drawings, a much easier start than having to reverse engineer a worn part. These provided all the necessary measurements and tolerances specified by the factory. The drawings were then digitised using design software which allows the engineers not only to view a 3D model of the part on-screen but also allows them to trial fit the part to other gearbox components in the software to check for fit and compatibility. This approach is both faster and more cost-effective than manufacturing physical prototypes.

Denis Welch Motorsport is now offering complete centre change gearbox lids for BJ7 and BJ8 centre change gearboxes. The BJ7 lids suit brass gear stick bushes and the BJ8 is designed to suit nylon bushes. The fully assembled lids are supplied complete with selector shaft, gear lever shoe, woodruff keys and oil seal installed. These lids are also available bare for customers who either have serviceable parts or who wish to build up their own assembly using new reproduction components. Each is a faithful reproduction of the original, cast in aluminium and then precision CNC machined which ensures compatibility with original gearbox cases. These parts are made exclusively by Denis Welch Motorsport and are not available anywhere else.

The new and exclusive Healey gearbox lids are one of the growing range of centre change gearbox parts in the recently launched 2016 Big Healey Performance catalogue. This now includes all the parts to build brand new centre change gearboxes. HRT

# Under the surface

**AFTER** an accident in a test session a week before this year's Goodwood Festival of Speed, Roger Clark Roger Motorsport was in a bit of a bind as it jeopardised the appearance of Gobstopper II, the car that was upholding the team's honour at the event.

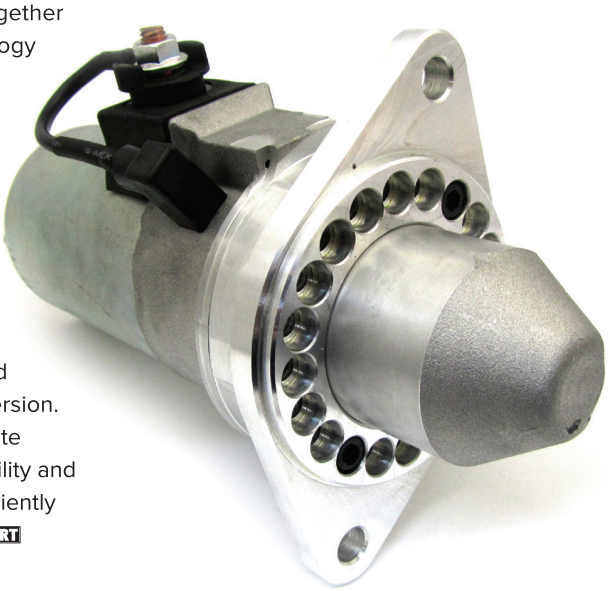
Working to a very tight deadline, the company that came to the rescue was Central Scanning, a British company that offers a variety of 3D scanning and reverse engineering services as well as being UK resellers for all products offered by Artec 3D. The first job was to scan and then replicate a vital aerodynamic component.

"At Central Scanning we are always willing to step up to the mark and in the circumstances, we hope we have proved that even if time isn't necessarily on our side, we can still deliver and make it a success," says Tom White, Central Scanning's application engineer. "With this project, came a fantastic added bonus, that the team at Roger Clark Motorsport made it a double glory, following on from its success last year when it again claimed the team's second consecutive victory at this year's Festival of Speed shootout finale." HRT

# Modern but looking original

**POWERLITE** claims that it is at the forefront of rotating electrical component manufacture and supply. For 2016 an increase in the range of its race-winning lightweight Slimline starter motor looks certain to make its products even more popular in the historic racing arena. These units weigh in at only 3 kg, are an impressive 1.6 kW, and also draw less current. There are no adjustments to be made as all are engineered to be direct replacements for the heavy inertia type starters originally fitted. The Slimline range includes patterns for the Ford X-Flow, pre-X-Flow, Mini, MG, Formula Ford 1600 & 2000, Jaguar and Austin Healey. The company also offers the bespoke re-manufacturing of starters and dynamos from any era for customers wanting to keep complete originality.

As well as its high-performance starter motors and alternators, it produces the Dynalite that brings together modern alternator technology with the classic looks and appearance of a dynamo that provides up to 80% more power and weigh up to 40% less than original dynamo units. In many cases the original dynamo pulleys can also be used on the new units, creating a simple and reversible alternator conversion.



The self-regulating Dynalite units offer increased reliability and performance charging efficiently across the full rev range. HRT

# Drexler makes history






*New limited slip differential Maserati 300S (1955 year of manufacture)*

Normally the limited slip differential manufacturer Drexler Automotive is known from numerous racing tracks, but also in connection with famous automobile manufacturers, as well as automobile refiners.
Regarding niche products, like limited slip differentials for historic cars, the company situated in Lower Bavaria has much to offer. “Especially in this sector we are well known for our reputation as limited slip differential manufactory”, as per Herbert Drexler. In most cases off the shelf limited slip differentials do not fit properly to historic cars. Further the assembly of the differential in those cars is often a bit tricky, because of their special characteristics and can only be done with the required deal of sensitivity. Or an adequate limited slip differential is simply not available.

In next to the development of the automotive series production over the past years, Drexler also wants to stay true to its´ and consumer customers. “Finally we do not want to forget, where we originally came from”, says Drexler. That is the reason why Drexler Automotive offers a selected range of limited slip differentials for historic racing and wants to provide the proven technology of the Drexler limited slip differentials to these customers as well.

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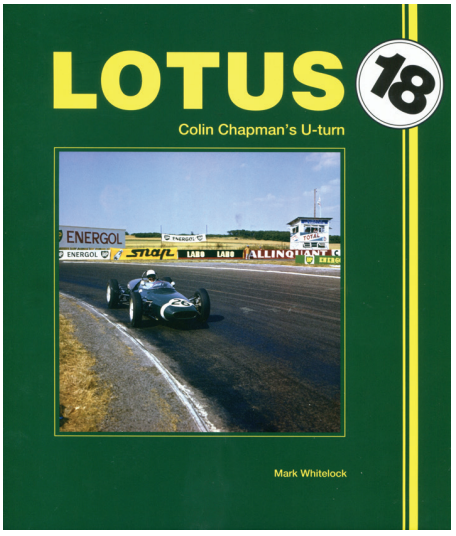
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## Lotus 18

*Colin Chapman's U-turn*
**Mark Whitelock**
Published by Veloce
ISBN 1-845845-20-9
192 pages
£50.00/$85.00




**AT** first glance it is hard to take in just what is meant by the subtitle – U-turn? What U-turn? The author Mark Whitelock, a retired banker who has had a lifelong interest in historic racing cars, quickly provides the answer: it was Colin Chapman's switch in moving the engine in a Formula 1 car from the front to the rear. In so doing, he redefined the single-seater racing car as we know it today.

Many will relish the memories of Stirling Moss beating Ferrari against the odds driving a Lotus 18 in what the author describes as his all-time great Grand Prix drives at Monaco and the Nürburgring in 1961; others might focus on Jim Clark in his first season in Formula 1 in 1960, coming to terms with the car and new circuits.

The book is absolutely packed with wonderful period photographs that capture the era so well, plus a number of detail colour pictures of the car along with line drawings of the Coventry Climax FPF engine. In fact there is a chapter devoted to it which makes fascinating reading.

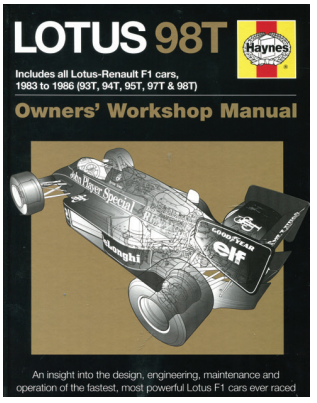
The book is mainly in chronological order so the narrative is easy to follow but then there's the chapter towards the end, called variations on a theme 1960-65, which will appeal to those who like to see how the car was developed for different race series around the world. By this time Colin Chapman had moved on to other creations but this chapter is full of anecdotes and great pictures.

A number of appendices, as to be expected in a book of this nature, detail a summary of individual chassis histories, a chassis by chassis race record and drivers who raced the Lotus 18.

Specialist in subject matter, this book will appeal to the true Lotus aficionado. HRT

## Lotus 98T

*Includes all Lotus-Renault F1 cars 1983 to 1986 (93T, 94T, 95T, 97T & 98T)*
**Stephen Slater**
Published by Haynes Publishing
ISBN 978 0 85733 777 1
156 pages
£22.99




**AS** regular readers will know, we are great fans of the Haynes Owners' Workshop Manuals, having reviewed a number over the last couple of years. The format is good and the picture quality second to none and author Stephen Slater continues the trend.

The Lotus 98T isn't perhaps the next Lotus to come to mind to feature in this series but as the author states in the Epilogue, the 98T is still the fastest Lotus car ever built and it featured the most advanced aerodynamics of its time. In addition, it was the swansong of the John Player Special livery.

The book starts with the usual potted history of Lotus, the meat of the book starting with the second chapter titled 'The Senna Years'. This alone will be enough to get many to buy the book. Not to be forgotten, though, is Johnny Dumfries, Senna's team-mate and the only other person to drive the definitive 98T.

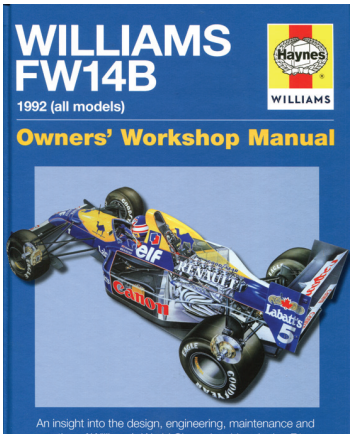
Chapter 3 is devoted to the anatomy of the 97T and 98T with plenty of fine detail studio shots, the section on its aerodynamics being perhaps the most interesting as this was the car that saw the birth of the barge board. It could be argued that despite the wings that sprouted on cars a few seasons before that, this was the real birth of aerodynamics as we know it in Formula 1 today.

One interesting anecdote was that as the 1985 and 1986 seasons wore on, McLaren and Williams were able to match the race pace of the Lotuses with lower fuel consumption. It was only the following season, when Lotus switched from Renault to Honda – which consequently gave it access to the Honda-supported 40% rolling road wind tunnel at London's Imperial College – that it turned out there was a mismatch between the data it supplied and that of the full-scale wind tunnel at the Institut Aerotechnique. The result was seen on the 99T that featured some significant aero revisions.

All eight cars produced still survive but are rarely seen as sadly they aren't eligible for any historic race series. HRT

## William FW14B

*1992 (all models)*
**Steve Rendle**
Published by Haynes Publishing
ISBN 978 0 85733 825 9
173 pages
£22.99




**AS** author Steve Rendle notes in the book, when the Williams FW14B arrived in South Africa in March 1992 for its first race it was the most technologically advanced car ever to compete in Formula 1. Its semi-automatic transmissions had been proved in the previous season's FW14 and its active suspension was the fruition of years of work, but the car was also pioneering in its use of electronic control systems and data logging, all of which had been designed in-house at Williams.

There is an excellent in-depth description of the active-ride system, complete with diagrams and photographs to give even the casual reader a complete understanding of how it all works.

There is an even more comprehensive section on the development of the Renault engine that details the changes made from the RS1 through to the RS4 with sub sections on the conrods, pistons, crankshaft and cylinder heads. There is also a good description of the pneumatic valve mechanism.

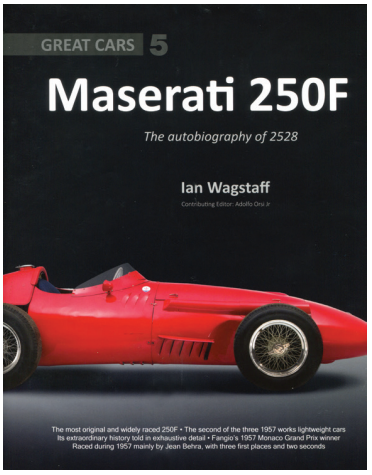
With electronics being an important element of the FW14B, there is an in-depth explanation of the Vehicle Control and Monitor module (VCM) that controlled the active suspension, gearshift, traction control and data logging. It communicated with the Engine Control Unit (ECU) supplied by Magneti Marelli using a then-new serial communications standard known as Controller Area Network (CAN), the first time such a system had been used in Formula 1.

CAN is now standard kit across cars racing in many series and also on many road cars. Such nuggets are not widely known but it is an example of why the FW14B is such an important car and how the author has dug them up by talking to the people involved with developing the systems at the time.

There is a chapter on the engineers which include Patrick Head, of course, Adrian Newey and Paddy Lowe, one on the drivers and a very short one on Williams Heritage. The appendices include the rival cars in 1992, the FW14B race results and statistics and the car's specifications. HRT

## Maserati 250F

*The autobiography of 2528*
**Ian Wagstaff**
Published by Porter Press International
ISBN 978 1 907085-38-3
340 pages
£60.00




**WE** have reviewed books by Ian Wagstaff before, including his one of the Porsche 917 in the same Great Cars series, a tremendous commitment to the printed word by this great publishing company. It goes without saying that everything about this book is exemplary in terms of writing, photographs and production values.

The Maserati 250F is one of the most iconic racing cars that epitomises the 2½-litre front-engine Formula 1 era of 1954-60. The car featured in this book, chassis 2528, is one of the three lightweight chassis that were made and the one in which Fangio won the Monaco Grand Prix and also Jean Behra the three non-championship grands prix at Pau, Modena and Casablanca.

The book comprises an evolution of the 250F with some stunning pictures before delving down into the story of chassis 2528, including its first victory at Pau. Within the chapter on Monaco, there is a great piece on a lap of the circuit with Tony Brooks.

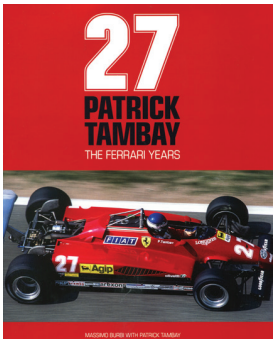
After the race-by-race chapters there are more on the one and only Fangio, with a lovely moody full-page picture of him seemingly lost in thought. Another shot captures Jean Behra, looking very coolly at the camera while smoking a cigarette. Then there's one of Harry Schell, whom Wagstaff describes as larger than life, smiling at the camera with a cigar clenched between his teeth. Where are such characters today in motorsport?

There are also chapters on the car's subsequent life, including ownership from 1964-71 by Charles Lucas (who has also contributed a chapter) and then from that year to the present by the Corner family.

This is not an inexpensive book but it is actually tremendous value for money and, with other such books in the series, a must-have addition to the library. HRT

## 27

*Patrick Tambay, The Ferrari Years*
**Massimo Burbi with Patrick Tambay**
Foreword by Alain Prost
Published by Evro Publishing
ISBN 978 1 910505 12 0
300 pages
£60.00/$89.95




**AT** first glance this really is a specialist book – Patrick Tambay was a relatively popular driver back in the day he was racing in Formula 1 but not to the extent that he became a household name. Nonetheless this is no reason to dismiss the book because it a fascinating account, not just of the races but of the political shenanigans at Ferrari behind the scenes.

As the title indicates, this is not a biography of the Frenchman as such, but of his two seasons driving Ferrari number 27 in 1982 and '83. As Alain Prost in his Foreword writes, it is an emotional rollercoaster of a book because of just what the number 27 meant to Ferrari fans. It was the number closely associated with Gilles Villeneuve, whose driving antics at the wheel of his car are emblazoned in the memory of everyone who watched him.

Tambay had the near-impossible job of replacing the French-Canadian driver immediately after his tragic death at Zolder in 1982. He recounts how he arrived at Ferrari's main gate in Maranello in his white Fiat Ritmo totally unnoticed just days after the fatal accident, this at a time when the announcement of Ferrari drivers was reminiscent of a new Pope being elected, writes Burbi.

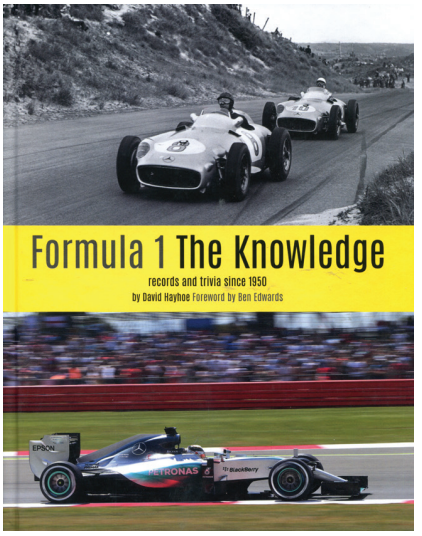
When the news was released that the Frenchman had got the job, it didn't go down well with the Italian media pointing out that there were many more Italian drivers who were faster. However, Enzo Ferrari knew what he was doing, but the pressure on Tambay was absolutely massive, and that is the point of this book. Not only is it a race-by-race account of his two years with the team, but the underlying commentary about how he felt and the burden he was carrying on his shoulders.

Tambay's two-year spell was moderately successful with some wins and in those two seasons Ferrari did win the prestigious Constructors' Cups, but the way his contract was terminated was brutal. He was unaware that his time with the team had come to an end before the season had even finished until he was contacted by an Italian journalist looking for a comment following the press release from Ferrari stating that he had been replaced. Tambay reacted in the way of the gentleman that he is by saying that he had arrived at Maranello in a very dark and tough hour and was pleased to have helped the team with the Constructors' Cup. He also thanked Enzo Ferrari and the team for the opportunity.

An unusual book but one that sets the record straight – a great read accompanied by many fabulous pictures. HRT

## Formula 1 The knowledge

*Records and trivia since 1950*
**David Hayhoe**
Published by David Hayhoe Publications
ISBN 978 0 9935329 0 0
434 pages
£35.00




**THIS** is a lifetime's work by Formula 1 statistician David Hayhoe, who has been plying his trade for years. While it may be seen by some to be about as interesting as the Wisden Cricketers' Almanac, it is actually an incredible piece of work. As with the *Grand Prix Data Book*, a Kimberley motor sport book originally published by Haynes Publishing in 1989, with subsequent updates, Hayhoe's latest book, which he has had the bravery to publish himself, is packed with fascinating facts and figures.

Where to begin? Distance competed in a season? Kimi Raikkonen in 2012, who covered 6081 km (3779 miles), followed by Daniel Ricciardo in the same year with 6023 km (3743 miles). How about two front rows on home soil in a season? Answer: Heinz-Harald Frentzen in 1999 (German and European), and Damon Hill in 1993 (British and European) and some others.

Then there's most number of races started without a win: Arrows with 382 starts, followed by March with 340. Sticking with constructors, how about interval between wins? Answer: Mercedes-Benz – from Italy 1955 to China 2012 – 56 years, 217 days, followed by Honda – from Italy 1967 to Hungary 2006 – 38 years, 330 days.

You name it and you will find it in this book. Apart from being an invaluable reference book it's something that will keep you amused for hours on end, much in the same way as the *Guinness Book of Records*, and there's no higher compliment than that. HRT

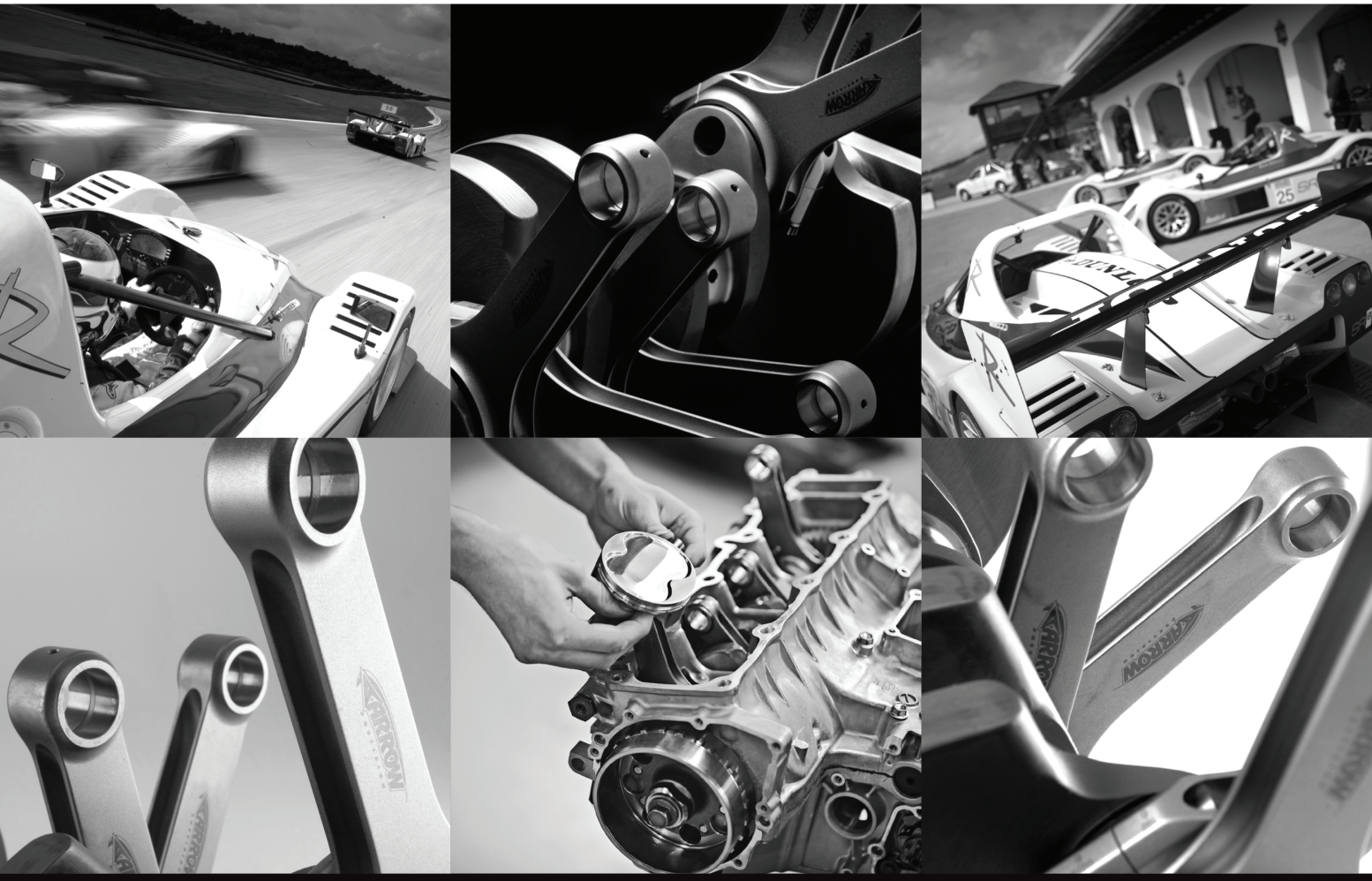
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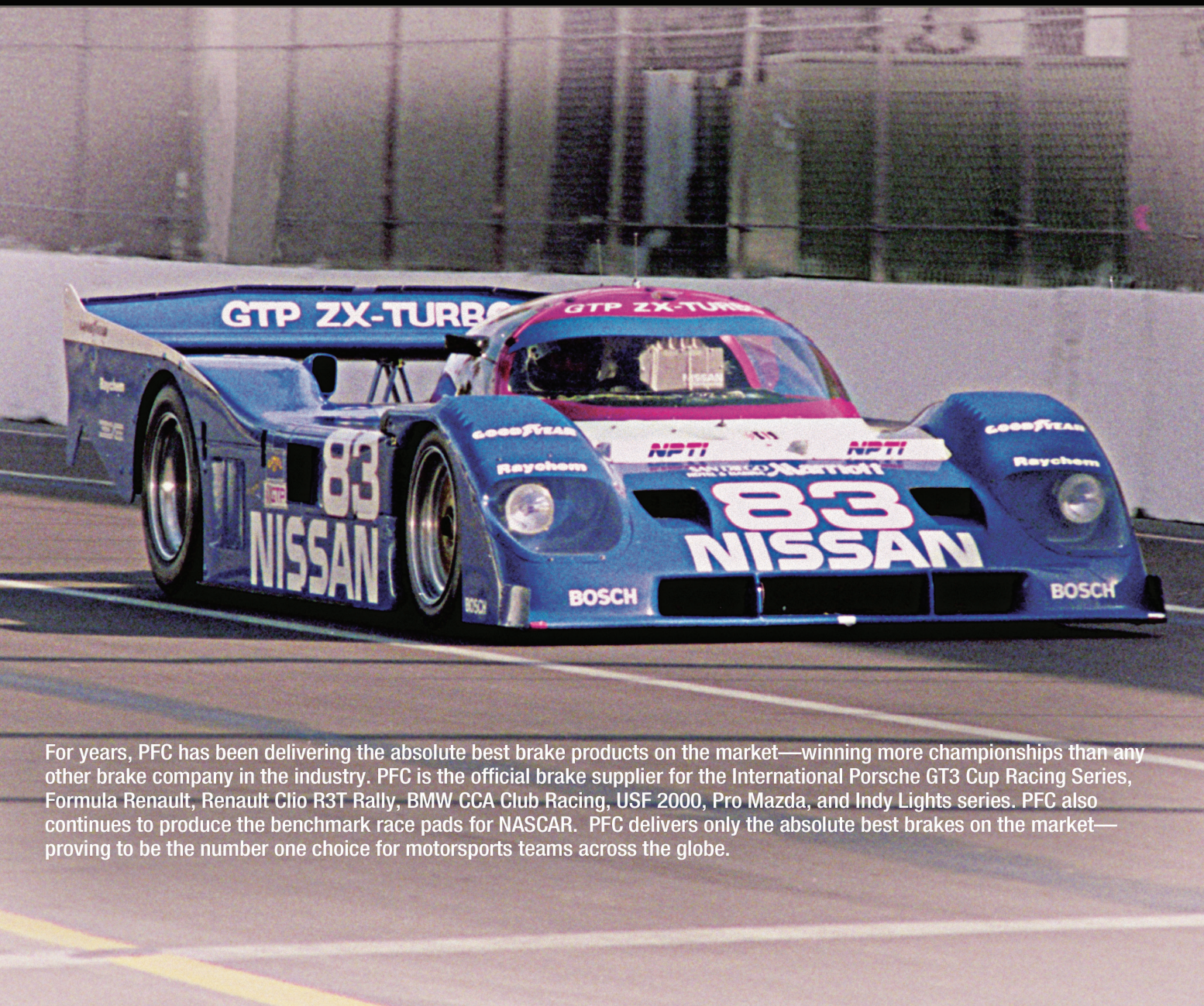
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