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AUGUST	10/11	Monterey Pre-Reunion	WeatherTech Raceway Laguna Seca
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SEPTEMBER	6/8	Historic Grand Prix	Zandvoort
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NOVEMBER	13/17	HSR Classic 24 Hour**	Daytona International Speedway
DECEMBER	5/8	Sebring Historics**	Sebring International Raceway

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Old cars, new threats

FUN, affordable and relatively unbureaucratic were the findings of a survey conducted by *Racecar.com* six years ago among members of the Motor Racing Legends series, the message being 'let us go and race relatively uninhibited by red tape and other such issues'. Over half a decade later, though, and that landscape has changed. While the fun and affordable are still to the fore, there are many other issues at stake over historic racing's future.

One such is the movement against older cars. In London, Transport for London has decreed that as from 25 October 2021, the Ultra Low Emission Zone (ULEZ) will be extended not just to cover inner London, but to incorporate the suburbs. What this means is that if you are driving any petrol or diesel vehicle within this enlarged area, you will also need to meet new tighter emissions standards or pay a daily charge which at the moment is £12.50 ($15 at today's rate of exchange). This has been done without consultation or a vote, it has just been decreed.

Such is the general feeling against older cars that it really doesn't take too much stretch of the imagination to see a possible looming threat over racing old 'dirty' and 'smelly' cars.

Another big threat facing the historic racing car industry is the lack of youngsters coming into it. It is nothing like as glamorous as Formula 1 and many of the skills learnt at university will not be called upon, so there's even less incentive to look for a job in the sector.

It is for this reason that we have supported the creation of the Historic Racing Association, which, as the lead News story explains, is open to anyone involved in any way with the industry. The mission statement is to promote and protect the historic racing industry. It is even open to enthusiasts who may not have a business interest but delight in the racing and the cars.

When the Motorsport Industry Association was created a quarter of a century ago, the motorsport industry was seen as an add-on to the automotive one, but it merited its own body. The same is now true of the historic racing industry. It needs a voice and one that will be listened to while at the same time addressing the problems such as a skills shortage that threatens the industry.

So fun, affordable and less bureaucratic are still very much part of the agenda, but with the threatening dark clouds looming on the horizon, now is the time to prepare for the worst.

On a completely different note, I would like to say thank you to our advertising manager Mike Norman who has been with us for many years but who has decided that the lure of not having to get up early and come into the office every day was too great and has therefore opted to retire. So, thank you Mike for all your hard work and making the magazine what it is. We will miss you. HRT

William Kimberley
Editor





ABOVE Historic racing is booming, but until the HRA there has been no wider body to promote and protect the industry

Historic Racing Association formed to address sector skills shortage

THE Historic Racing Association has been created in the UK to address the looming skills shortage in the historic racing sector as well as to promote and protect the industry as a whole.

Based on the feedback from companies and teams, it became apparent that while the overall popularity of the historic racing sector was extremely high, the sport had a major obstacle in the way of continued growth due to an ageing workforce and a lack of young people interested in technical careers within the sector. It represents a serious threat to the future growth of historic motorsport.

In line with his findings on the current state of historic racing, Brian Sims, who founded the Motorsport Industry Association a quarter of a century ago, gathered a small, but influential discussion group together at Bicester Heritage, comprising people from various sectors of historic motorsport, including Dan Geoghegan, Bicester Heritage CEO, and Professor Gareth Neighbour, former head of engineering for Oxford Brookes University, to ascertain opinions as to the ways that the issues discovered might be remedied.

It was agreed by those present that it was essential that the historic motorsport sector maintained and increased awareness of its own identity, as opposed to being mixed into the needs of the motorsport industry in general. As an example, while the MIA itself represents the motorsport industry, by definition it is mainly concerned with new, advanced technologies. The future rather than the past. There was consensus that the historic sector needed to strengthen, not weaken its own identity.

Addressing the skills shortage is top of the agenda for the new HRA but before a solution can be found, Sims said at the Bicester Heritage meeting that it was important to create an entity that would encompass and bring together all of the various sectors that comprise historic motorsport.

This has set in motion one of the ground rules of the new HRA which is to build a core network that consists of race and event organisers, circuit owners, preparation specialists, parts suppliers, academia, historic clubs, car manufacturers, drivers, auction houses, banks, insurance, legal, media, lifestyle brands and, of course, historic racing fans. “The objective will be to provide an effective communication platform, when and where appropriate, for representing, or lobbying on behalf of historic motorsport in respect of future issues that may impact the sport, whether with the FIA, the government or even circuit owners,” said Sims.

It was agreed that the new Association would not charge high membership fees but would rely more on sponsors for its various initiatives such as the proposed education and apprenticeship programmes. “As such, I’m already in touch with two very major brands about helping with an education programme and have found an amazing amount of interest in that particular need, especially relating to apprenticeships and programmes of a similar nature,” said Sims.

“In summing up, our aim with the HRA is to provide a central point of information within the historic racing sector for career enquiries, media contact and the co-ordination of career development programmes along with actively promoting and protecting the industry.” HRT



ABOVE Ecurie Ecosse has shown off its LM69, a homage to one of the greatest sports cars to have never raced at Le Mans

Ecurie Ecosse reveals tribute to XJ13

DESPITE never actually competing in the 24 Hours of Le Mans, the Jaguar XJ13 remains one of the most iconic cars associated with the French endurance classic.

The prototype was built in 1966, and was powered by a brand new, mid-mounted quad-cam, 5-litre V12 engine, which Jaguar hoped would help it add to its collection of Le Mans trophies. However, the stunning car remained unraced thanks to changes in sporting regulations, and was subsequently mothballed and all but forgotten as other projects took priority.

More than fifty years later, however, Ecurie Ecosse, the team that twice took Jaguar D-Types to Le Mans victory in the '50s, has revealed that it is continuing the XJ13's story by launching a homage to the classic named the LM69.

The bodywork has been sympathetically developed to ensure it still retains the striking good looks of the original, while the quad-cam V12 remains at the heart of the car. The LM69, which is road-legal, was designed and built adhering to all the same regulations as the original, using design details and technology that entered motorsport no later than 1969 to ensure it meets FIA homologation requirements.

Under this brief though, there was still plenty of scope to ensure the car was competition ready. As such it benefits from '60s innovations, such as composite materials, experimental aero devices, wider wheels and an improved engine.

In total, just 25 of the re-imagined cars will be made, each with a price tag of £800,000- £1,000,000. HRT

Sonoma Speed Festival confirms dates for second event

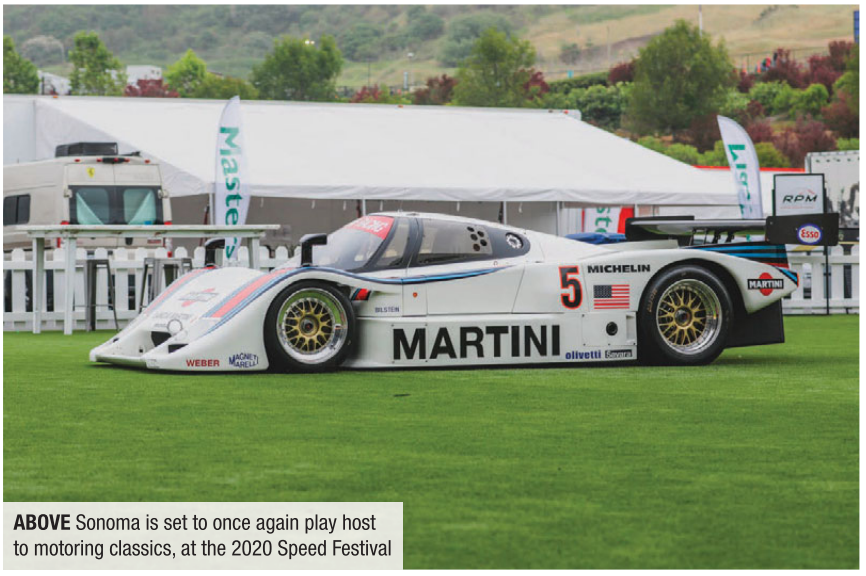
IT HAS been confirmed that the second Sonoma Speed Festival will go ahead, taking place on May 28-31 2020 at Sonoma Raceway in California.

As at this year's inaugural running of the event the Speed Festival will feature some of the rarest authentic race cars spanning the history of motorsport, from the very earliest racers, right up to more modern flyers. Attendees will be able to watch these cars battling it out on track, as well as visiting motorsport exhibitions, on-site car shows and more.

The 2020 running of the Sonoma Speed Festival will build on the success of the previous event, which saw more than 200 cars on track, including two rare Ferrari GTOs, as well as demonstration runs by the only McLaren F1 GTR Longtail. In addition, two ex-John Wyer Gulf Racing Porsche 917ks, and two Gulf Racing Ford GT40s were competing.

The festival was also host to one of the most successful F1 cars ever, the 2016 Mercedes-AMG W07/04, which made several demonstration runs with simulator and test driver Esteban Gutierrez, who smashed the full-course configuration lap record by more than five seconds, posting a 1:15.430.

"Our inaugural event was a smash hit with both fans and participants," commented Ryan R. Turri, Sonoma Speed Festival general manager. "We look forward to making this event even better for 2020." HRT



ABOVE Sonoma is set to once again play host to motoring classics, at the 2020 Speed Festival



ABOVE The 1959 Ferrari 250 TR is one of the Prancing Horse's gems to be shown at Hampton Court

Race-winning Ferraris join Hampton Concours of Elegance

HAMPTON Court Palace's Concours of Elegance will feature two of the most beautiful race-winning Ferraris of the 1950s, with the 1955 Ferrari 500 Mondial and 1956 290 MM – later 250 TR - the latest of more than 10 extraordinarily rare Ferraris confirmed to be attending the event.

The 1955 500 Mondial in attendance is one of only 19 ever built, and one of five bodied by Scaglietti. Its appearance at Hampton Court Palace is the latest in its history that started in 1955, with a third place in the Coppa Mare Monti, before winning the Ethiopia Grand Prix in in the hands of Guido Petracchi.

In 1956 the car won the Cote de Asmara being driven by Gaetano Barone. This was followed by a further two victories before the car was put into long-term storage. The car was bought in 1970 by collector and dealer Colin Crabbe, who was shown the vehicle while on holiday.

Joining the Mondial is the 290 MM, which with Phil Hill and Maurice Trintignant at the wheel drove to victory in the 1956 Swedish Grand Prix. In 1959 the car had its V12 replaced with a V12 Testa Rossa unit. The car was then sold once again, this time to Brazil, where it won a number of races between 1960 and 1962. Following an accident and a spell as a V8 special, the car was laid up, before being rediscovered in 1986.

The two fifties icons will be joined by four of the most significant 166 MM chassis, including the ex-works #0008M – which is widely regarded as the most significant Ferrari in the world. It was uniquely piloted to a debut victory at both the Mille Miglia and the 24 Hours of Le Mans in 1949, making it the only car of any marque to ever have achieved that feat.

"This year's Concours of Elegance is a real once-in-a-lifetime event for Ferrari fans. Not only will we be celebrating the 70th anniversary of the 166 MM's historic victories at Le Mans, Spa and the Mille Miglia with four different examples but we'll also have a total of over 10 of the most iconic and important Ferraris ever – with these two '50s racers just the latest to be announced," enthused Concours of Elegance director Andrew Evans.

"We've always said that it's the stories the cars on display tell that makes them so special, and both the 500 Mondial and 290 MM/250TR coming to Hampton Court Palace have a novel-worthy history of racing victories, far-flung lands and mistaken identity. And don't forget, these are two examples of around 1,000 cars set to gather in Hampton Court Palace from 6-8 September as we host the most astonishing Concours of Elegance yet." HRT



ABOVE Visitors to the Concours of Elegance will be able to see one of only five Scaglietti-built 500 Mondials

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ABOVE Sir Jackie turns back the clock to celebrate and to highlight a worthy cause

NEWS

Jackie Stewart recreates maiden victory at Silverstone

HALF a century ago, in July 1969, Jackie Stewart celebrated his first ever victory in a British Grand Prix, electrifying his home fans to take the win at Silverstone.

This summer, modern fans had the chance to enjoy the spectacle, with Stewart climbing into the victorious Matra-Ford from that race and completing demonstration laps to mark the Golden anniversary. However, Stewart was not only looking to the past with his run, but also seeking to make a difference by raising awareness and funds for dementia research, a charity cause close to his heart.

"I was looking forward very much to getting back to Silverstone in the Matra, even if not at quite the same speeds as 50 years ago!" said the triple champion.

In that race, Stewart was outqualified by Jochen Rindt in his Lotus 49. The pair duelled, swapping the lead many times until Stewart spotted that a part of the wing on the Lotus was starting to come loose and dangerously starting to rub on a rear tyre. Stewart warned his rival, who was forced to pit for repairs, leaving the Scotsman to take the victory.

"The 1969 British Grand Prix was one of the most exciting and enjoyable Formula One races that I ever had," recalled Stewart. "Jochen was one of my best friends. The cooperation we had in not trying to block each other allowed us to definitively run away from the rest of the field. We knew, because in those days there was no aerodynamic sophistication, that we could draft each other and pass if we were not blocked. Almost every lap, we exchanged the lead on the Hanger Straight and going into the 155 mph Woodcote corner, which in those days had no chicane. We pointed to each other which side to be passed on, to avoid reducing our lead from the rest of the pack. We exchanged the lead more than 30 times and it was a fantastic race for both of us."

Stewart, who during his racing days was a tireless campaigner for driver safety, added that he was also proud to be raising money to fight dementia, a condition from which his wife, Lady Helen Stewart, suffers.

"I am extremely grateful to the organisers for supporting Race Against Dementia," said Stewart. "Helen will be truly proud of what we're doing to challenge her illness and the challenge dementia poses to us all." HRT

Donington announces dates for Historic Festival

THE dates for the 2020 Donington Historic Festival have now been confirmed, with Friday 1st, Saturday 2nd, and Sunday 3rd of May all penned in for the event.

Friday will see an action-packed day of qualifying, with attendees able to see every single grid out on track over the course of one day, while Saturday and Sunday will see full-on racing from an international cast of hundreds of world-class historic race cars.

As well as the on-track action, there will also be a range of other attractions and parades, including displays from dozens of car clubs. Visitors to the festival will also be able to enjoy access to the competition cars in the open-access paddock, with everything from 1920s and '30s Bugattis, Bentleys and Alfa Romeos to 1990s Touring Cars on show.

Tickets for the event will go on sale on November 1st. HRT

BELOW Another important date for the diary



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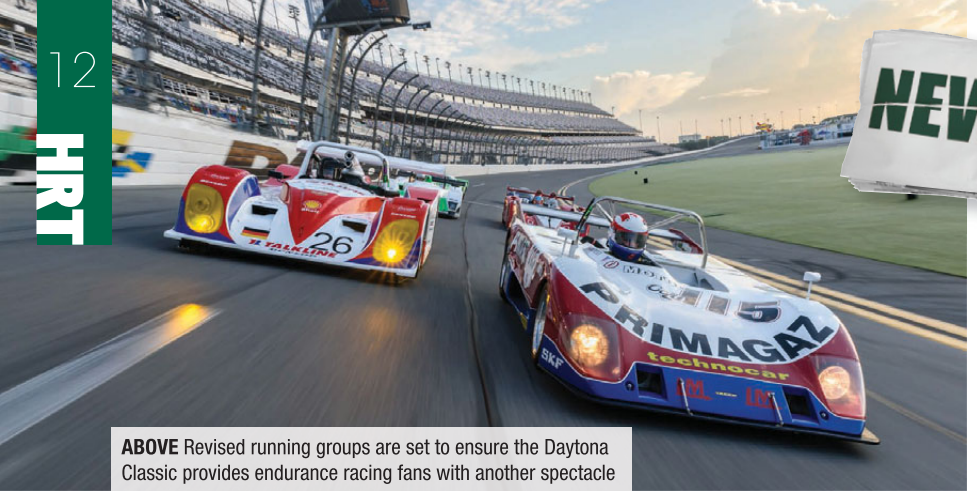


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ABOVE Revised running groups are set to ensure the Daytona Classic provides endurance racing fans with another spectacle

Daytona Classic 24 to feature adjusted run groups

AHEAD of this year's running of the IMSA-presented Historic Sportscar Racing Classic Daytona, officials announced a change and expansion of the Run Group structure for the classic endurance race.

The most significant change to the event, which returns to Daytona International Speedway on the 13-17 of November, is that Group E will now be split into two individual classes, with each featuring modern prototypes and GT cars from the turn of the century.

Run Group E will remain a showcase of iconic machines like the Audi R8, Pescarolo Judd, Peugeot 908 and Lola B07 LMP cars, that now compete with Daytona Prototype International, and LMP2 race cars.

The split means that the ORECA FLM09 Le Mans Prototype Challenge cars and Gen 2 and Gen 3 Daytona Prototypes will now be able to compete for overall honours in a restructured Run Group F.

Group F previously contained cars not represented in the other six groups. This matching of cars will now be renamed to Run Group G, and will continue to offer a variety of primarily production-based cars, including many of the same teams and cars that compete in HSR's Vintage GT and Historic GT groups.

Groups A-D will continue with no major technical change, although for the first time, Groups C and D will compete simultaneously, albeit for different podiums and awards.

"Daytona Prototypes and LMPC cars have become quite popular with HSR competitors in recent years," explained HSR President David Hinton. "Both have been competitive but are a little outmatched against the LMP machines that have set the standard in Group E since the inaugural HSR Classic Daytona in 2014. Moving 'DP' and 'PC' to Group F, where they will be able to contend for the overall victory, has been a popular decision with our competitors and brings back a familiar scene for race fans that watched both classes compete at Daytona in their prime just a few years ago." HRT

Silverstone Classic enthrals record crowds

THE 2019 running of the Silverstone Classic was record breaking in a number of ways, from the record grids, record car club attendees and record spectator figures, with 109,000 people coming to watch the action over the three-day event.

The historic racing festival featured 21 races, packed car club displays, iconic anniversary parades and lots of off-track attractions. Saturday at the event saw the Classic's opening 12 races, as well as the event's live music festival, which this year celebrated the 50th anniversary of Woodstock.

The racing continued on Sunday, with the ex-John Watson McLaren MP4/1 (featured in Historic Racing & Technology issue 22) stealing the show, after going toe-to-toe with Mike Cantillon's Williams FW07C, coming out on top and taking home the trophy for the FIA Masters Historic Formula One contest by just 0.382 seconds.

In the trophy for Pre '66 Grand Prix Cars, old rivals Lotus and Brabham turned back the clock, with Sam Wilson in the Lotus 18 beating Jon Fairley's Brabham BT11/19 to take overall honours.

"The Classic lived up to its 'Rocking and Racing' billing – the cars were the stars and all the families had brilliant fun," said Nick Wigley, Silverstone Classic CEO.

"The race programme was the most varied yet and the Mini races in particular will live long in the memory. In truth, the entire race programme has been extraordinary both in terms of great cars and exceptional driving skills."

Following on from the success of the 2019 running of the Silverstone Classic, organisers were quick to provisionally confirm its dates for the next instalment. Continuing the tradition of taking place a fortnight after the British Grand Prix, the 30th running of the Classic is scheduled to take place on the weekend of 31st of July to the 2nd of August. HRT



ABOVE A wide variety of cars electrified record-breaking crowds at July's Silverstone Classic

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The quest to unite historic motorsport

William Kimberley reports on the formation of a new association, conceived to provide representation for the entire historic motorsport sector

WHAT might be regarded as nothing more than a cottage industry by some, the historic racing sector is in fact a multi-billion pound one in the UK, going into the tens of billions if the burgeoning interest in other countries is also taken into account. However, there is no organisation that exists, at least in the UK, to represent, promote and protect the interests of those who make a living out of it.

A FOCUSED ORGANISATION

There are a number of bodies that already exist, such as the Motorsport Industry Association (MIA) which does a great job in introducing its members to industries that can utilise the specialist skills that motorsport companies offer, but there's no specific organisation that provides a united association representing the historic racing sector. Hence the creation of the not-for-profit Historic Racing Association (HRA) in the UK.

Brian Sims is a name that will be familiar to some people, especially as 22 years ago he was the founder of the MIA before handing over the reins to Chris Aylett. An active *éminence grise* behind the scenes in the motorsport industry, he has never lost touch with its needs and requirements.

Sims became aware of the skills shortage a couple of years ago when he was commissioned by a leading UK university to carry out a six-month feasibility study to ascertain the potential for setting up a motorsport engineering degree course at the university's new Engineering and Digital Technology campus. However, it was his opinion that this sector, both at university and technical college levels, was overcrowded in the UK, with 17 universities offering degrees of various levels within that sphere. He then switched his focus to the historic motor racing sector and found a very different picture emerging.

Based on the feedback from companies and teams, it became apparent that while the overall popularity of the historic racing sector was extremely high, the sport had a major obstacle in the way of continued growth due to an ageing workforce and a lack of young people interested in technical careers within the sector. It represented a serious threat to the future of historic motorsport.

> "A major lack of understanding of the structure of historic racing, which played a key role in the lack of interest in career potential"

GREATER AWARENESS

Through his involvement with three major British universities – one of which is recognised as being in the top three motorsport engineering faculties worldwide – one of the reasons for the lack of interest amongst young people



Newspress

in looking at careers within the historic scene became quite clear: a lack of awareness and full understanding of the sector. This was also true at school and college levels.

In line with his findings on the current state of historic racing, he gathered a small but influential discussion group together at Bicester Heritage. It comprised people from various sectors of historic motorsport, including Dan Geoghegan, Bicester Heritage CEO, and Professor Gareth Neighbour, former head of engineering for Oxford Brookes University. The group's objective was to ascertain opinions as to the ways that the issues discovered might be remedied, including ▶



ABOVE Brian Sims's research identified the fact that youngsters had a worrying lack of knowledge of the opportunities in the historic sector



ABOVE Historic motorsport is teeming with diversity, but has had no unified body to fight on its behalf

18+

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approving apprenticeship programmes.

It was agreed by those present at the meeting that it was essential that the historic motorsport sector maintained and increased awareness of its own identity. With this in mind,

> **“Exciting and new dynamic apprenticeship programmes”**

Sims proposed that the Historic Racing Association be formed to provide representation for the entire historic motorsport sector. He further proposed that Kimberley Media Group, a company ideally positioned to provide the level of communication that would be needed to grow and promote the activities of the HRA, should be the catalyst for this initiative.

A UNIFIED APPROACH

Based on the experience he gained in establishing the MIA, Sims proposed that before a solution to the skills shortage could be found, it was important to create an entity that would encompass and bring together all the various sectors that comprise historic motorsport. His research at university and college levels had shown that there was a major lack of understanding of the structure of historic racing, which played a key role in the lack of interest in career potential.

His view was that there was an urgent need to embark on a major awareness programme among school children at an early age, preferably before they were 12 years old, as well as their parents and not to wait until they were at near school-leaving age. There also needed to be a central point of information for anyone to find out what historic racing might offer.

“One of the HRA’s objectives is to increase awareness of historic motorsport at all levels of the sport,” Sims explains. “The aim is to increase spectator audiences and interest in the sector as a potential career opportunity within schools, colleges and the academic sector. We therefore want to develop and create skills training pathways in association with major education establishments, particularly in respect of developing exciting and new dynamic apprenticeship programmes, aimed specifically at tackling the skills shortage amongst young people within the historic racing sector.”



ABOVE The students from the Oxford Universities Motorsport Foundation go wheel-to-wheel with the Jordans’ A40 at Thruxton. More youngsters need to be encouraged into the sector

Jeff Bloxham



Newspress

BELOW As this buzzing paddock illustrates, the historic sphere is incredibly popular. However, it faces some major threats

This has set in motion one of the ground rules of the new HRA: to build a core network that consists of race and event organisers, circuit owners, preparation specialists, parts suppliers, academia, historic clubs, car manufacturers, drivers, auction houses, banks, insurance, legal, media, lifestyle brands and, of course, historic racing fans. “The objective will be to provide an effective communication platform, when and where appropriate, for representing, or lobbying on behalf of historic motorsport in respect of future issues that may impact the sport, whether with the FIA, the government or even circuit owners,” says Sims.

BELOW Idyllic scenes as a Ferrari 250 GT SWB is chased by an Aston Martin DB4 GT as they race after the sunset at Goodwood. But who will fight for historic racing's corner when the environmental lobby comes calling?

Nick Dungan/Goodwood

"I had a chance meeting with Alain de Cadenet at the Goodwood Revival meeting last year. He suggested that the skills shortage problem could be eased, at least in the short term, by recruiting men and women who are leaving the armed services as they are very well trained, skilled and looking for a job. There's an organisation which is partly owned by the Ministry of Defence and a recruitment company that looks after such affairs for people leaving the armed forces, but they needed to engage with a representative organisation, which doubly reinforced the notion that an association like the HRA was needed."

Another core issue that was discussed at the Bicester Heritage meeting was how the Association was going to be funded. The conclusion was that it should be through sponsorship, rather than high membership fees and requesting further payments every time anything happens. "As such, I'm already in touch with two very major brands about helping with an education programme and have found an amazing amount of interest in that particular need, especially relating to apprenticeships and programmes of a similar nature," says Sims.



ABOVE Contour Autocraft's Bruce Macleod teaches students the craft of the English wheel. Addressing a skills shortage is one of the HRA's aims

TO PROMOTE AND PROTECT

"In summing up, our aim with the HRA is to provide a central point of information within the historic racing sector for career enquiries, media contact and the co-ordination of career development programmes along with actively promoting and protecting the industry." HRT

Meet 'Petronella'

Any car named after a grandmother is going to be cherished, but as **William Kimberley** discovers, there are details that make Petronella particularly special



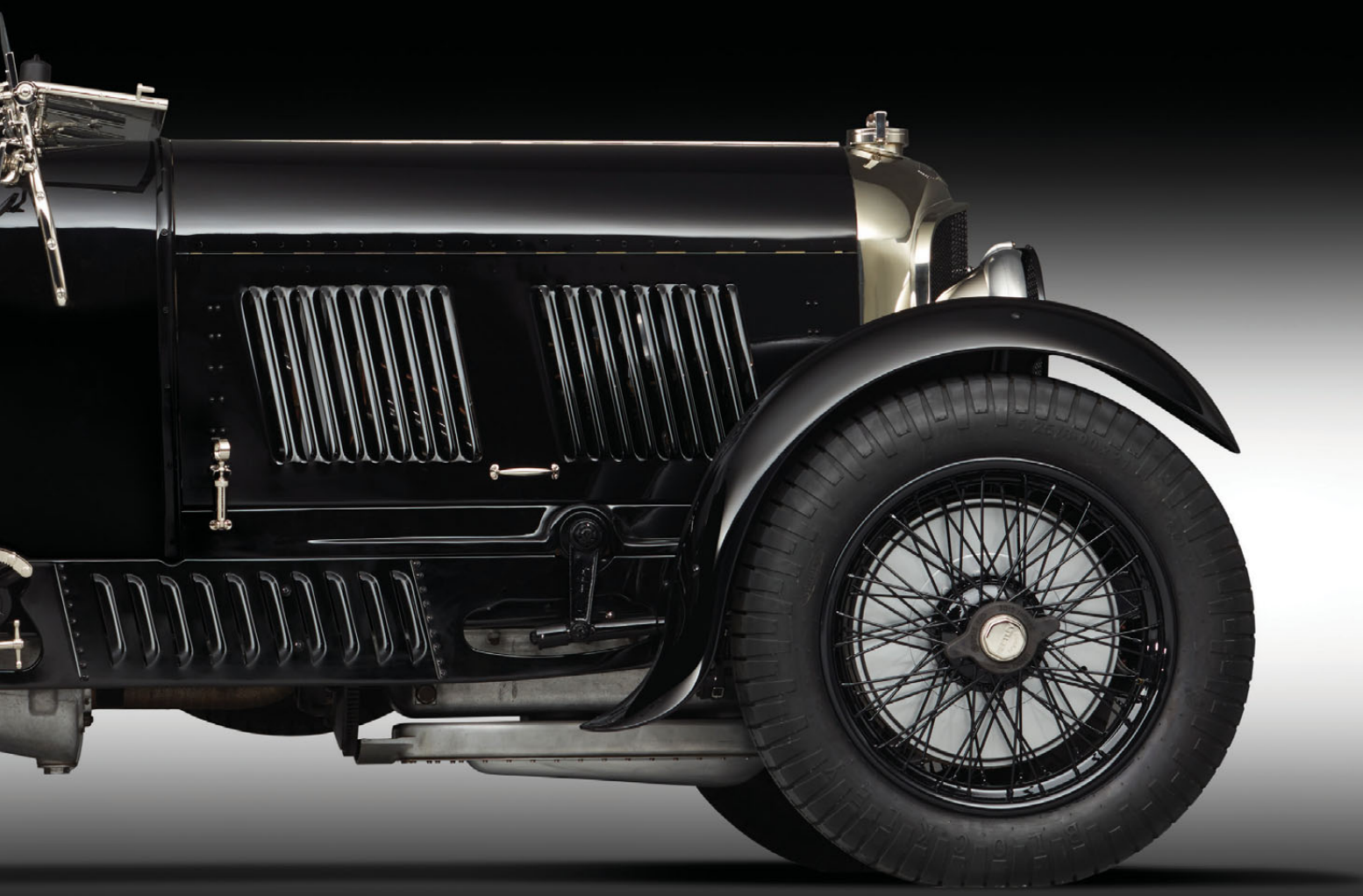
ABOVE Beautifully designed, Petronella captures all that made the W.O. Bentleys special

STUNNINGLY gorgeous, crazy and mad fun to be around! Often that girl that you let in and love quicker than you would other people. This is the *Urban Dictionary* definition of the name Petronella. It is also the name given to Tim Cresswell's vintage Bentley but not for this reason, for a far more romantic one, and that is the car is named after his grandmother, or rather, her West End stage name. The connection is more than just affectionate, though, because she knew some of the original Bentley Boys, even being a passenger to one of them in a beach race at the time.

Tim runs VBE Restorations in the Midlands, a company set up by his late father Richard in the late '90s. Up until then, he had spent the lion's share of his career at Jaguar Cars, gaining his apprenticeship with the company and then moving up through the engineering ranks, particularly in vehicle development and testing. As such, working with Norman Dewis and alongside Peter Taylor, he was heavily involved in the development of the XJ6 and XJ-S. He was also the official demonstration driver for the Jaguar XJ13 on several of its outings.

In the early 1980s he then set up and ran Jaguar's North American extreme weather test facilities, designing and building the base in the Sonara Desert in Arizona where temperatures frequently reach 48ºC. Subsequently he went on to take over the leadership from Dewis of Jaguar Cars' Vehicle Proving Group where he looked after test operations in five countries as well as all UK testing for the next 10 years,

In what he had of his spare time, he raced in the British Clubman's Championship in 'The Phantom', a car he designed, built and drove, and with which he won the 1974 Shell Clubman's Championship. He also rebuilt a Speed 6 Bentley in the '80s, which had competed ▶



at Brooklands in the mid-1930s, which he sold before buying another car. After he took voluntary retirement from Jaguar following Ford's takeover of the company in 2000, requests came from vintage Bentley owners as to whether he could look at their car and slowly the business built up in the garage behind the family home. As it grew, so did the need for more space, the company ultimately moving to its current location in Flecknoe, Warwickshire.

A FATEFUL CALL

Encouraged not to join the family business by his father who advised him to get work experience elsewhere, Tim took an apprenticeship at GEC-Alston Turbines Division where he trained in all aspects of machining and precision fitting. He went on to become a turbine engineer, specialising in inspection and non-destructive testing (NDT), using ultrasonics, eddy current and magnetic particle inspection. He then moved to Australia where he operated as a consultant, travelling internationally to conduct on-site inspections and reports.

"Then one day my father phoned me up and said he needed my help," recounts Tim. "That was about 12 years ago. On joining the business, I then did four years on the shop floor working in all departments before moving into the office. We also developed an entirely new section of the business producing extremely high-quality replacement parts. It was almost another apprenticeship again.

"On the restoration side of the business we've done a lot of work for American customers along with customers from around the world whether they want concours or modified to be more useable. In fact, the overseas element accounts for around 50 per cent of our business."

This is where Petronella enters the story. "VBE's own project car, Petronella, is a great showcase for our unique in-house skills," says Tim. "Petronella has been our way of showcasing what we can do. Everything had to be the best it could be. With the car being a 'bitza', I wanted it to have enough to be a real W.O. Bentley car and not a special. For

> **"With the car being a 'bitza', I wanted it to have enough to be a real W.O. Bentley"**

BELOW Thoughtful touches like new Cibie spotlights ensure Petronella is always ready for a blast



Photo courtesy of *Rolls Royce and Bentley*



ABOVE VBE carried out almost all work in-house, allowing the exquisite level of detail to be maintained throughout



example, I didn't want it to have a more modern Bentley engine as I wanted it to keep the vintage one."

The original three-litre engine was consequently converted to a 4.5-litre specification with a 5.3-litre cylinder block. "It has a forged semi-counterbalanced crankshaft which my father designed with Arrow Precision. The originals are not counterbalanced at all."

The crankcase needed quite a bit of machining as the Arias forged pistons sit lower in the cylinder block, so the bores had to be opened up. "We line bored it to take the larger 4½ crankshaft and then converted it to shell bearings, which are far superior to the original white metal ones. It also has forged Arrow Precision rods, uprated needle roller rockers and lightened valve gear."

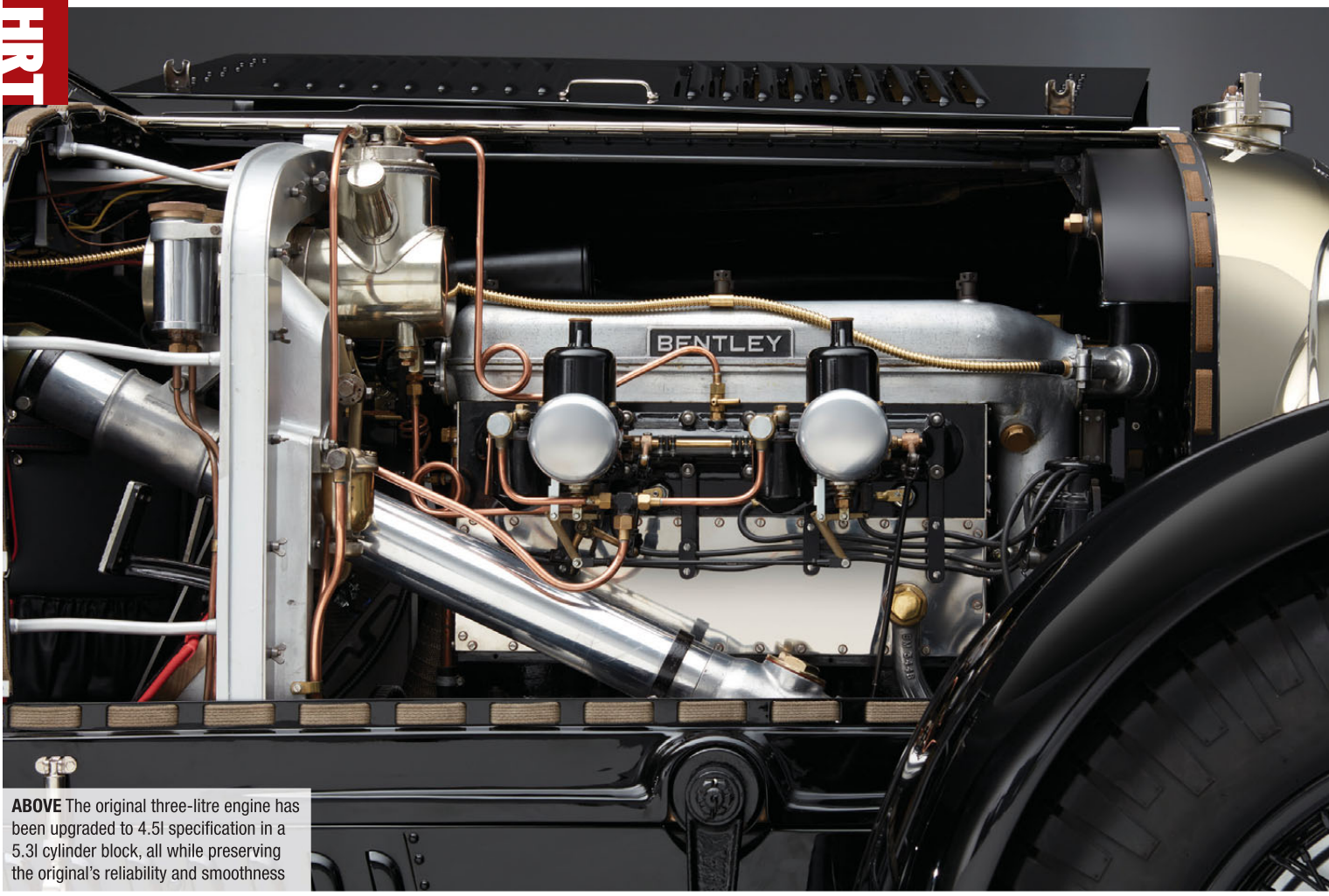
"We haven't gone over the top in trying to get high compression because we are using a three-litre crankcase. At 7:1, the compression ratio is significantly higher than the original, but not enough to be detrimental to reliability and smoothness."

An original spec camshaft has been used because as Tim maintains, there hasn't been an improvement on the original. However, an area where there has been a modern improvement is the oil pump. "What we've done is increase the number of teeth so doubling the pumping speed. I did run double volume gears as well but it flooded the top end with oil."

RELIABILITY AND PERFORMANCE

The oil draining system was modified as there is insufficient gap between the cylinders. "The oil on a 4½ drains through the water jacket between the cylinders and drops back into the crankcase, but the cylinders on a 5.3 block are so close that you cannot run anything between them. You have to make quite an elaborate pipework system inside the water jacket to come out at the rear of the engine."

The car features more modern E Type H6 carburettors, which Tim says are far more tuneable and keep their tune as well. "Unless the original Slopers are in absolutely perfect condition, which 90-year-old carburettors tend not to be, they don't ▶



ABOVE The original three-litre engine has been upgraded to 4.5l specification in a 5.3l cylinder block, all while preserving the original's reliability and smoothness

even keep their tune," says Tim.

"We've also had a high-torque starter motor especially made for us which is very light and cranks very quickly."

The fuel tank has been made in-house to a 4.5 litre design for extra capacity and a switchable duel fuel supply so it has both an Autovac and a fuel pump with two separate lines, so if the latter fails, the Autovac can be brought into play.

The ignition system has been converted from ML magnetos to Delco Remy coil ignition. "As coils were so new and to W.O. Bentley were still unproven, he hedged his bets and had one magneto and one distributor on the six-cylinder cars. However, I'm running two distributors as magnetos, which can be problematic. Rather than having a dynamo we've got a geared-up motorcycle alternator and get 45 amps rather than the nine amps a dynamo produces."

A brand-new radiator built with an interleaf core that is said to give significantly more cooling was installed on the car. "My issue was that I couldn't get the damn thing hot," says Tim, "so I had to mask the radiator, but even with that I was still struggling to get the temperature above 43 degrees.

"What we have subsequently done is to engineer in a thermostat from a BMW 2002 Turbo into the pipeline, which has worked extremely well. It's very similar to the original which did have a thermostat, a huge bronze casting that hung on quite a delicate water rail, so was terribly affected by vibration. One of the copper pipes runs very close to the magneto flange, which then rubs and consequently leaks and the thermostat would fail in the closed position. We often now delete these on cars."

SMOOTH SHIFTING

The car features a Brooklands-type exhaust system. "I toyed with the idea of having a four-branch manifold, but it looked so different from the original so haven't done anything fancy."

The original Bentley C type gearbox casing has been converted to take D type close ratio gears as per the later Blower cars. A Laycock overdrive has been fitted with an uprated main shaft, allowing the car to cruise at 80 mph at only 2200 rpm.

"We have upgraded the main shaft inside the overdrive by using better material," says Tim. "We have also removed the many obsolete circlip grooves as our experience showed that this was a real weak point causing failures."

"The original C type gearbox was designed for the original heavier bodied cars. The first gear was very short so we machined gears that are the same as the D-ratio 'box, which was the same in the supercharged cars and some of the 4½s. It was the most desirable of the ratios, so we machined all the blanks and had them cut to the D-ratio, so it's got evenly spaced close ratio gears for a much more useable gearing which in turn makes an easier shift.

"We also machined a lightweight flywheel to keep the engine lively that we used in conjunction with a diaphragm clutch which was originally fitted to a tractor to cope with the increased torque levels."

The half shafts are all from the 8 Litre and so are much thicker and there is a ▶

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completely new differential. “We made the high-tensile aluminium diff housing, including the patterns so that it has thicker flanges and is more robust and so can take the power. A 90-year-old diff housing with a huge amount of torque going through it can be a weak point and while some survive very well, I thought I didn’t want to risk it.”

Petronella features double-mounted lightweight aluminium Andre Hartford shock absorbers, as per the Le Mans team cars, rather than the standard steel ones. “We have reduced the pressure back further due aluminium having higher friction properties than steel,” says Tim.

The braking system has been converted from rod operated brakes to hydraulics. “There was a weight issue, but part of the reason for Petronella having hydraulic brakes was that is that it didn’t have many brake components, and the rod brakes, compensator and Perrot shaft and all other bits added up to about £15,000. The set up was a revised version of what my father had fitted to his car.”

Tim is very proud of VBE’s in-house capabilities. “We have very comprehensive workshop that enabled us to do 90 per cent of the work on Petronella in-house. We have the capabilities to fabricate windscreens, body frames and dashboards, the upholstery and even panel manufacture on an English wheel. With our capabilities in working on engines, gearboxes and axles, there is very little that we can’t do in-house. It’s only some of the heavier machining jobs such a boring the cylinder blocks and the crankcases where specialist machines are needed that are consequently not done in house.”

> **“We used a diaphragm clutch which was originally fitted to a tractor to cope with the increased torque levels”**

The car has been completely rewired while the old fuse box has been machined out to accommodate modern fuses. Tim also points out the car has two black Cibie spotlamps at the front as the original lights on a vintage Bentley are not very efficient.

Tim had originally planned to build a Vanden Plas body and for it to be green, but as time went on, he saw so many of them and thought that perhaps he should do something different. “In my opinion the Barnato Blower car with Gurney Nutting coachwork was by far the best-looking vintage Bentley ever built, and that’s what I thought it’s got to be. The body, which sits on body mounts to allow the chassis to flex more, is made out of laminated timber rather than ash so the car is now much lighter compared to the original heavy body.

“As we didn’t have access to the original car, Cliff Ruddell from the Jaguar styling department who used to work with my father, digitally designed the body. However, one issue we had to overcome was to stop the car looking too short. “The original car was a 4½ and so had a 10 foot 10 inch chassis while mine was the 3 Litre’s nine foot nine so we had to



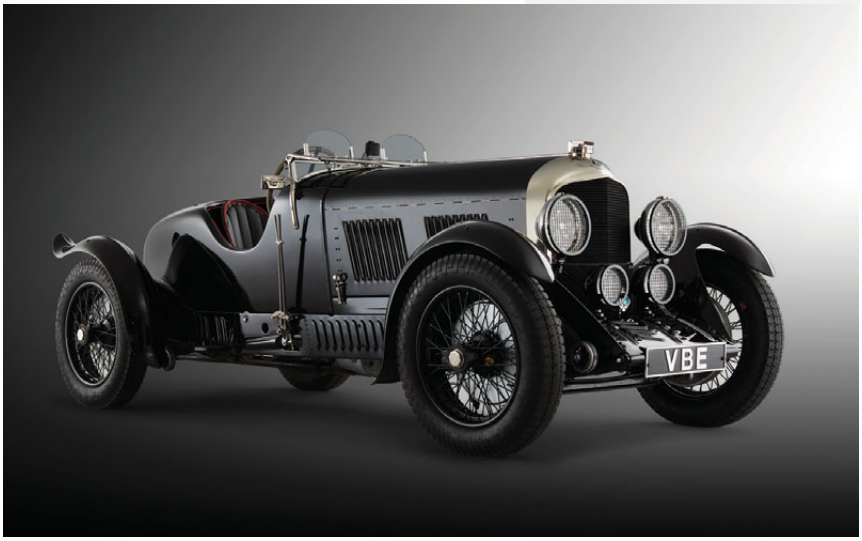
ABOVE VBE’s experience with the marque means there is nothing it can’t handle



ABOVE The custom coachwork hides the fact Petronella is more that a foot shorter than the car to which it pays tribute



ABOVE & BELOW "The best-looking vintage Bentley ever built", according to Cresswell, and Petronella, the car it inspired



try and draw it out to make it look more elegant. Without any paint, it didn't look that good but once we painted it black, it was visually slimmed down."

Tim pays huge credit to his highly skilled workforce, but like many in the industry is worried about the future with the ageing workforce and the lack of suitable youngsters coming in to replace them.

"When I came into the business, it was far easier because everyone knew what they were doing as they'd been working for my father and they were great in guiding me and helping me understand things and teaching me, but as time went on they have all left. I have tried various people and tried to get some younger people from the race industry, but their knowledge is so far away from what we are doing that it just didn't work.

"There are apprenticeships but year on year they're getting dumbed down and with all the mechanical help that's now available, it's taking the knowledge away. I would rather employ a mechanic from a backstreet garage than from a main dealership because they have a much better knowledge."

When it comes to stunningly gorgeous, crazy and mad fun to be around, cars like Petronella could soon be a thing of the past, which would be a shame. HRT

A new take on pre-war tech

For the first time since 1933, it's now possible to buy a completely new Alfa Romeo 6C engine. **Chris Pickering** investigates

THE history of motor racing is littered with the names of great drivers. But just occasionally you come across an engineer whose name is mentioned in the same reverential tones. That's certainly the case with Vittorio Jano – the Italian maestro who burst onto the scene with the sensational Alfa Romeo P2 in 1924.

Over the next four decades he went on to design a string of iconic engines for Alfa Romeo, Lancia and Ferrari. Perhaps the most numerous of all of Jano's designs, however, belong to the Alfa Romeo 6C family, which can be found in everything from supercharged Mille Miglia-winning sports cars to fixed-head saloons.

The job of caring for these engines today falls to a small band of specialist firms like the Jim Stokes Workshop (JSW). Arguably the world's foremost authority on pre-war Alfa Romeos, Jim Stokes set up the business in his back garden some 40 years ago, but it now spans five large and immaculately prepared industrial units – each one bursting at the seams with beautiful and eye-wateringly valuable machines.

Alfa Romeo engine rebuilds have always been a major part of JSW's work, but over the years the company has progressed into the production of complete replacement engines. First it was the 8C straight-eight, which underpinned Alfa Romeo's fastest and most exotic models during the 1930s. Last year, however, its six-cylinder sibling, the 6C, joined the JSW line up.

Until recently, the case for building a brand new 6C engine would have been fairly marginal. Comparatively speaking, these cars were far more numerous than their 8-cylinder counterparts, with more than 2,800 examples produced in six main variants between 1929 and 1933. This meant that it was still reasonably practical to source the major components second-hand. Over time,



ABOVE Y-shaped Memini carbs were one of the trickiest things to reproduce



ABOVE The scarcity of parts, allied to the compromised integrity of those that remained, prompted JSW to produce complete 6C engines

> **“We can now machine the whole carburettor body in two hours and 20 minutes, but it still takes 25 tool changes”**

however, original parts have become scarcer and many are now reaching the stage where they are no longer cost effective to rebuild. The thin-walled cast iron cylinder blocks, for example, can be prone to cracks, while the heads tend to run out of space for replacement valve seats after they’ve gone through a few overhauls.

As is often the case, the tipping point came with the rising values of the cars. A rebuild on an existing engine can cost upwards of two-thirds of what you’d pay for a replacement item, while it still leaves a question mark over the integrity of the structural components. With some of these cars now edging into seven figures, the extra outlay for a new engine – from £98,000 +VAT depending on the variant – has become far easier to justify.

“These cars weren’t overly valuable for most of their lives, so a lot have been mistreated or poorly restored. People had done things to them in the past that made further restoration very difficult, even with modern techniques like laser ▶

welding, so we took the decision to start producing complete engines a few years ago," explains JSW founder Jim Stokes.

The project began with a series of pre-production engines, which mixed new and period parts. But now – for the first time since 1933 – you can buy a completely new 6C engine, complete with supercharger and all other ancillaries. Essentially, JSW can supply an engine to match any one of the six main variants. The key distinction is the cam drive: the first four generations have a separate aluminium tower that houses the vertical shaft used to drive the valvetrain, whereas the later engines have this incorporated into the rear of the cylinder block casting. There are also slight differences with the sump flange, which are reflected in JSW's castings.

> **"None of this is rocket science – it's the sort of things Alfa could have done in-period if they'd continued to evolve the engine"**

LIGHT FANTASTIC

Both the 1750 (1,752 cc) and 1900 (1,917 cc) variants are available. Originally, some of the 1750s were supercharged, but all of the 1900s were naturally aspirated. With the new engines, however, JSW supplies both variants in supercharged form, using the later 145 mm blower design. While the supercharged 1900 is aimed at primarily road and rally use, the 1750 is eligible to compete as a period-spec engine.

It's all essentially 1930s technology. JSW holds hundreds of period drawings, but it has also undertaken a significant reverse engineering programme over the years, digitising the parts using SolidWorks and a CMM machine to capture their exact geometry. There have been a few discreet enhancements along the way, however, and perhaps the most significant of these is the choice of materials.

Originally, all 6Cs used an aluminium crankcase paired with a separate cast iron block. Most of the cylinder heads were produced in cast iron, but the final series used a lightweight aluminium version. It's this pattern that JSW has chosen to follow with its new engines – and with good reason.

"The difference is quite amazing, it's 13 kg for an aluminium cylinder head, versus 33 kg for a cast iron one," comments Stokes. "On top of that you get a cooling benefit from the improved heat transfer. That's not generally an issue on these engines, but it's good to know that the additional cooling capacity is there."

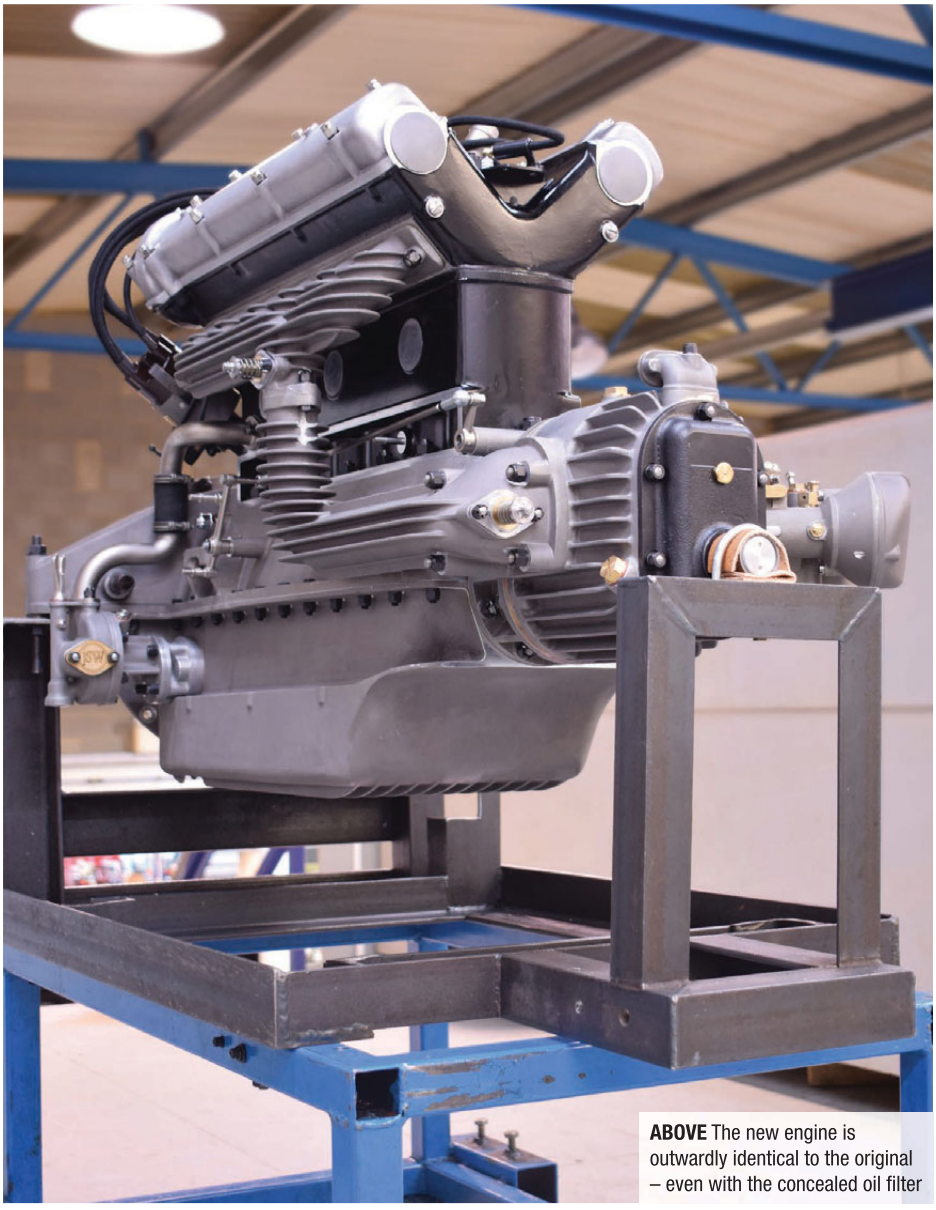
JSW has also gone a step further, producing its cylinder blocks in aluminium in place of the original cast iron (although thanks to a stove enamel

BELOW New con rods are machined from billet



finish it's impossible to tell that the underlying material has changed). Here, the weight benefit is less pronounced as the original cast iron items were very thin, but the aluminium blocks offer better heat transfer. JSW has also anchored the head studs deeper, spreading the loads going into the block and eliminating the original design's tendency to crack.

As you'd expect, there are changes to the internal parts too. The crankshafts in the new engines are made from gas nitrided 722M24 steel, while the connecting rods are 817M40T. Both would have been forged originally, but the crankshafts are now machined from billet material.



ABOVE The new engine is outwardly identical to the original – even with the concealed oil filter

WELL OILED

A lot of the refinements to the new engines focus on their lubrication systems. "We noticed while testing a car with one of the rebuilt original engines that the oil pressure would nosedive if you went through a downhill right-hander," Stokes recalls. "The oil pick up is in the rear right-hand corner of the sump and the original baffling is very poor in that area, so the oil just runs away. These engines were generally beautifully engineered, but that bit was an uncharacteristic oversight from Alfa Romeo, to be honest."

On its earlier rebuilds, JSW experimented with moving the oil pick up to the middle of the sump. For the new engines, it has taken this concept a step further, incorporating the pick up into the casting and adding a spin-on oil filter, which is fitted from the underside. Due to the deep, finned sump on the Alfa engines the new filter is totally hidden unless you're looking up from directly underneath the car. What's more, the oil filter fitting is manufactured in-house and left part-machined until the engine build, which means it could still be fitted to an original crank case.



In terms of filtration, the new system is a vast improvement over the original filter, which was simply a mesh screen. This wouldn't have been quite so critical with the original white metal bearings, but JSW has taken the decision to fit modern shell bearings, which are far more sensitive to debris. This is largely done for the sake of cost, with white metal bearings coming in at 10 or 20 times the cost of line boring the crankcase and fitting a set of more durable shells.

Interestingly, Stokes says it's not practical to use shell bearings in the larger 8C engines because the oil pump is only just adequate and struggles to deliver sufficient pressure at tickover. White metal bearings will tolerate this to a certain extent, but shell bearings will not, so fitting them would require significant external modifications to improve the oil supply.

The new 6C blocks feature improved built-in oilways, which supply the required lubrication without any design changes to the crankcase, Stokes explains: "The oil feed runs up the front of the crankcase, into the block and into the cylinder head to feed the camshaft. Invariably, when the cast iron block began to rust, you'd end up pumping oil into the water jacket. That ▶

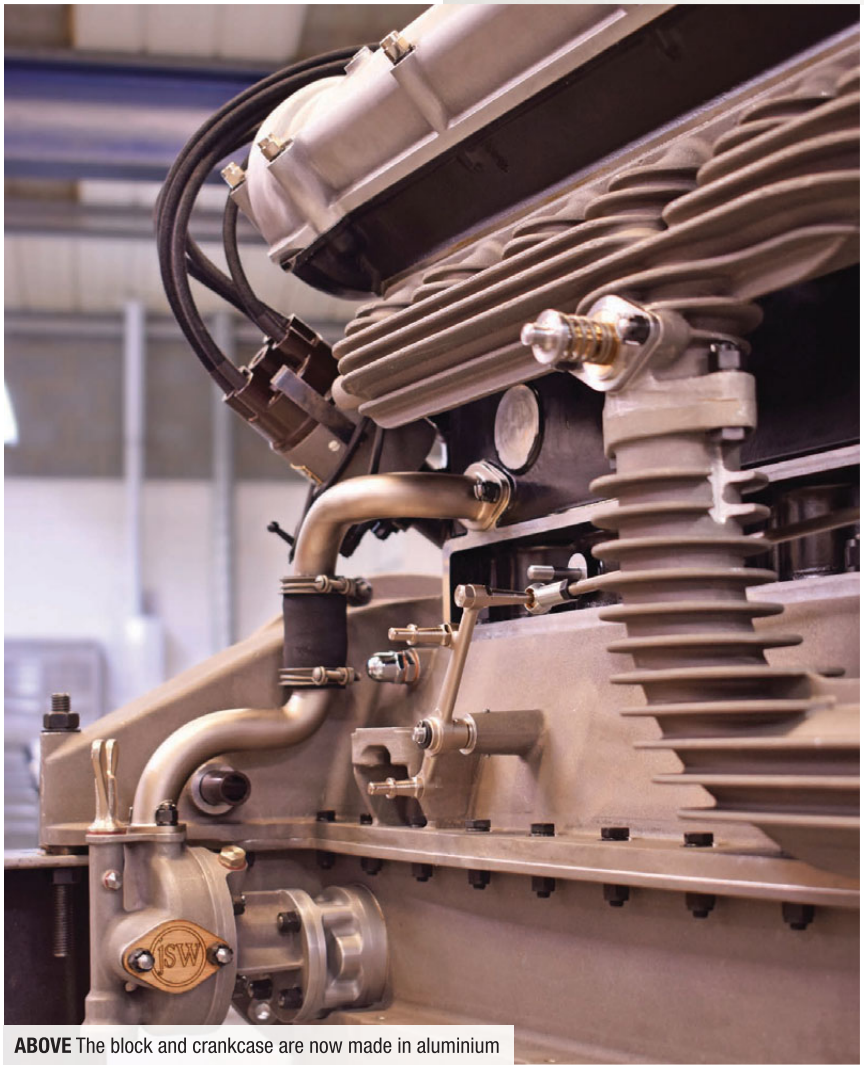
meant that a lot of the early engines were later modified with an external oil feed. Now that we've re-designed ours with the aluminium we no longer have that problem, so it looks exactly as Alfa Romeo designed it."

Likewise, there have been some improvements to the camshaft lubrication. This was originally fed by a set of external tubes that ran along inside the cam covers to the bearings from where the oil would splash feed out to the cam lobes. Instead, the JSW heads now pass the oil down the centre of the camshafts, with the lobes fed by drillings in the cam profiles.

"None of this is rocket science – it's all the sort of things that Alfa Romeo could have done in-period if they'd continued to evolve the engine," notes Stokes. "A lot of it comes down to how the engine is looked after as well. These days we use Driven Racing Oils from Joe Gibbs



ABOVE The camshaft vertical drive bevel gear



ABOVE The block and crankcase are now made in aluminium

due to the high zinc content. Providing they're looked after, these engines should run and run – I would expect 60,000 or 70,000 miles to be fine, with only minor servicing."

CARBURETTOR COMPLEXITY

One of the hardest parts of the engineering process was replicating the Y-shaped Memini carburettors, we're told. These are cast and then finished using a five-axis machining process, with slight modifications incorporated into the design to allow them to use widely-available Weber jetting equipment.

"Carburettors are pretty complicated things to make," comments Stokes. "We can now machine the whole carburettor body in two hours and 20 minutes, but it still takes 25 tool changes. The casting is quite tricky too. Most of our parts use sand casting, but we use a lost wax investment casting process to get extra detail for the Memini script on the top of the carburettor."

Like the fuelling, the ignition is relatively conventional, with a traditional single spark arrangement using NGK plugs. JSW has developed a programmable ignition module, which is a popular choice for road and rally applications. The company also ▶

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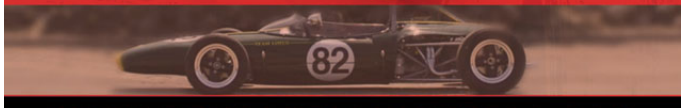
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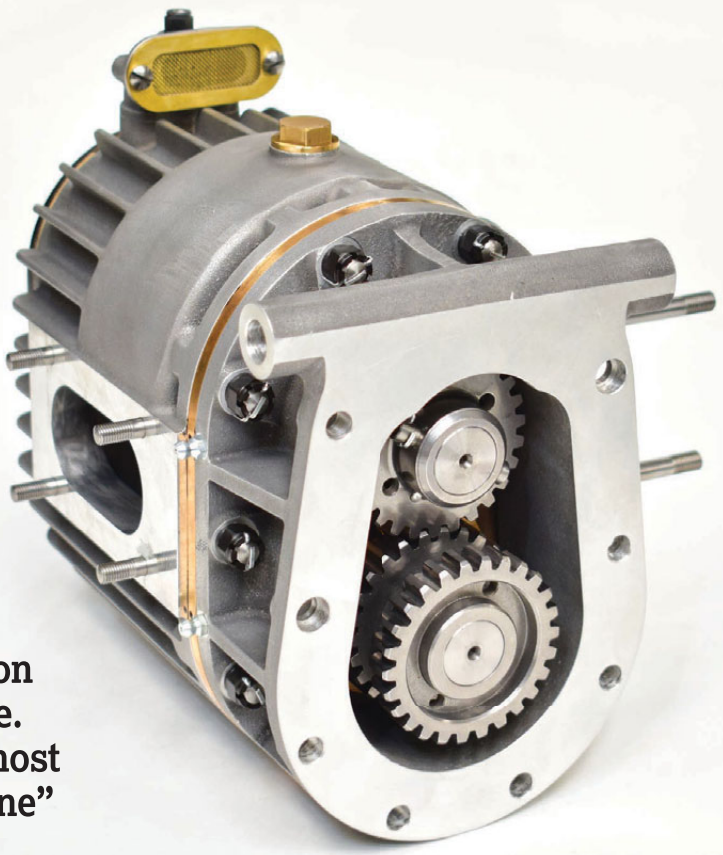
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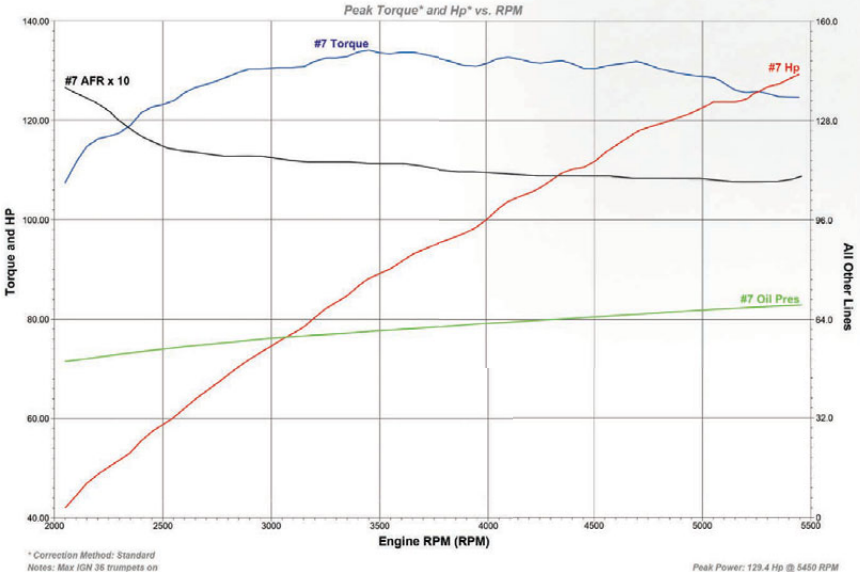
uses this to test advance curves, which can then be applied to a mechanical distributor for a race-legal setup.

"We can get exactly the same performance out of the engine with points ignition, but the mechanical systems wear out quicker and you can have problems with things like condensers," comments Stokes. "You usually have to run points for racing, but electronic ignition is preferable for rally events like the Mille Miglia as it gives you that extra reliability."

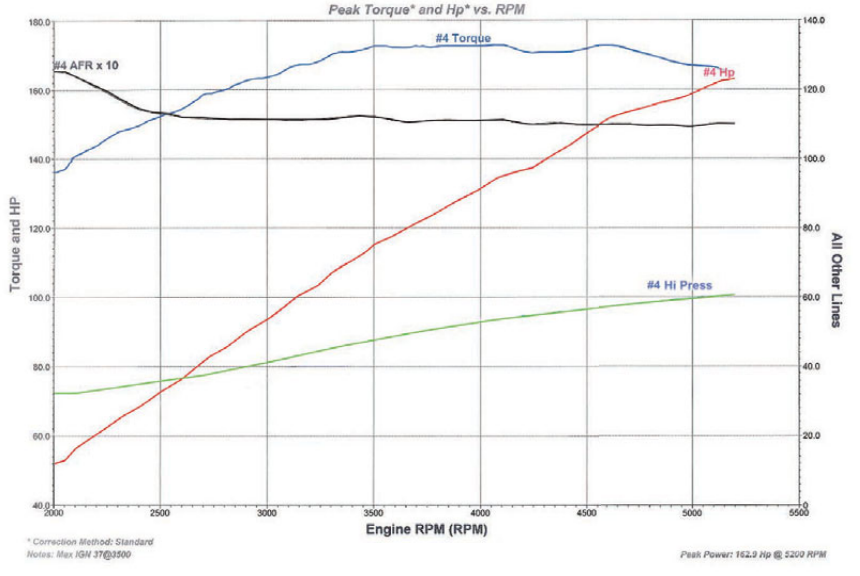
> **"The air-to-fuel ratio control on the new engine is incredible. When you see the trace, it almost looks like a fuel injected engine"**



ABOVE JSW follows the later 145 mm supercharger design. With modern fuels they can be overgeared to produce more boost



ABOVE & BELOW 6C 1750 torque and power curves. The engines now pull to over 5,500 rpm



PEAK POWER

Developed to run on 1920s petrol, the compression ratio of the original 6C engines was only around 5.5:1 – even on the naturally aspirated variants. The supercharged JSW engines run on regular 95-octane pump petrol, but thanks to the vast improvements in fuel chemistry over the last 90-or-so years they can now run at the dizzying heights of 7.2:1.

This increased compression ratio helps to significantly boost the engines' power output, aided by better ring sealing and some mild porting. The 1750 engines run a 1:1 gear ratio on the supercharger as they would have done in-period, but the 1900s are geared up to 1.22:1, which takes the boost pressure from 7 or 8 psi up to around 11 psi. That's largely done to compensate for the additional volume inside the cylinder on the larger engine (in theory, it would be possible to do the same on the 1750s, but it's not a request that JSW has yet had).

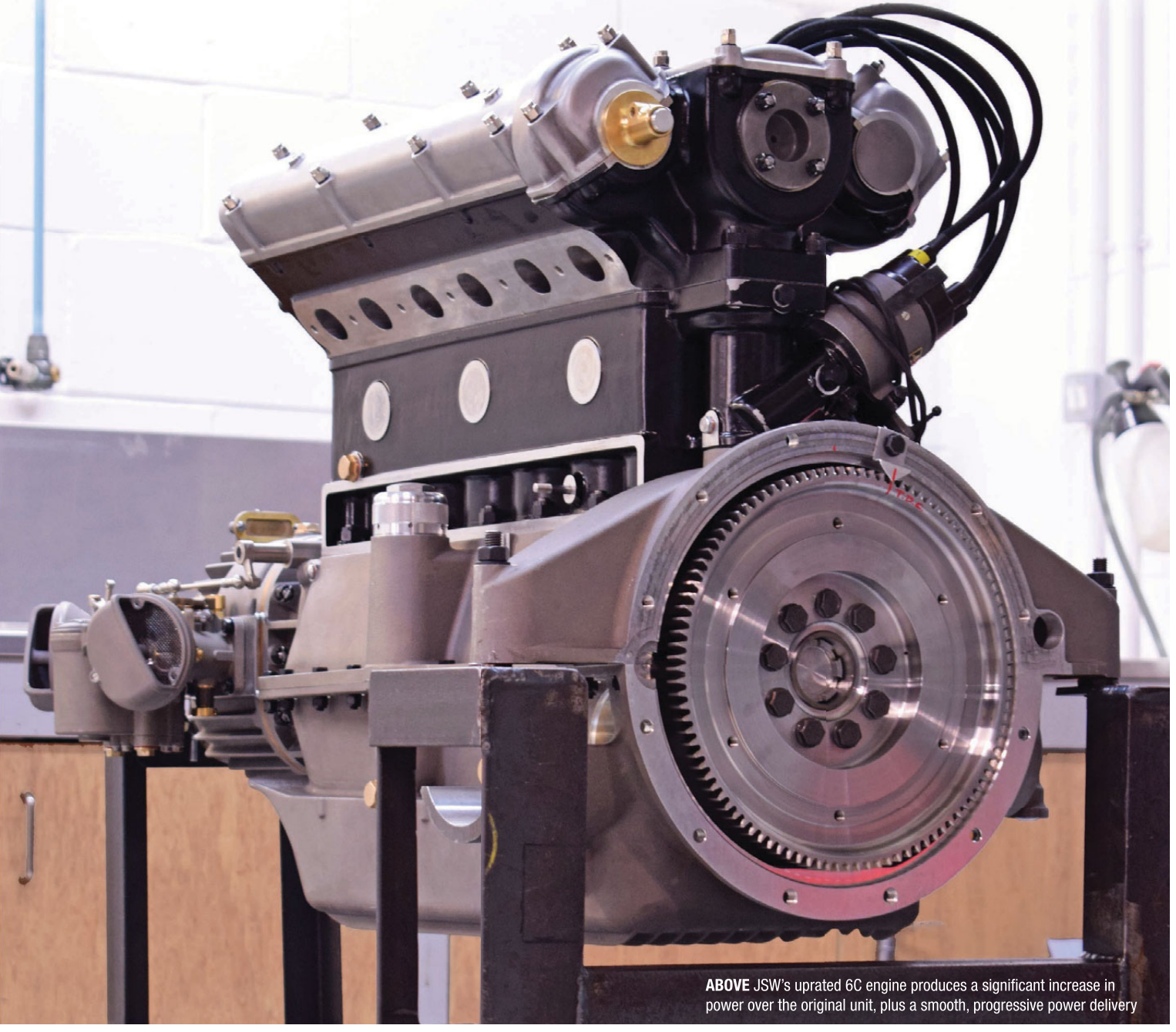
It helps that the new engines have a larger rev range too. Historically, they would have run out of puff at around 4,500 rpm. When it came to dyno testing JSW's first replacement engine, the team decided to call it a day at 5,500 rpm, with the power output still

climbing. “The air-to-fuel ratio control on the new engine is incredible,” comments Stokes. “When you see the trace, it almost looks like a fuel injected engine.”

It all adds up to a big difference. An original supercharged 1750 engine produces somewhere in the region of 85 bhp, but the JSW equivalent is around 130 bhp. Meanwhile, the new supercharged 1900 engine delivers 168 bhp – enough to keep you on your toes in a car that weighs less than a tonne and sits on 1930s rubber.

“The 1750s are fantastic little cars – they’re very light and nimble,” comments Stokes. “The only thing is that they do tend to get left behind with the original engines if they’re in a rally with the 8Cs. This brings them a lot closer to the performance of an original 8C (with around 160 to 180 bhp).”

One of the side effects of this increased output is that the original clutch – already fairly marginal with a standard 1750 engine – has to be uprated. To make the car more driveable, JSW fits either a single plate or twin plate organic clutch (depending on the power). Similarly, the company now produces its own gearboxes, subtly re-engineered to prevent them jumping out of third gear as the originals are prone to doing. In fact, JSW now offers virtually all of the parts that would be required to make a brand new 6C. As yet, that’s not actually happened, but the company has produced a complete 8C in the past, so it’s not beyond the realms of possibility. Another one of Vittorio Jano’s glorious designs brought to life could only be a good thing. HRT



ABOVE JSW’s uprated 6C engine produces a significant increase in power over the original unit, plus a smooth, progressive power delivery



ABOVE The March 09R, a homage to the past using some of today's most advanced technology

Digital development

Today's engineers have tools that would have dropped the jaws of history's most renowned designers, but as **Alan Stoddart** discovers, deploying them effectively is a whole other matter

MANY lifelong motorsport fans have one particular racing car that, to them, stands out above all others. It may not be the fastest, it may not have been driven by the best driver or competed in the most prestigious series. It may not even have won any races, but for someone, it will tug the heartstrings and quicken the pulse.

There are also some petrolheads that through a combination of hard work and dedication, as well as a smattering of luck, are able to realise their dreams and get their hands on that special racecar. However, sometimes the saying 'never meet your heroes' rings all too true, and the practicalities of running a dream car can be all too overwhelming.

A classic racing car is almost certainly going to be frighteningly expensive to run, while the lack of modern safety standards and equipment means that actually racing it is also going to be a test of nerves. What's more, old cars, even those that are showered with lavish engineering attention, are probably going to be unreliable, and when something does go wrong, sourcing parts for a motor that was rare in the 1950s, say, is going to be another massive headache.

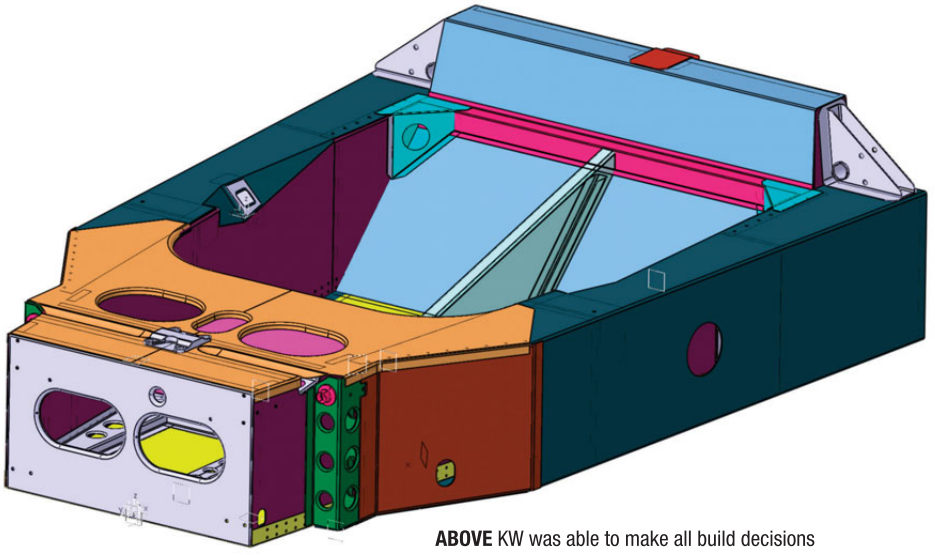
And this is to say nothing of the other incongruity, that these cars often also have to serve as investments, and that after giving it some thought, hooning your retirement plan around at 120 mph may be deemed a tad financially reckless.

After pondering all this for a while, you might come to the opinion that there is a better option. Perhaps there is a way to own a dream car, and race it on high days and holidays, but for the majority of time, instead rely on something that has all the appeal of the original, but was designed from the ground up to be a more sensible way to get some racing kicks.

This was the situation that one owner of a March 75S found himself in. He

wanted to race regularly, but the aforementioned hurdles, as well as an inability to qualify for club events, meant that he wanted another option. He wanted a version of his March that he could run in the Sports 2000 Duratec Championship, a series that uses a standard Duratec engine, that costs £1,650 and only needs rebuilding every four or five years.

To build this modern interpretation he turned to one of the most technologically advanced names in the business: KW Motorsport



ABOVE KW was able to make all build decisions virtually, before committing to them on the real car

REYNARD EXPERTISE

KW Motorsport was set up by ex-Reynard Motorsport colleagues Will Phillips and Kieron Salter. These partners established the firm when Reynard went out of business, and ended up taking over some of the work, including a Le Mans project that went on to become the iconic Reynard 02S. The work kept coming, and KW continued to work on IndyCar projects as well as some well-known Le Mans entrants such as the Nasamax biofuel racer, and the Creation Autosportif cars. Then came the call about the March.

The first step in creating a more usable version of a rare '70s sportscar was to scan the original.

"We scanned it and reverse engineered it to get new patterns and moulds," explains Salter. "We were setting up so he could remanufacture, refurbish and recommission the 75S.

"We also did the chassis and various bits around the engine, so we started to create some digital assets and some CAD data for the car. This would enable him to not only restore his 75S as a collectors' piece, but also to create information that we could use to develop a Sports 2000 car out of."

Crucially, particularly for a racer destined to compete in such a low-powered formula, the digital assets meant that KW could optimise the aerodynamic efficiency of the design rather than simply recreate the original. This process of optimisation, which was conducted using a Computational Fluid Dynamics (CFD) analysis of the car's digital twin, rather than a windtunnel programme on the car itself, was important given the original car had a relatively poor lift to drag ratio of 1. This figure is less than half that of the contemporaneous Porsche 917/30 and only one quarter as high as KW's final, optimised version.

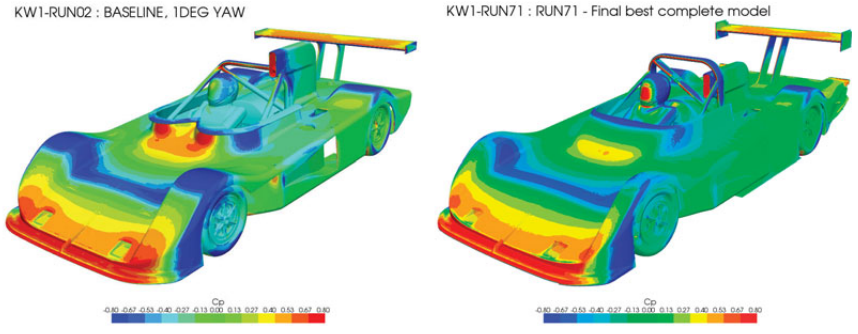
"In those days, it was basically put some big wings on to get some downforce and then add more power to get the straight line speed, but no one cared too much that you were just creating drag by putting those devices on, efficiency didn't seem so important," explains Salter. "But we optimised the car for the power available.

"Basically if you took the March 75S and what we ended up creating, which we called the March 09R, the 09R looked like a 75S. It had the characteristic air snorkel inlet system, and it had the same sort of rear end and bodywork features, but if you put them side by side you could see they were completely different in terms of the actual details. So we ended up with a car that was slightly narrower, had smaller wheel arches, slipperier bodywork, a longer tail, a different splitter underneath, a different rear wing and a smaller snorkel giving a smaller frontal area.

"But importantly, to the customer the styling themes were the same car."

The car was also a significant one for KW, as it demonstrated the value of some of the company's skills in areas away from top-tier motorsport, where they previously hadn't been plied. The skills must have also impressed the customer, because it wasn't long before he turned to KW once again, only this time for a project even further removed from motorsport's cutting edge. ▶

> **"You can do the same things they were doing 50 years ago but instead of guessing at it, you can do it with some science"**



ABOVE KW was able to make quantifiable improvements to the 75S (left), resulting in the 09R (right)



ABOVE Replacing a one-off Amilcar gear shift was another tall order that the team rose to

The customer realised that KW's engineers had some skills that the engineers at his company didn't. His employees were very good chemists, but that didn't help with problems that needed innovative mechanical engineering solutions. One of these problems was for a frame for large machines used in industrial printing. The company was used to using large aluminium and steel structures, which were too heavy, not very stiff and very susceptible to problems caused by thermal expansion (a critical element in high accuracy industrial inkjet applications). It was also an incredibly complicated component, with many different brackets and other addendum simply bolted on.

KW's motorsport heritage, and its engineers' obsession with lightness and efficient packaging, stood it in good stead, and after carefully assessing the shortcomings of the existing technology, delivered a carbon fibre monocoque solution. Some of the benefits of using carbon fibre were obvious and the team were able to reduce the weight of the part by 760 kg, taking it down from 900 kg to just 140 kg. The carbon fibre also suffered from none of the thermal expansion problems that plagued the aluminium version and was significantly stiffer.

There was another significant benefit to using KW's solution, but this one less expected: it actually turned out to be cheaper in terms of the whole project costs and benefits.

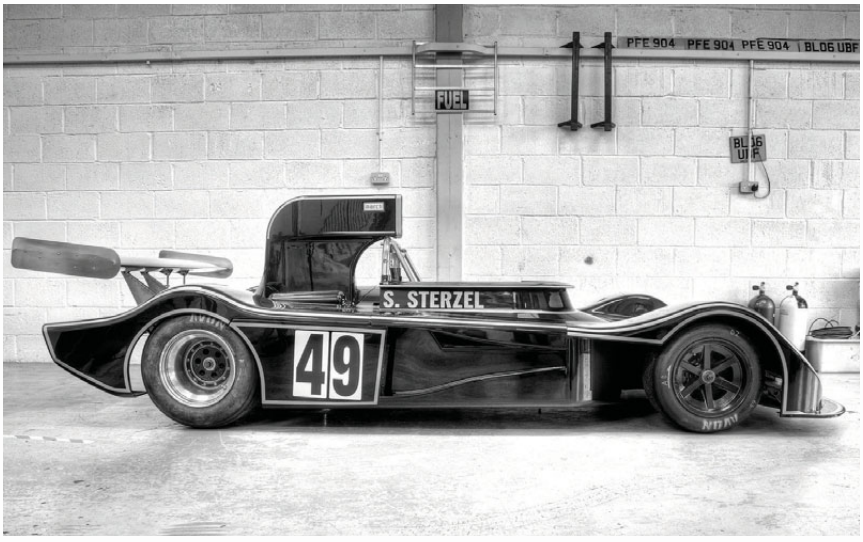
The success of this project proved to Salter the value of his engineers' motorsport skills in the wider world and gave him the confidence to set up KW Special Projects, a business dedicated to applying motorsports engineering away from the racetrack. Ironically, what ended up happening is that motorsport teams started to become interested in some of the capabilities KWSP was now offering the industrial world, including its design and additive manufacturing abilities.

DIGITAL TOOLING

One of the uses that F1 found for these new skills was digital tooling.

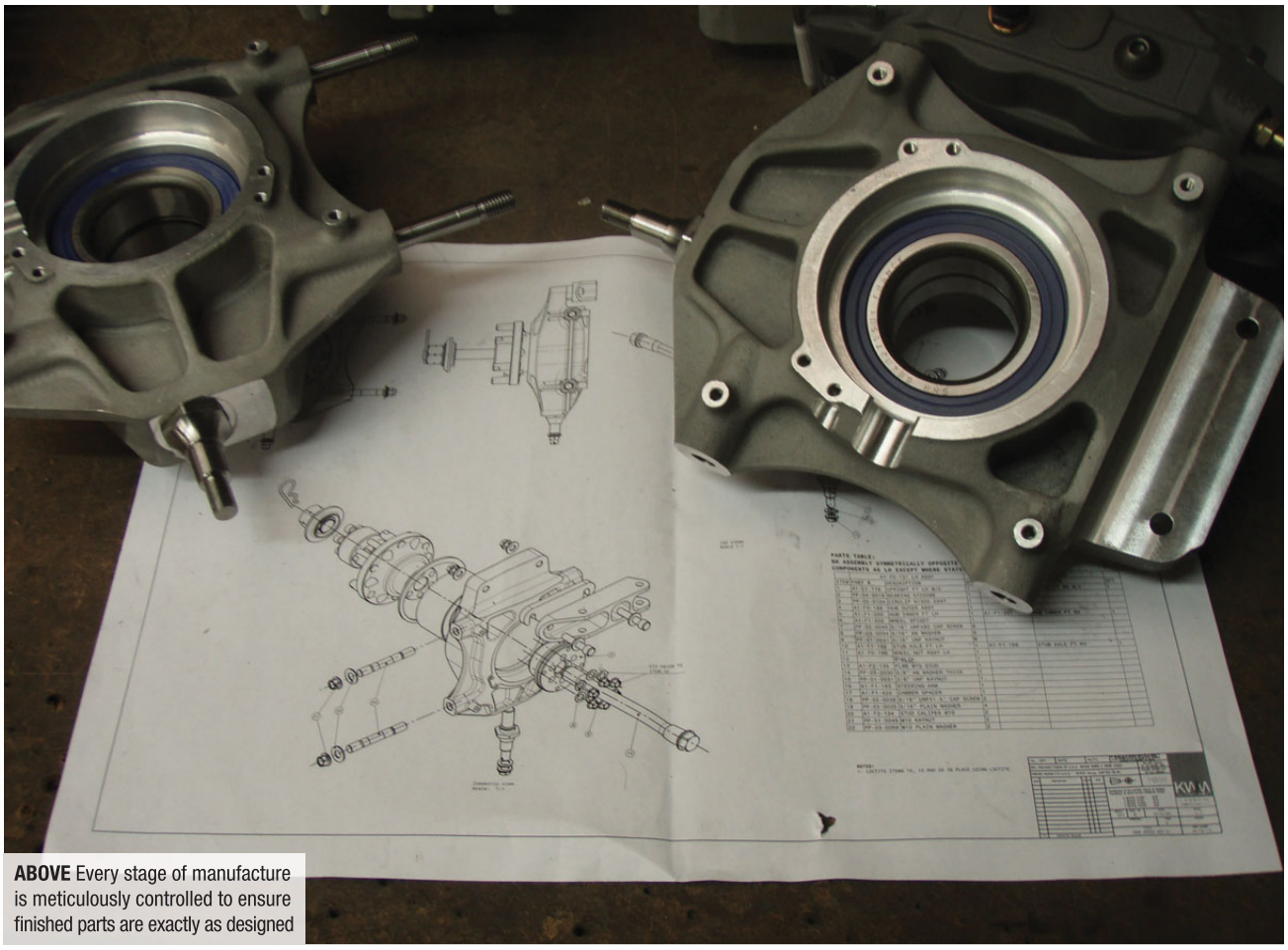
"The concept of digital tooling is that you can print the manufacturing tooling you need to make the parts, and then the tooling is consumed during the manufacturing process," explains Salter.

"So, when you need to make the



ABOVE & BELOW The March 09R has all the character of the 75S, but a much more refined shape





ABOVE Every stage of manufacture is meticulously controlled to ensure finished parts are exactly as designed

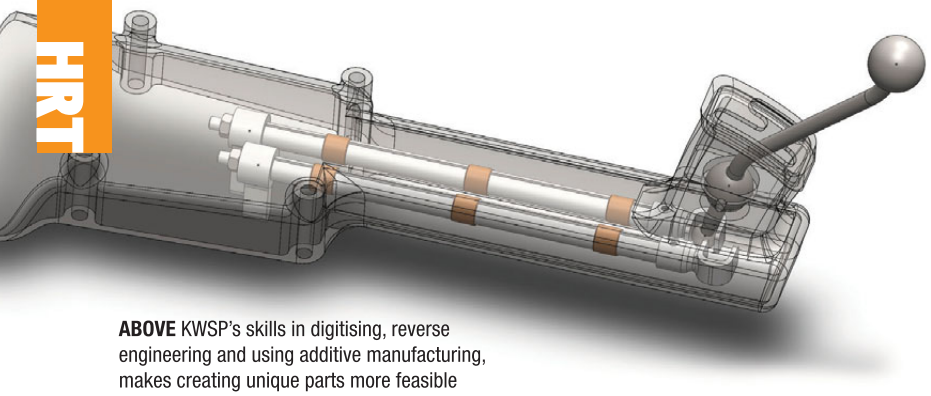
next part, you need to make some new tooling, but because it is made using the A.M. process, it is relatively low cost. The big advantage however is that because it is digitally driven by software, when you come to make your next set of components, you are not limited to making the parts that you have previously made the tooling for."

"It means you can make parts you couldn't contemplate making before because you were constrained by the manufacturing process. It also means you can make highly customisable parts from one part to the next. This is ideal in F1 because the rate of development is so high."

These myriad technological abilities, experience with wider engineering solutions and proper motorsport pedigree are all brought together in the latest KW division: KW Heritage.

Salter explains that one of the most important skills KW Heritage offers is its digitisation and scanning services, because many of the cars predate CAD systems and so have no digital ▶





ABOVE KWSP's skills in digitising, reverse engineering and using additive manufacturing, makes creating unique parts more feasible

assets. Unfortunately having these digital assets is almost essential to be able to manufacture anything today, and not having these digital drawings often makes a full restoration of a car nigh on impossible.

The importance of this digital ability was highlighted in the very first project that the team undertook. The car in question was an Amilcar C6 from the 1930s, which the customer was having restored at a more traditional restoration company. This was fine for some parts of the work such as the bodywork, where traditional craftsmen can apply their skills, but there were mechanical parts that were needed that couldn't be sourced. These weren't insignificant parts either.

"We said we could probably help him," recalls Salter, "but all he had was a photograph of the car, would you believe, and he wanted us to make a new gearbox!

UNIQUE CHALLENGE

"He needed a new gearbox casing. He had the internals and a small bit of casing, but the rest of it, along with the shift mechanism was missing. It was even more of a challenge than that because it wasn't even normal Amilcar bits he wanted – his Amilcar was unique."

The standard C6 has a very long gear stick, that has a very long throw. For the car's original owner, that proved to be a problem, so, being an engineer himself, he had created a bolt-on additional housing and modified linkages to make a shorter shifter. KW's customer wanted to recreate this system from the very limited information he had.

KW started by carrying out a scan of the car and any parts of the assembly that were still intact. This scan had to be incredibly detailed, because the original castings were manufactured from handmade patterns, and lacked exact features within the cover from which hints about the original component could be gleaned. After completing this scan KW was then able to create a digital model of the car and designed the new components, putting them together in the virtual world to ensure that the entire assembly fit as it should.

Prototypes of these parts were then 3D printed in ABS plastic, put together and were bolted onto the gearbox, allowing the car's owner to sit in the C6, check it was exactly what he wanted and make small adjustments, fine tuning it to meet his preferences. With the customer happy, KW then used the digital versions it had built ▶



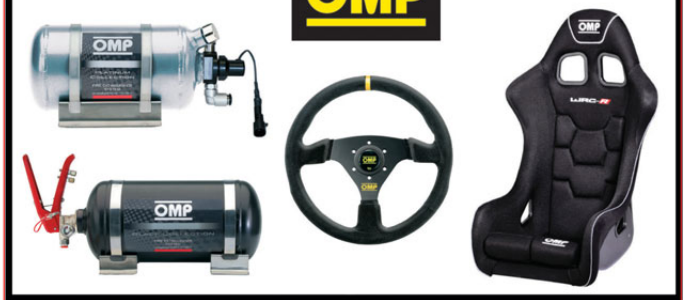
BELOW Finding parts for any Amilcar C6 is a challenge, but doubly so for a car which was customised by an early owner



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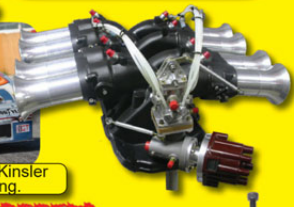
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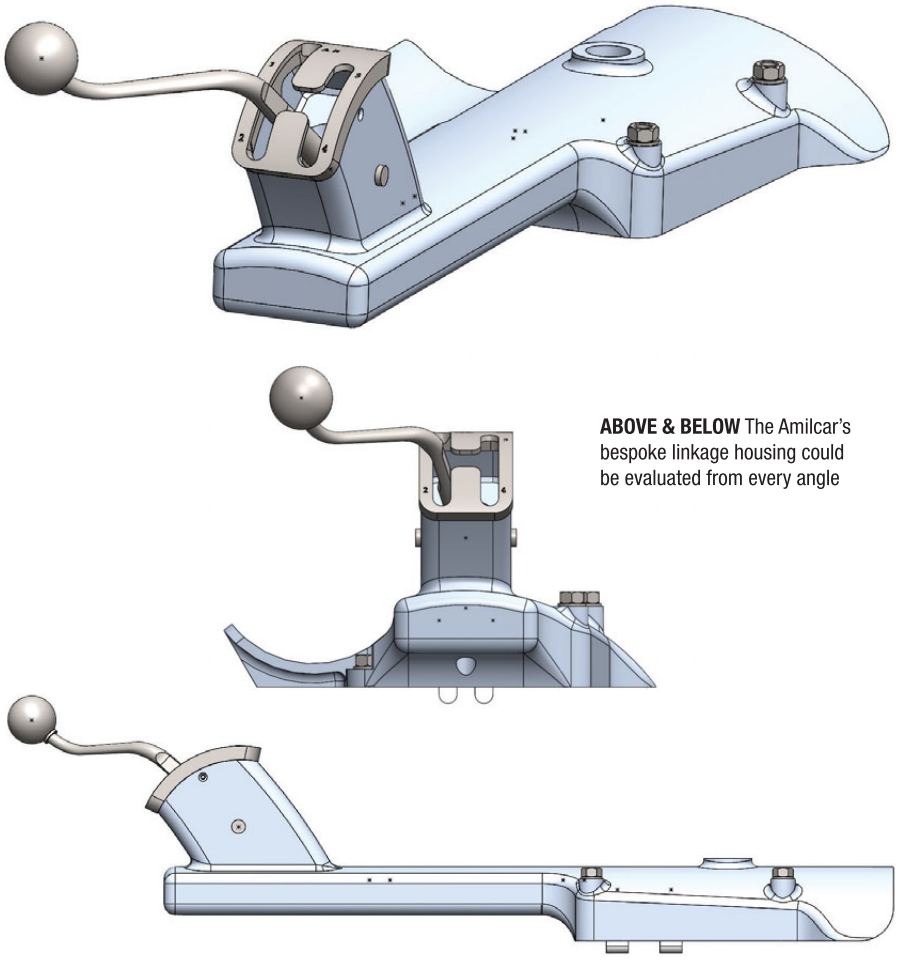
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ABOVE & BELOW The Amilcar's bespoke linkage housing could be evaluated from every angle

up to create the sand moulds for the casting, before having the final parts cast, efficiently delivering a completely bespoke, one-off unit.

"The reason we were able to manufacture a one-off for him, and, okay it wasn't cheap, but it was a very affordable way of achieving something that would otherwise been impossible, the reason we could do that was that we used modern manufacturing techniques to make a heritage part."

Given historic motorsport's unique position as a form of motorsport where preservation is as important an imperative as winning, this adoption of modern technology could put KW Heritage in a difficult position. Is it really possible to use technology unimaginable to Ferdinand Porsche, Walter Owen Bentley or Karl Benz to interpret and recreate their work without detracting from what made it special a century or more ago?

Salter thinks so, but he acknowledges it puts him in a position of responsibility. "It isn't a challenge to existing methods," he insists. "I've been very keen to make sure that we are never suggesting that we are replacing anything that exists in the supply chain, only complementing it. Digital manufacturing is never going to solve English wheeling of an aluminium body panel, but it may help you make that part better or easier and conserve some of those skills.

"That's why we are here at Bicester [Heritage]. We are the only contemporary engineering service on the site, most other companies are preparation companies and building cars, but we feel that our skills are complementary to all of those.

"Whether that is making carbon fibre bits for more contemporary heritage cars, or whether that is creating the jigs and fixtures to help restore a car from the 1920s. It could be making trim jigs or assembly jigs or inspection tools... there is a lot of opportunity to blend the technologies."

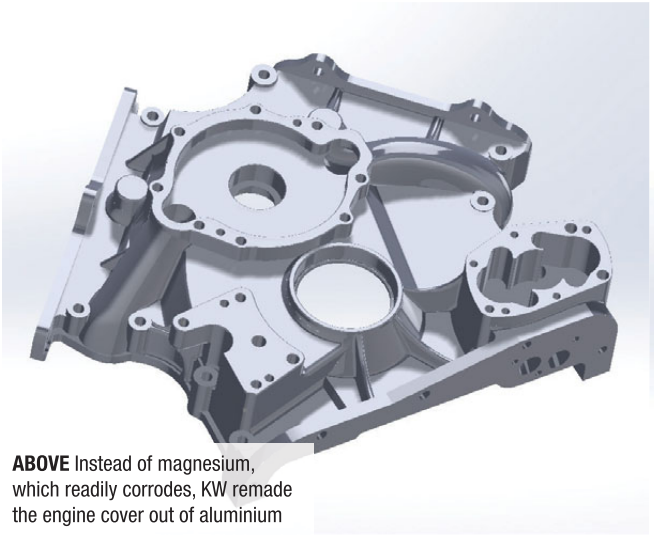
The difficulty is knowing how far to go. In a potential affront to some purists, Salter admits that he isn't particularly "hung up" on authenticity. "Do we continue to make something that is unsafe?" he asks. "Do we continue to make something that doesn't work? If it was an aeroplane you would probably not worry too much about authenticity if it was unsafe and I knew I could make it safer."

AUTHENTICITY vs PRAGMATISM

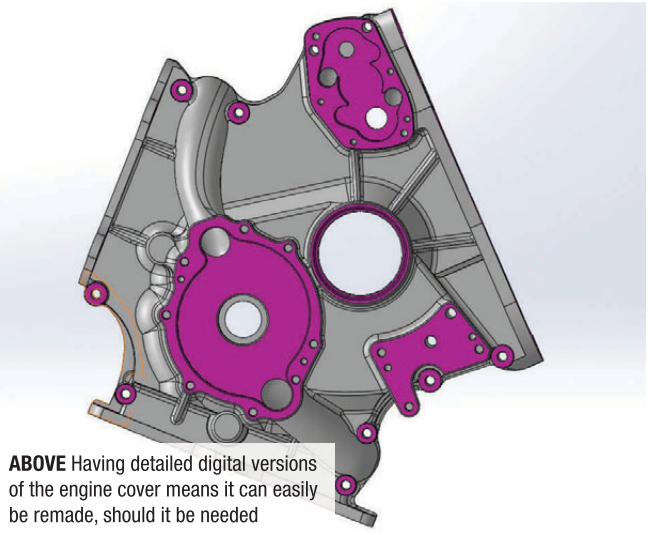
Similarly, there are projects that KWSP has completed where changes are not for performance, but are instead pragmatic substitutions to ensure a car can be used instead of being shut away in a garage, continually awaiting repairs. One such project was for the front engine cover of an Alfa Romeo Tipo 33. The original cover was made of magnesium, which corrodes rapidly, causing failures. The owner wanted something to make the car usable, so KW made an exact replica, only this time out of aluminium. A new magnesium piece can always be fitted to return the car to absolutely pristine originality, but until then, the material change means the Tipo 33 can be used reliably and enjoyed by both the owner and spectators alike.

> **"All he had was a photograph of the car and he wanted us to make a new gearbox"**

The waters become a little muddier when it comes to actually improving historic race cars, with every man and his dog having an opinion on exactly what constitutes a reasonable change and what is a sacrilegious bastardisation of engineering artistry. Gut reactions can be misleading however, and Salter is measured in his response to any potential criticism, highlighting how, in the same way as using additive



ABOVE Instead of magnesium, which readily corrodes, KW remade the engine cover out of aluminium



ABOVE Having detailed digital versions of the engine cover means it can easily be remade, should it be needed

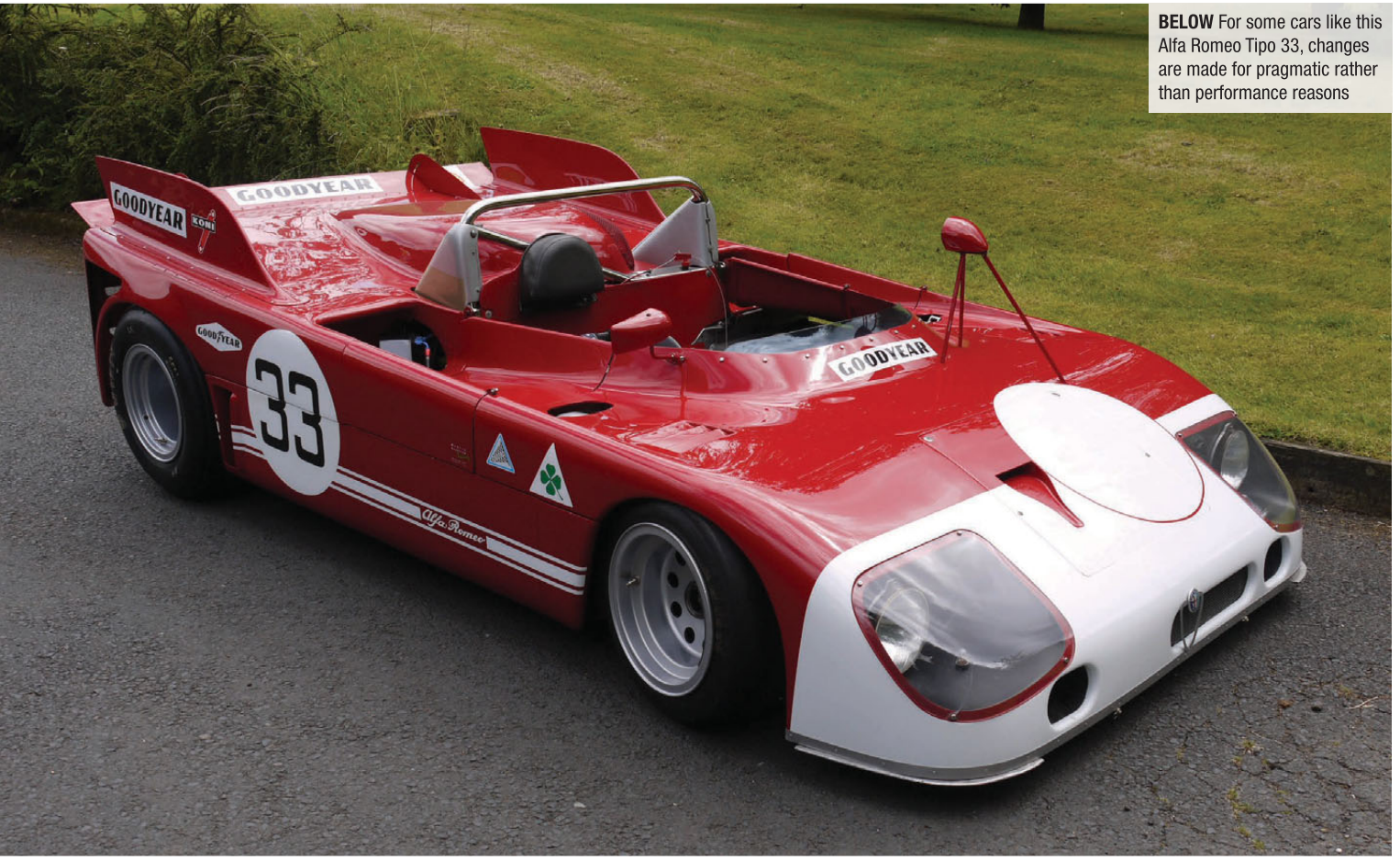
manufacturing techniques to make tooling, many of the improvements made can be seen as new ways of achieving the same objective.

"If you have got a digital asset and you've got scan data of the entire car, you can do CFD of the entire car and you can start to understand the original car's performance better and make appropriate setup adjustments," he says. "You can do the same things they were doing 50 years ago in terms of optimisation and set up improvements, but instead of guessing at it, you can do it with some science.

"You can make improvements to the aero, the brakes and cooling for example, that is still the original car, but you are just using the digital tools available to understand the car better."

Ultimately though these choices are made at the discretion of a car's owner and the rulebook of any competition that he or she wants to compete in, KW Heritage simply provides the option. The company, which has years of experience winning races and championships at the very highest levels of motorsport, as well as a breadth of knowledge and adaptability that stems from working across a multitude of industries, is able to use all that ability, along with some of the most technologically advanced design and manufacturing methods available to preserve and resurrect history's greatest racecars.

Many lifelong motorsport fans have one particular racing car that, to them, stands out above all others. Thankfully, the considerate use of technology from the likes of KW Heritage means that the future of those cars looks secure for a while yet. HRT



BELOW For some cars like this Alfa Romeo Tipo 33, changes are made for pragmatic rather than performance reasons

Why there's a rush into 'Retro'

As World RX has scaled new heights, so interest in the sport's history has rocketed too. **Hal Ridge** examines some of the new recruits – and the issues they bring



WITHOUT question, historic motorsport is in a boom period. But, while it could be argued that historic racing was conceived for drivers to enjoy machinery from halcyon days, without concerning themselves too much about results, humans are by nature competitive beasts.

As such, some quarters of historic motorsport have become more about winning than the taking part. Look no further than the amount of pace-setting Ford Cortinas in historic touring car races, or MkII Escorts in historic rallying. When there is the potential to win, at some now well established and prestigious historic events, people want a chance of achieving just that.

A sector where the historic scene has been growing somewhat under the radar, and has so far avoided the extreme competitive element for the most part, is rallycross.

> "Doran set FTD, even compared to current top-spec Supercars, driving his father's RS200"

In part, that's thanks to the makeup of the mixed-surface sport's 52-year history, with such a diverse range of cars created for various classes through the decades, built to relatively open rules compared to those in other disciplines. It's also helped because, aside from a few cases, almost all rallycross cars were one-off creations, not mass-produced homologated rally machines, for instance.

As such, defining a rule set for historic rallycross is far from straightforward. While Motorsport UK is set to include definitive rules for historic rallycross in the 'Blue Book' of technical regulations in the near future, the current Retro Rallycross Championship that has been run at British Rallycross Championship events with increasing popularity since 2012, has some key technical guidelines.

'Retro Rallycross Championship is for cars that have, or a type that have, been used in British or European Rallycross up to the end of 31/12/1991 and featuring modifications of a type that would have been made in period' states the series regulations. 'The onus to demonstrate the eligibility of a car and any modifications rests with the competitor.'

Without any kind of homologation on componentry in period, it's tricky to define what should and should not be allowed in Retro RX. But one clear element is that sequential gearboxes, which wouldn't have been available until later than the Retro cut-off date, are not allowed.

MINIS VS GROUP B

Cars competing in the series are as diverse as you would expect from a rallycross grid. Think back to the season-closing 'Rallycross Grand Prix' of the late 1980s at Brands Hatch with Minis and Vauxhall Novas taking on the might of four-wheel drive Group B machinery, door-to-door, with wayward rear-wheel drive Ford Escorts and front-wheel drive Vauxhall Astras. A similar range of cars compete in Retro RX today.

Of course, the most heralded era of rallycross, Group B, is a favourite of both fans and drivers alike. While Group B machines are used less and less in competition due to being ineligible, and because of their intrinsic value, more are gradually being used in Retro ▶



ABOVE At the wheel of his father's RS200, Liam Doran has demonstrated that in rallycross, as in historic circuit racing, the speed of the older cars can still unsettle modern counterparts









ABOVE Steve Harris's RS200 is based around a tub that was never completed for competition in period

RX, especially with a gentleman's agreement that the racing won't be quite as hard as it is either in headline rallycross series today, or as it was in the Group B heyday.

The aim is to provide a spectacle, not cause expensive damage unnecessarily. That isn't to say they are not driven hard, though: at a recent round of the British RX at Lydden Hill, World RX driver Liam Doran set the fastest lap of the day in Retro RX, even compared to current top-spec Supercars, driving his father Pat's Ford RS200.

Retro RX is a mix of period machines being restored and 'new' creations being built in the theme of period cars and regulations. So far, that loophole of openness hasn't done any damage to the class, but Motorsport UK plans to define the rules further to guard against anyone building cars that solely use technology from the new millennium.

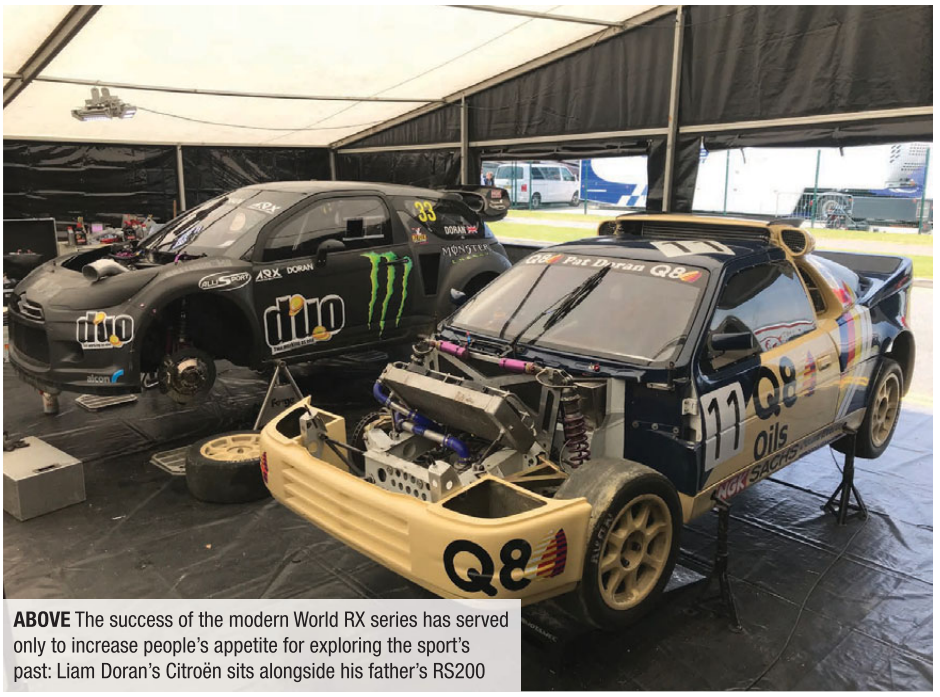
Of the Group B cars currently on the grid, a 3.0-litre Metro 6R4 that was campaigned in period by Rob Gibson is in the specification it was raced with when the monstrous machines ruled the rallycross world. Other 6R4s have been restored and are of period specification, with various engine capacities.

Doran's Ford RS200, with which the former rally driver raced in the European Championship in the early 1990s, has been through a number of technical re-births. The most recent has seen it returned to an as-period type specification, but with modern twists.

> **"The grey area is between what was permitted in period and what was actually used"**

That work has been undertaken by LD Motorsports, headed by son Liam, while the family's close links with rallycross technical wizard Julian Godfrey have also played their part. The Q8-liveried machine had been converted to run a sequential transmission, to make it easier to drive and more reliable than the period h-pattern setup, but the Xtrac five-speed dogbox has been re-fitted to make the car eligible for Retro RX.

The car has also been returned to a twin-damper setup at each corner. Instead of the rudimentary Bilstein units on which the car would have sat originally (before being switched to Sachs items for rallycross use), some of the latest technology from rallycross damper specialist Rieger now suspends the tub-chassis above the ground, attached to the as-original cast aluminium uprights and steel arms. It's a similar story with the engine management, with a Cosworth Pectel SQ6 system being used to control the



ABOVE The success of the modern World RX series has served only to increase people's appetite for exploring the sport's past: Liam Doran's Citroën sits alongside his father's RS200

Ford BDT 2.1-litre Evo engine, rather than the original Bosch Motronic setup.

Doran's car is a period machine. Like most rallycross cars, however, it's not dissimilar to Trigger's broom: *Only Fools and Horses* fans will recall that Trigger claims his road sweeper's broom is 20 years old – then casually reveals it has had 17 new heads and 14 new handles!

A sister car built by LDM for another former rally driver, Steve Harris, is dressed in a replica of Mark Rennison's British Rallycross Championship-winning livery of the late 1980s, but underneath is very similar to the Doran car. It is based around a brand-new tub that was never built into a car, back in the day.

"There's more and more demand for the older stuff now," admits Godfrey. "The RS200s have more modern electronics so that they run nicely and reliably, and you can do something with them now: you've got some login data, whereas the old Bosch units had no log in; you had chips and things like that, but you can't buy chips any more for them.

"Now we can start to see problems before they occur, and with things like checking the boost levels. They are on electronic boost control now. In the old days, we had manual boost and the drivers kept turning them up and up because they wanted to go faster, but it actually made them go slower. We're running out of things like original gearbox casings now: they were just magnesium and at 35 years old they're very brittle now. It's like the engines, there's not many of them around now. ▶



ABOVE The DSRM colours, an iconic livery for rallycross fans, adorn Steve Harris's RS200



ABOVE & BELOW The PPJ Racing Volkswagen Beetle has been offered a new lease of life by the harnessing of modern technology





A guy in New Zealand is re-making heads, but there are very few blocks."

The engines used by the top-level Group B RS200 runners in period were the Evo version of the BDT, and while ancillaries can be updated, it's more difficult with engine blocks and internal parts. For instance, while Godfrey would like to run a Swedish-made Auto-Verdi oil pump on the RS200s, as on his YB-engined Supercars, the evolution pump is inside the block.

"It's run by a chain rather than a belt, so it's more difficult to try and convert it," he explains. "But it's something we'll probably have to do eventually to make them more efficient as it just stops them leaking oil. They don't scavenge very well.

"We're running modern turbos now though. On these cars we use the BorgWarner FR range, which is the same as some of the modern Supercars, but without the restrictor. Even with the smaller turbo it's still probably 700 horsepower, so there's enough power there. You don't really need any more than 700 horsepower and you've got a good range of power from 4,000 rpm right through to 9,000 rpm as you've got no restrictor, so there's a good range. We're just trying to keep the engines alive rather than stressing them too much."

EXPLOSION OF INTEREST

The value and fascination of Group B rallycross machines is only increasing. While other replica cars have been built for Retro RX, with one Audi Quattro already on track and others in the pipeline, enthusiast Adam Keeler bought his dream car, an MG Metro 6R4, from Finland. His plan was to own a period rally car, but when he discovered it was a former Will Gollop rallycross machine, it was that livery he returned the international-specification naturally aspirated car to (see HRT 11).

Gollop's legendary 1992 European Championship-winning Bi-turbo 6R4 has also been returned to usable ▶

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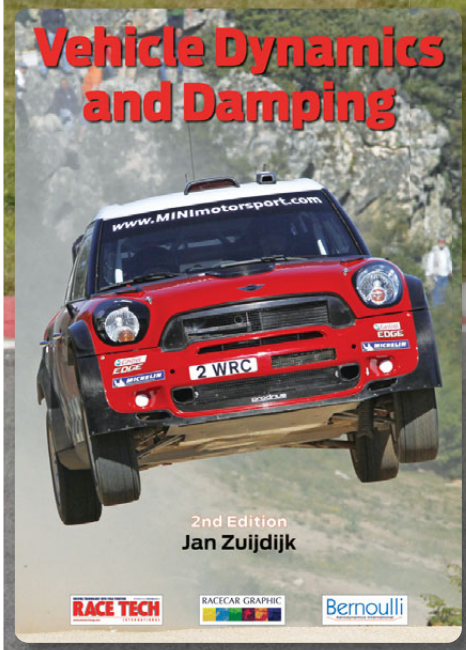
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condition, by Northern Irish collector Enda Garvey. Although not used in competition, the car is seen in demonstration events.

As rallycross has grown at the highest level with World RX, the interest in the sport's past has increased too. The lure isn't reserved just for those evocative Group B machines, but for the eclectic mix of machinery used in the sport too. Many of these were born from a set of regulations based on Group 5 rules, which continued to evolve until the early 1990s when, following the banning of the Group B cars, Group A-based rules for the sport's top level were adopted.

Several competitors have switched from running older cars in the two-wheel drive Supernational category into the Retro division. Other cars that would have raced in similar two-wheel drive categories in the past are also coming out of the woodwork, their owners enticed by the less intense environment of Retro RX.

A good example of a bespoke rallycross car that has been given a new lease of life through the ability to use modern technology, is the PPJ Racing Volkswagen Beetle. Featured in HRT8, the ex-Peter Harrold car was propelled into the limelight when Jenson Button sampled the monster on a television slot for the BBC. Shocked by the brutality of the machine around Lydden Hill, the former F1 world champion claimed it was "the maddest thing I've ever done".





ABOVE & BELOW Phil Collard's mid-engined Renault, equipped with a 2-litre Vauxhall engine, is a welcome addition to the ranks

Since then the turbo has been changed, to a Garrett TO4S, and engine management switched to a MoTeC system to improve drivability. The always-troublesome gear selection issue has also been resolved with the implementation of a gear linkage system from Fortin Racing in the United States, to select gears in the Hewland DG300 gearbox.



ABOVE Rolf Nilsson's Porsche 911, winner of the first ever Rallycross Grand Prix at Brands Hatch, is among an increasingly stellar Retro cast

RENAULT RETURN

One of the most recent additions to the grid is a mid-engined Renault 5 now owned by former Supernational racer Phil Collard. "This is a great group of people," says Collard of the Retro paddock. "I've had a few problems in the first few events and the other guys come and help us work on the car to try and sort it. We all help each other; we want to put on a show and race competitively.

"These are such valuable cars, especially the RS200s and things like that, but people just want to see them on track. When they start up and you hear the sound of a Metro 6R4 engine, there's nothing quite like it. This is a great class."

Having been off the track for 25 years, Collard's Renault 5, originally built in the late '80s, went through a number of hands before its restoration. Initially it used a 1600 eight-valve engine and a UM1 Renault gearbox. The only thing that now remains truly as period is the fantastically over-engineered front end of the car, and suspension geometry all round.

"The engine, gearbox, brakes (housed in OZ Racing wheels), hubs, roll cage, ▶

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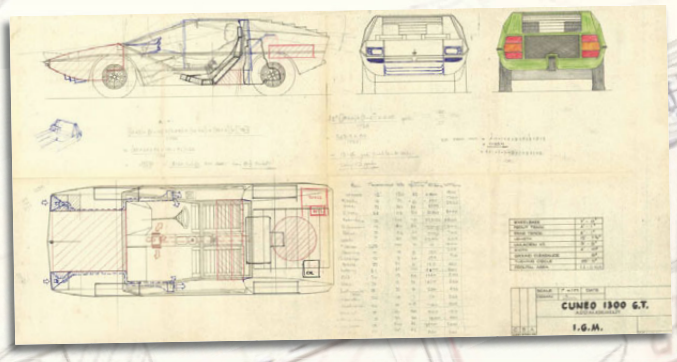


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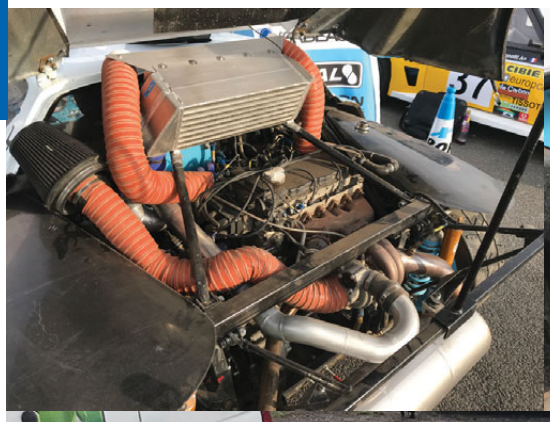
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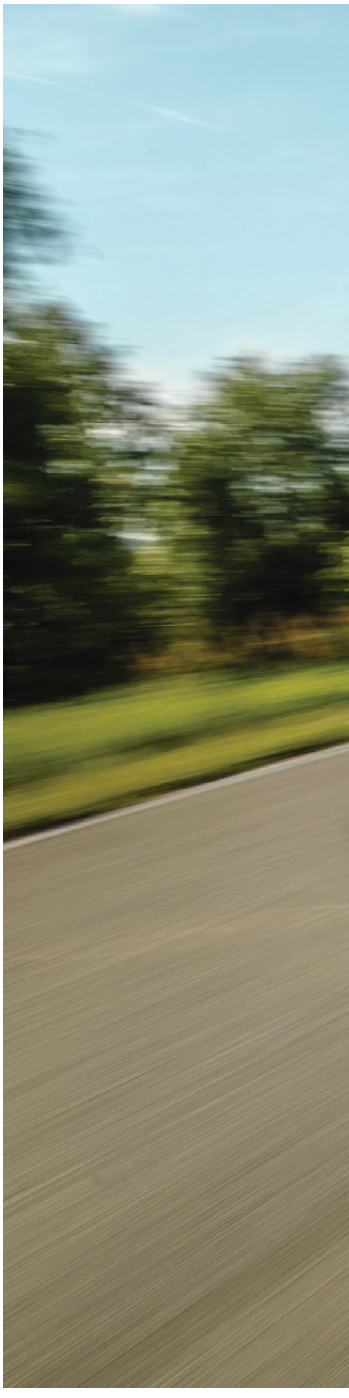
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LEFT & BELOW John Cross' ex-rally Lancia (left), now fitted with a VW engine from a VR6, is at the opposite end of the spectrum to Alex Wurz's rebuild of his father's Euro rallycross title-winning Stratos (below)



> **"The whole idea is to get as many different cars as we can. We don't want to all come out with MkII Escorts"**

everything is different and to a good and current spec," says Collard. "We're using (three-way adjustable) Black Art Designs dampers and uprights fabricated by me. We've got a Subaru WRC 5-speed straight-cut gearbox (serviced by Elite Racing Transmissions), plated differential, and the engine is a Vauxhall red top [C20XE 2.0-litre], almost a standard hot-rod engine effectively (using an AIM dashboard), but with throttle-bodies (covered by a K&N filter) so it's about 250 horsepower."

Collard's Renault 5, like all Retro Rallycross cars, runs up-to-date safety equipment, with various modern suppliers used like Corbeau seats, Sparco steering wheels, Schroth Racing harnessess and Lifeline fire extinguishers. It fits into the rule set because it is of a similar specification to what was run in period. The grey area of the category is between what was permitted in period by the regulations, and what was actually used.

For instance, if the ruling was only for items used in period, as is the case with historic motorsport for cars from homologated series, sourcing original parts for one-off rallycross machines would be almost impossible from a practical and cost perspective, even if it could be proved what each car actually used. Of course, the front-running machines were well documented, but for those further down the order, which are just as entitled to be used, there is often little information available. Sometimes it's about finding as much information as possible and taking an educated guess.

A car that sits inside the grey area of the rules, but is enjoyed by fans and fellow competitors alike, is a Lancia Stratos created for the class by former European Championship Supercar racer John Cross. Using a spaceframe rally chassis built in the 1980s,

it isn't an original in the way that the Stratos used by Franz Wurz to win first FIA European Rallycross Championship in 1976 [featured in HRT17] was born from the factory and recently restored by son Alex Wurz. But, Cross' machine does have an MSA rally log book from when it was built and used in the '80s. Fitted with a V6 engine, from a Volkswagen VR6, it's also turbocharged. While not an as-period set up, Cross' car would have been permitted to run in that trim in by rallycross regulations and as such it's allowed to compete.

"I think the whole idea of it for me, is to try and get as many different cars as we can," suggests Cross. "We don't want to all come out with MkII Escorts. I just think it's going to be more and more popular. We do the British Championship rounds, Shirley [Gibson, Retro Rallycross founder and series manager] arranges for us to go to shows and we go to the British and French rounds of World RX too. I think next year it's going to get bigger and bigger."

Retro rallycross has grown year-on-year since its inception, with other countries, like France and Ireland, also having created their own similar initiatives. Now it has a strong base, and with cars continuing to be converted or built for purpose – including a Matti Alamaki Porsche 911 – and replicas like a Martin Schanche Escort MkII in the pipeline, hopefully the incredibly diverse history of the sport can continue to be enjoyed at a wide range of events both in the UK and abroad. HRT



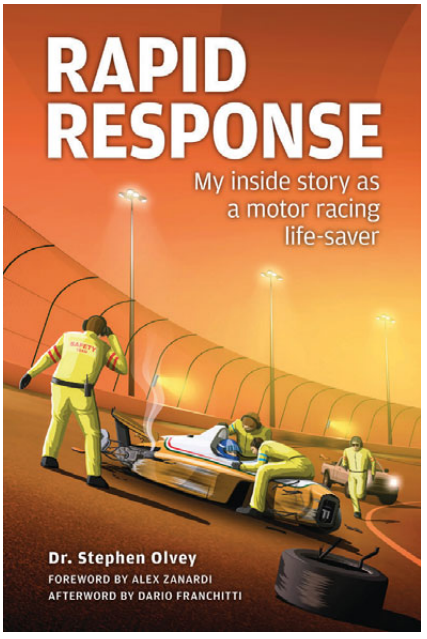
My inside story as a motor racing life-saver

In this extract from his book, *Rapid Response*, **Dr Stephen Olvey** looks back at an event that was to revolutionise safety in motorsport: the coming of HANS

IN the fall of 1999, Dr Trammell and I were preparing our presentations for the annual meeting of the International Council of Motorsports Sciences to be held in London. This was the first time the ICMS would meet jointly with the Medical Commission of the Fédération Internationale de l'Automobile (FIA).

The ICMS is an organization that arose following a meeting held in 1985 that included Dr Trammell and I, along with Dr Dan Marisi and Dr Jacques Dallaire, both from McGill University. The four of us met in the bar of the Hilton Hotel in downtown Indianapolis following the 500 Mile race. Jacques and Dan had been testing the fitness of Formula 1 drivers and other elite athletes for a couple of years in Canada. They studied the physical and mental attributes of a competitive racing driver and what sets the good ones apart from those who are not so good. Jacques and Dan were both exercise physiologists, with Dan having a second doctorate in sports psychology. Each of them had a keen interest in what constitutes a successful racing driver.

Because Terry and I had the same interests, the four of us became acquainted when our paths inevitably crossed at the Speedway. Jacques and Dan were helping Canadian driver Jacques Villeneuve with his training and fitness programme and as such were frequent visitors in the garage area. Informal discussions among the four of us were growing more numerous and we decided to have dinner at some point over race weekend. As we were enjoying cocktails before dinner, I voiced the opinion that we probably weren't the only scientists interested in racecar drivers. There were likely several professionals scattered throughout the world either observing, or actually studying, the effects of motorsport on the human body. The others agreed.



ABOVE *Rapid Response* is the compelling story of the author's often tragic, sometimes funny, and frequently frustrating journey through the volatile world of professional motorsport

We kept in touch over the remainder of the year and succeeded in forming a fledgling council after sending inquiries to the few people we knew that might be interested. By the spring of 1986, our collective efforts had garnered nearly 30 members. The inaugural meeting of the new organization was set for May in Indianapolis, exactly one year after our cocktails at the Hilton.

That first meeting was held in a small auditorium at Methodist Hospital. The programme consisted of mostly anecdotal stories of each other's experiences with some spectacular crash pictures thrown in. Although there were few, if any, real scientific studies presented, a great deal of positive energy was generated from the meeting. We adjourned with the charge of finding new members for the following year and encouraging current members to submit papers.

By 1999, 14 years later, membership had grown to more than 140. Representation included delegates from 11 different countries. Most of the members were physicians, but there was a sizable contingent of nurses, paramedics, athletic trainers, exercise physiologists, and biomechanical engineers. The meetings had advanced in stature and now included a number of valid scientific papers. The organization gained most of its early credibility from the data that Terry and I generated with our crash recorders.

ARE DRIVERS ATHLETES?

The information we presented had tweaked the interest of Dr John Melvin and Dr Jim Lighthall from General Motors, Dr Robert Hubbard from Michigan State University, Dr Pria Prasad from Ford Motor Company, Dr Ted Knox from Wright-Patterson Air Force Base, Dr Richard Jennings from NASA, Dr Hubert Gramling from DaimlerChrysler, Dr Andy Mellor from TRL (the UK's Transport Research Laboratory), and several other well-known crash and injury investigators. As the meetings ▶



IndyCar

ABOVE The Head and Neck Support device, seen here on five-time IndyCar champion Scott Dixon, has been developed to the point where it has become an everyday part of a driver's safety equipment

progressed, these scientists began to work collegially on improving safety and performance within the sport. As the organization's initial chairman, I tried to encourage this cooperation.

Several independent projects were soon undertaken at various locations throughout the world. With Dr Lighthall, an exercise physiologist, I attempted to settle the question of whether or not a racing driver is an athlete by designing a study to monitor heart rate during competition. Dr Trammell analysed crash recorder data together with Dr Melvin, the better to understand the mechanisms for spine and extremity injuries. Dr Hubbard developed his now famous HANS device with his brother-in-law Jim Downing during this same period. Dr Prasad worked on improving computer simulations of crashes and Dr Mellor and Dr Gramling developed improvements in the Formula 1 cars. That 14-year period was the true renaissance period for motorsports safety.

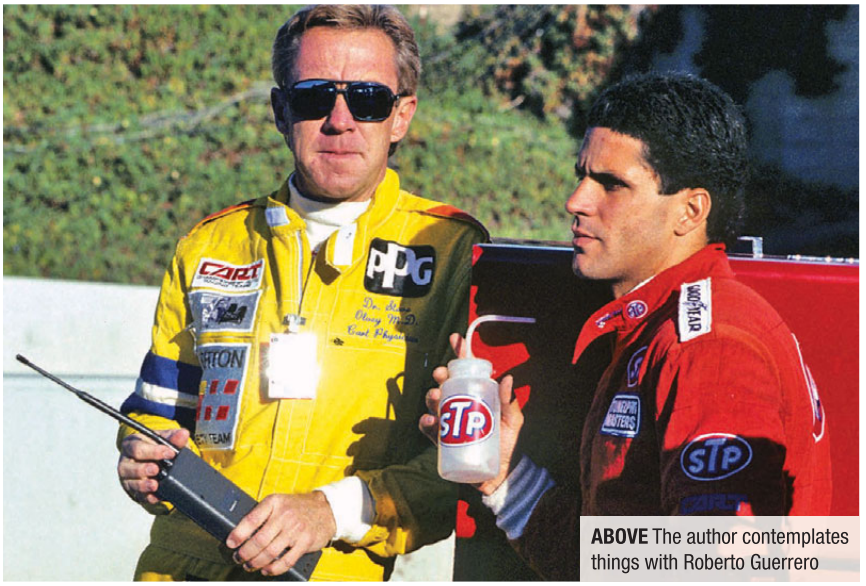


ABOVE The first HANS device, the wrap-around-style Model 1, featured the distinctive 'Darth Vader' look

SHARED INFORMATION

Toronto's Dr Hugh Scully became chairman of the ICMS in 1998. I continued on the Board of Directors while Jon Potter served as the organization's Executive Secretary. Scully was a long-time friend of Professor Sid Watkins, the Medical Delegate for Formula 1 and founder and head of the FIA's esteemed Medical Commission. Scully thought the time was right for a joint meeting of the FIA and the ICMS. Potter, Scully, and I began to plan such a meeting. Scully presented the plan to Professor Watkins who accepted it without reservation. The first joint meeting of the two organizations was scheduled for mid-winter in London.

> "The true renaissance period for motorsports safety"



ABOVE The author contemplates things with Roberto Guerrero

By meeting jointly, we were able to share information with a new group of scientists and professionals from Europe. Even NASCAR was represented with the appearance of Dave Holcomb, their risk manager. Never interested before, NASCAR got wind of the meeting and felt they should be represented. Instead of sending a physician or nurse, they sent their risk manager. NASCAR had never had a Medical Director and had always left ▶

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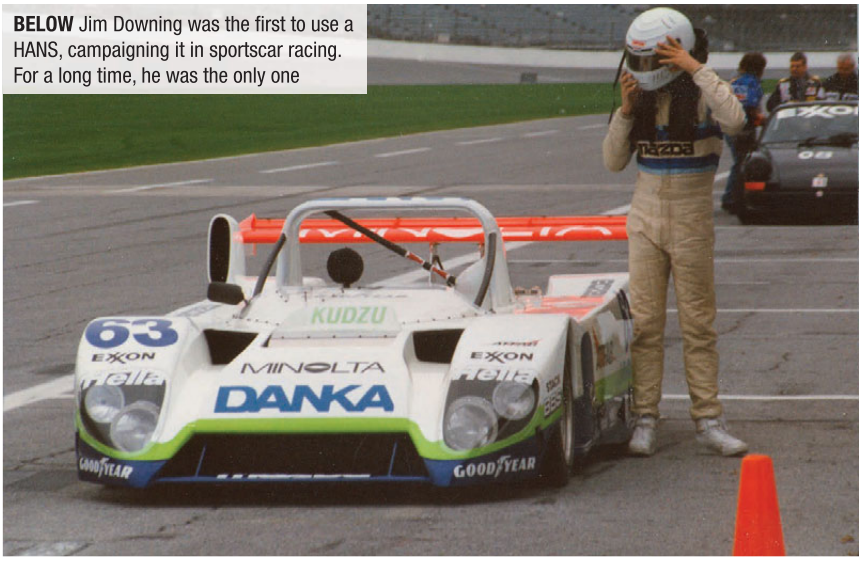
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safety in the hands of the participants and the racetracks. Holcomb would eventually become a board member of ICMS and NASCAR's representation and interest within the organization would increase in the future.

The ICMS is now well established with valid research ongoing. Improvements in the provision of on-track care, drivers' personal equipment, in-car protection, safety at the race tracks themselves, and spectator safety have all benefited from the efforts of the members and their various research projects. Examples of these cooperative efforts include but are not limited to: the development of improved head and neck protection in the cockpit with a newly designed head-surround system; improvement of seatbelts and their anchor points; improvement in car integrity and design; better methods for the extrication and initial treatment of drivers; improved in-car seating; and the development and implementation of the HANS device worldwide.

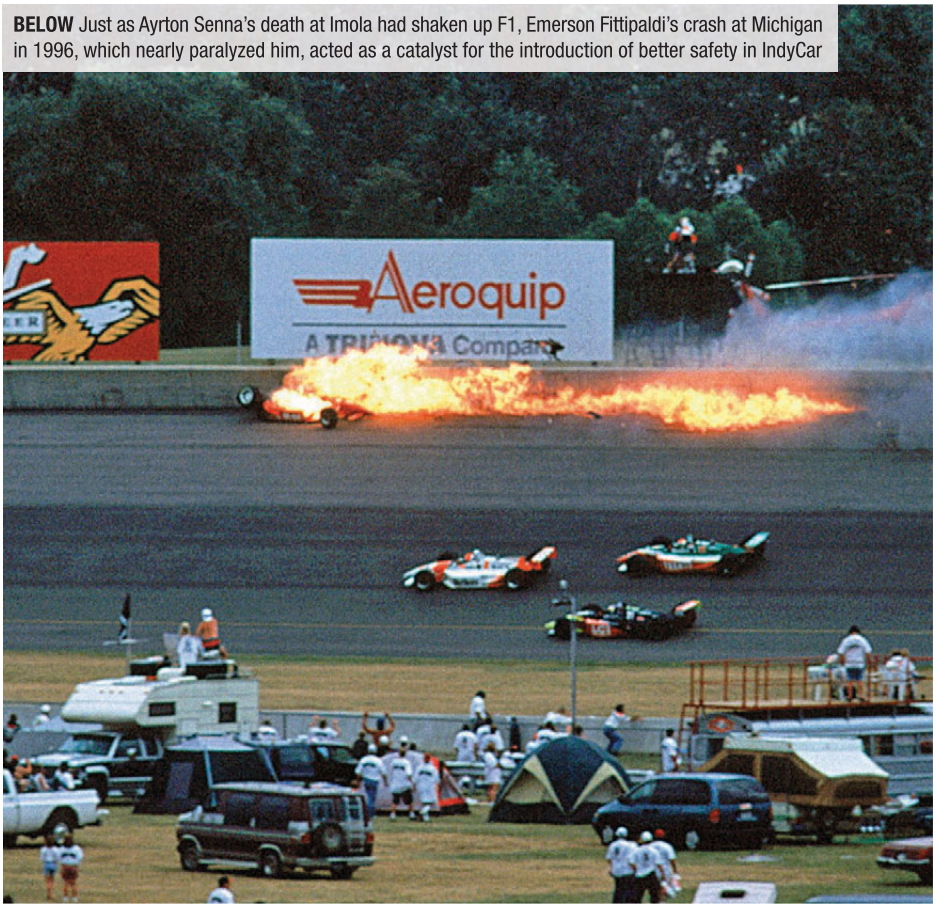
Dr Robert Hubbard presented his HANS device at that winter meeting in London. He had presented it for the first time years earlier, but it was impractical for open-wheel cars due to its size and configuration. HANS simply stands for Head And Neck Support. It's a collar-shaped device with a yoke arrangement that fits over the driver's shoulders. The collar extends upward behind the neck and contains a tether on each side that attaches to the helmet. The HANS is anchored in the car by the driver's shoulder belts. It is made from lightweight composite materials. With the HANS in place the head, neck and thorax all move in the same direction during a crash.

BELOW Jim Downing was the first to use a HANS, campaigning it in sportscar racing. For a long time, he was the only one



> **"Out of curiosity, a HANS device was compared to the airbags. To everyone's surprise the HANS outperformed the airbags in every type of simulated crash"**

BELOW Just as Ayrton Senna's death at Imola had shaken up F1, Emerson Fittipaldi's crash at Michigan in 1996, which nearly paralyzed him, acted as a catalyst for the introduction of better safety in IndyCar



DECEPTIVELY SIMPLE

The device appears deceptively simple. Refinement took more than 13 years. Mario Andretti tried it during a tyre test sometime in the mid-'80s and found it to be unbearable. Hubbard doggedly stuck with his design. He eventually presented the device to Dr Melvin at Wayne State University in the late '80s. Melvin studied it in his laboratory and showed that, on dummies at least, neck loads in a crash were decreased anywhere from 40 to 60%. Jim Downing, Hubbard's brother-in-law who actually thought of the device, used the HANS faithfully when he raced his sportscar. For a long time he was the only one.

The HANS device smouldered along for a number of years with only a few drivers following Downing's lead and using it in sportscar competition. Definitive testing of it had not yet been accomplished. That would soon change, however. In 1994 a massive tragedy befell Formula 1. Two drivers were killed ▶

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ABOVE Members of CART's safety team salute the drivers

on the same weekend at the San Marino Grand Prix. On the Saturday, Austrian rookie Roland Ratzenberger died in a heavy impact. The following day the sport's reigning superstar, Ayrton Senna, was also killed. After his death, which was captured on TV, the FIA launched an intensive investigation into the cause. Senna's head injuries were substantial. A piece of suspension had reportedly penetrated his visor and lodged in his brain. He had also smashed one side of his head against the concrete retaining wall where the crash occurred in the Tamburello corner. The investigation determined a need to improve the in-car protection of the driver's head and neck; the same goal we were pursuing in CART at the time due to fellow Brazilian Emerson Fittipaldi's crash in Michigan.

Tests were soon launched at DaimlerChrysler under the direction of Dr Hubert Gramling to see if airbags had any use in racecars. During these tests, a colleague of Dr Gramling, mostly out of curiosity, offered a HANS device to compare it to the airbags. To everyone's surprise the HANS outperformed the airbags in every type of simulated crash. Armed with this information, Gramling began a concerted effort to develop the HANS further in order to make it more user-friendly. He and Hubbard worked closely together to refine it for potential open-wheel use.



ABOVE Hubbard/Downing Inc was formed after existing safety companies declined to produce the HANS device

The end result was a new, composite HANS, lighter in weight, much smaller, and less obtrusive. What happened next would revolutionize safety in motorsports, but I'm getting ahead of the story. Suffice it to say that the newly-designed HANS performed well in laboratory crashes using high-speed sleds and dummies. Gramling and Hubbard presented their findings at the London meeting. Terry and I were very impressed by these results and started to push the HANS within CART.

We asked our colleagues at Ford to apply Gramling's data to a simulation of the Rodriguez crash at Laguna Seca. The Ford engineers determined that, had Rodriguez been wearing a HANS, he would have likely survived the crash. With this new bit of information in hand, I invited Dr Hubbard to present the device to our drivers at the start of the 2000 season. Dr Trammell, a graduate engineer as well as a physician, was convinced the HANS would be the future for neck protection in a racecar.

Hubbard's presentation to the drivers was generally well received although there were a few sceptics. Following the



ABOVE The second-generation HANS, resulting from the link with Mercedes-Benz, was significantly less bulky than its predecessor. It entered service in F1, IndyCar and NASCAR

meeting, I met with one of the biggest, Christian Fittipaldi. Emerson's high-strung nephew was one of the pickiest drivers in the whole lot. He needed to have everything in his car, and on himself, just so. Most Brazilian drivers are picky about their creature comforts, but Christian topped the list. He was also a good friend of mine, so I was able to convince him to be the guinea pig for the HANS.

When we started the project, he was driving for the Newman-Haas team. Fittipaldi generously devoted his entire winter test season to HANS development. Hubbard worked closely with the team and by the time the season rolled around Fittipaldi was ready to wear the device in competition. If he was comfortable with the device, I knew we could eventually make all of the drivers comfortable. I pushed CART to make the HANS mandatory for oval tracks in 2001. I strongly encouraged its use on road courses as well. Dr Trammell was in total agreement. We were the first motorsports organisation to mandate the HANS. Several lives have been saved and many injuries have been prevented since its implementation. The racing world owes a large debt of gratitude to Bob Hubbard and Jim Downing for their marvellous invention. HRT



BELOW The AMR IndyCar Safety Team now consists of around 30 safety personnel with a minimum of 18 attending each event – a trauma physician, an orthopaedic physician, two paramedics, 12 firefighters/EMTs and two registered nurses

IndyCar

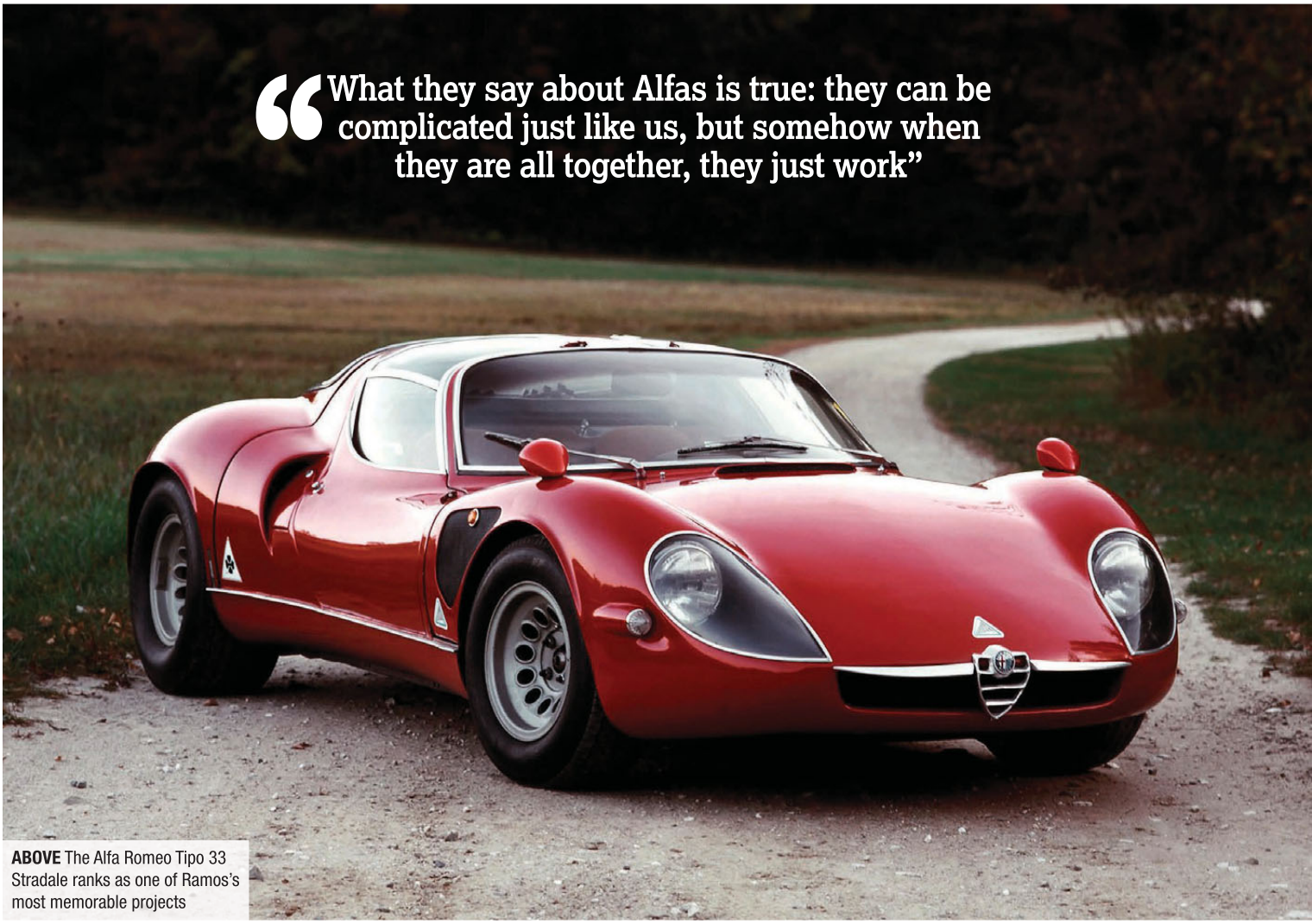
"When perfection is the only option"

Purdue School of Engineering student Christian Ramos tells **William Kimberley** why bringing historic racing cars back to life can be even more rewarding than working on state-of-the-art modern racecars

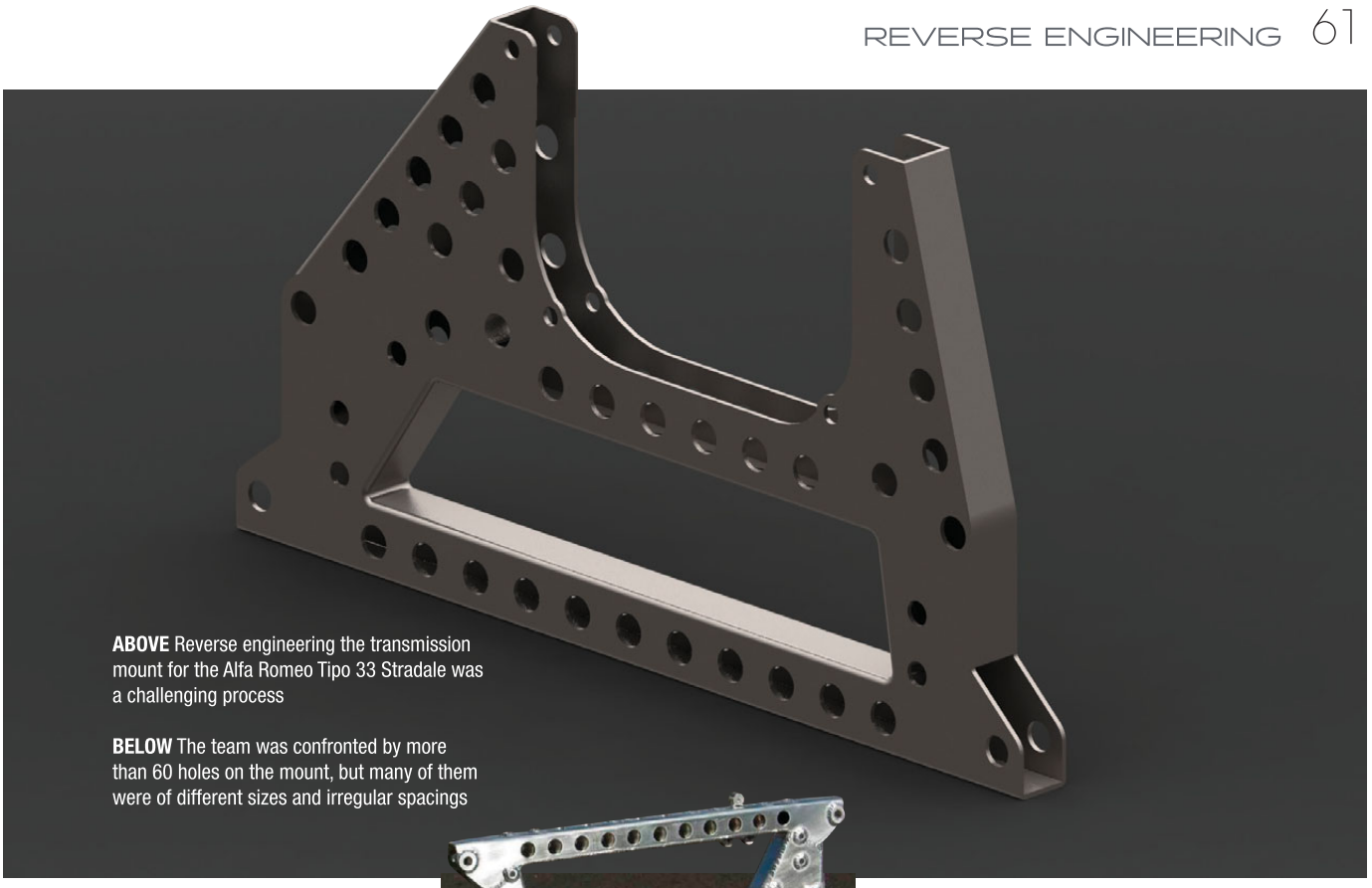
WHILE the growth in historic racing has risen exponentially over the last few years, one of the biggest threats the sector faces is the lack of young engineers prepared to forsake trying to join a Formula 1, NASCAR, IndyCar or other professional race team in order to work on something 'old'. However, the skillsets required to work on historic racecars sometimes exceed those demanded in modern racing. The question is how to get into it.

As a senior year Mechanical Engineering student at the Purdue School of Engineering in Indianapolis, there were quite a number of opportunities open to Christian Ramos. He opted for a relatively small company that in its short lifetime had already established a reputation in excellence.

"Redstone Performance Engineering is a great example of a small company that does great things," says Ramos. "It is a team of only four people, small in quantity but immense in passion, also huge in talent. Combined, we have

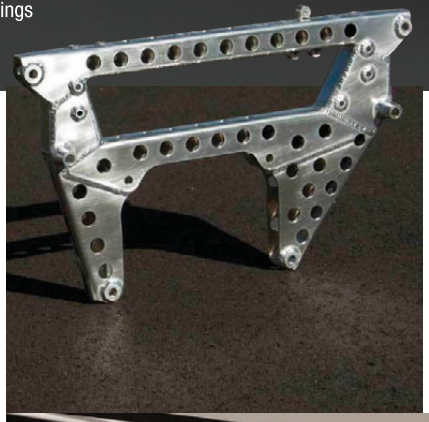


ABOVE The Alfa Romeo Tipo 33 Stradale ranks as one of Ramos's most memorable projects



ABOVE Reverse engineering the transmission mount for the Alfa Romeo Tipo 33 Stradale was a challenging process

BELOW The team was confronted by more than 60 holes on the mount, but many of them were of different sizes and irregular spacings



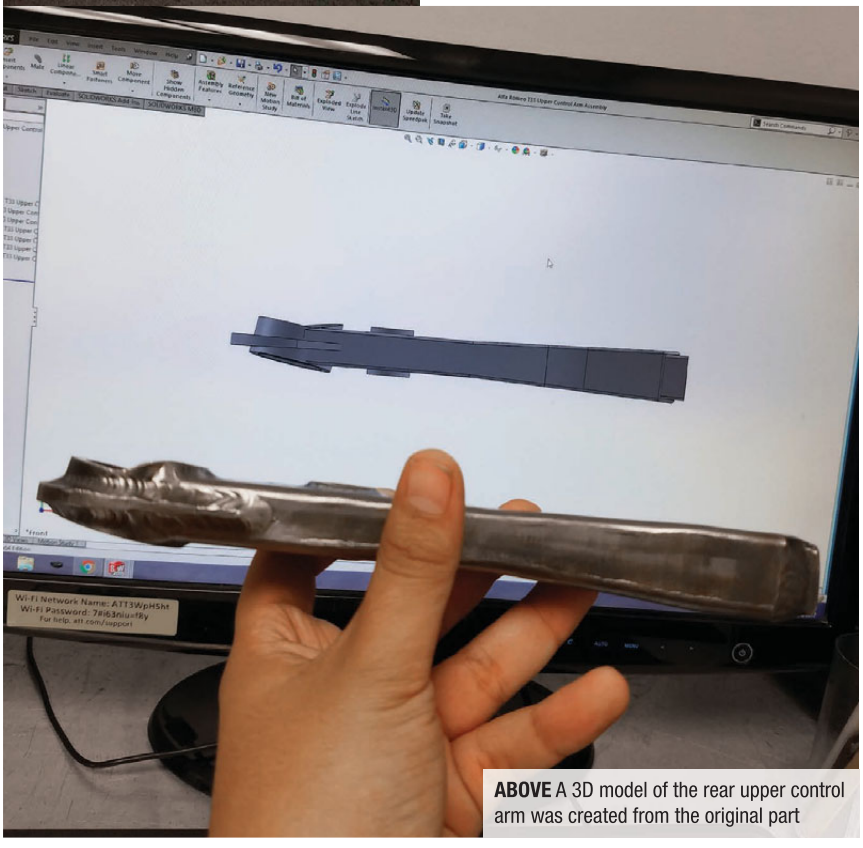
experience that goes from Sprint Cars to Formula 1 and pretty much everything in between. We have built cars 100% from scratch with the engine, gearbox and hardware being the only exception. Every panel, every tube, aerodynamic piece and external engine component is designed, or reverse engineered, and fabricated in-house. We have a small but amazing team."

Most of what Ramos does is reverse engineer, re-design and design components for every car that comes through the door, from a '69 Challenger to an Arrows-Footwork Porsche F1 car. "I have worked with many special cars over the last two years, some more significant than others, but one of my most memorable projects was the stunning Alfa Romeo Tipo 33 Stradale, a car that is as Italian as it gets," he explains.

"I was asked to reverse engineer the transmission mount and the rear suspension. These parts were made from titanium, something that impressed me very much. Doing the lower control arms for example, wasn't too bad, they were made of eight different pieces welded together. Other than properly measuring everything such as the angle of the tilted mono-ball carrier, it went quite smoothly.

"The problem came when I had to reverse engineer the transmission mount. This piece was made of more than 12 different pieces welded together, some on top of each other, and there were more than 60 holes on it; none of them were equally spaced and most were different sizes.

"Reverse engineering this was quite frustrating since I couldn't get dimensions of all the pieces. I needed ▶



ABOVE A 3D model of the rear upper control arm was created from the original part

to draw them individually because it needed to be an *exact* reproduction of the original following the customer's request. Obviously, I could not take it apart so I just had to take huge amounts of time measuring and making sure my drawing would come out just like the original when put together.

"This situation made me not like the T33 for a moment, but then I realized that what they say about Alfas is true: they can be complicated just like us, but somehow when they are all together, they just work."

After spending about three days with the part, Ramos was able to re-create each individual piece and when put together in his model, it all matched. "The parts were fabricated by Garnet [Beeput, the company founder] and the final result was fantastic," he says. "They were like mirror images of the original parts. I was satisfied and more importantly our customer was happy."

"THAT IS NUTS!"

Another memorable car that Ramos worked on was a Porsche 935/84. "When I see one, I think, 'That is nuts', and if you get to know the car as I have done, that feeling stays," he laughs. Redstone offers RSRs, 934s and 962s, but even so the 935 remains Christian's favourite.

"A little over a year ago, Garnet showed me some drawings," he recalls. "There were no dimensions and they were 1:1; they were also original – in other words, old and huge. Knowing the historic significance of what I had in front of me, I asked what we were going to do with it. He replied that I had to do a 3D model of it, so we could pre-bend the tubes to make the fabrication process easier, faster and more accurate. At this point I have had more than 100 parts under my belt, both reverse engineered and originals, and I had even designed a spaceframe chassis during my Formula SAE days. However, this was different. With such a big 'part', mistakes can be easily done. An inch here or there can offset the entire thing and when you are going to invest on production, perfection is the only option.

"So, I laid the drawings on a table and started to look at them. I had top, side and frontal views, but there was something missing – the entire cockpit section. This wasn't very good. The only 'original' 911 part of the entire car was the roof, and failing to do that section correctly would be a disaster. Luckily, we had another 935 chassis in the shop, although it wasn't finished, the doors didn't open, and I could not access the roof section. After realizing all of this, I ▶

> **"When you are going to invest on production, perfection is the only option"**

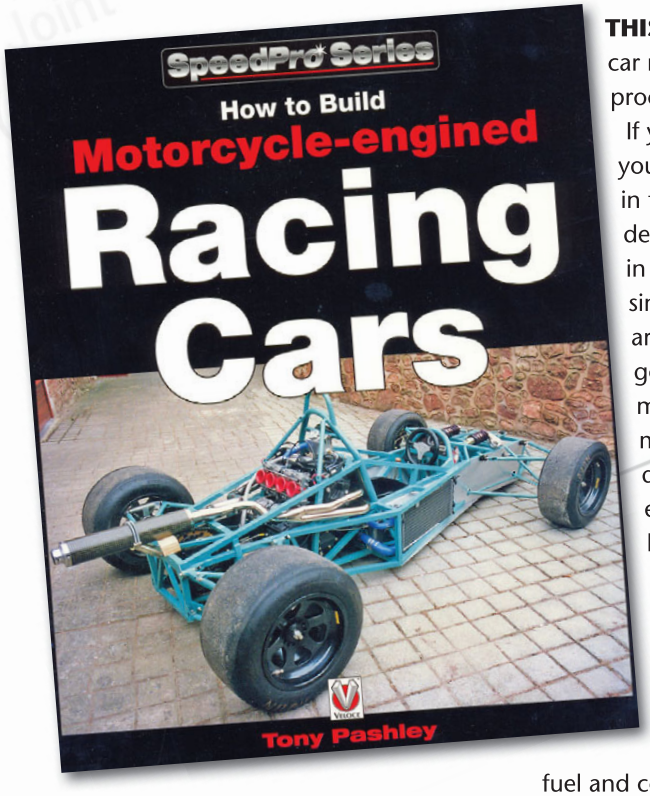


ABOVE The Porsche 935 chassis comes together – due reward for all the hard labour behind the scenes

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Essential BOOK for the motorsport engineer's library:

How to Build Motorcycle-engined Racing Cars: £30



THIS book takes the reader from the conception of a budget racing car right through to its appearance on the racetrack, with the whole process described in easy to understand steps. By Tony Pashley

If you are aspiring to build a racing car this could be the book that you've been waiting for! Tony Pashley revisits the path that he took in the Pashley Project articles in Race Tech magazine during the design and construction of two successful hillclimb cars. This time in great detail with a view to enabling the reader to carryout a similar exercise for themselves. Although hillclimb and sprint cars are the focal topic, a lot of the book is applicable to race cars in general. The cars under discussion in the book are powered by motor cycle engines which, in the smaller racing car classes are meeting with great success. The total process of building a car is described beginning with the selection and procurement of the engine. Chassis and suspension design is covered in a simplistic but adequate manner as the author's aim is to minimise the inclusion of involved calculations. Two recipes for chassis construction are illustrated in detail along with guidance on the processes of construction and a description of the required equipment. Following on from this the fabrication of the suspension is explained. Further chapters are dedicated to the remaining aspects of the vehicle covering; transmission, brakes, fuel and coolant systems and electrics. The book is heavily illustrated with 200 photographs and extensive explanatory diagrams and tables. This book is a vital addition to any would be kit car builders library.

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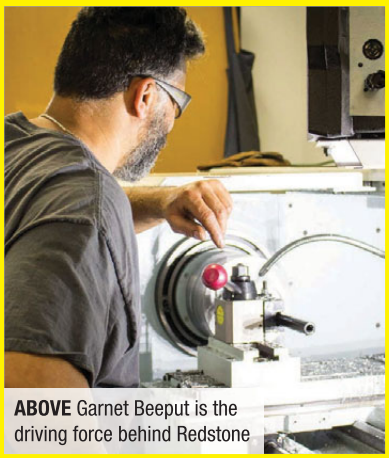
From banger racing to F1

FOUNDED by Garnet Beeput in 2014, most of the work at Redstone Performance Engineering, a premier Porsche specialist restoration, coachwork and fabrication shop located in Indianapolis, is in taking projects from design to finished products for the world of motorsport and the street. Redstone is formed by lead mechanic Matt Starkey, master coachbuilder/fabricator John Hajduk, design engineer Christian Ramos and head fabricator/owner Garnet Beeput.

Founder Beeput has a long history in racecar engineering. The twisted metal and chaos of banger racing, which he watched on the weekends with his grandfather and uncle in England, first drew him into the circle of racing. By the age of 18 he was working for a British touring car team that won the championship running a Cosworth RS500.

Since then his career highlights have been many and varied. They include spells in Formula 1 with McLaren, the Atlantic Championship series, the SCCA Trans-Am Championship, the World Sports Car Championship, British F3000 and IndyCar.

Most of the work at Redstone is accomplished in-house with complete fabrication facilities, a service repair centre, an engine room, and a machine shop with plenty of room to spare. HRT



ABOVE Garnet Beeput is the driving force behind Redstone



ABOVE The rulers, compass and notebook were well used as the project progressed

just set to work."

After evaluating the drawings, Ramos selected a zero point and its distance to a theoretical 'ground', in this case the zero point being the centre line of what he would call the 'Banana Box', a sheet metal crossmember that is attached to the main hoop. The lower control arms attached at both ends of the 'Banana Box' are usually called 'Banana Arms', hence the name.

"I selected five lines parallel to the 'Banana Box' that would serve as planes in my model," he says. "Everything was going to be connected through these planes. The first part of making a 935

> "Small in quantity but immense in passion, also huge in talent"

was a model of the 'Banana Box'. I had done this previously since I had to make sheet metal drawings and a bend list to get them done for a customer, so that made for a good start. Then came the fun part: measuring everything.

"I had all the drawings on the table and after giving them one more look, decided to start with the floor, which meant looking at the top view drawing.

"I had several rulers, a compass and a notebook where I would draw and write down the dimensions I collected from the drawings, which was the start of a really long process."

The chassis presented some challenges. From the front hoop onwards, the floor raised at an angle, then about three inches from the 'Banana Box' it would turn and go up some more. This tube was turning at an angle while it was going up at another angle.

"As I mentioned before, I did not have a sideview drawing of the cockpit section, so in order to find out where everything was, I lined my two front and rear side view drawings, and used the wheelbase to find out the distance between the front hoop and the main hoop," he reports. "With a little help from the second chassis we had, I was able to find out the numbers I needed. I repeated this process using different references for the roof and front window section.

"I spent more than 40 hours measuring, calculating, reverse engineering, double and triple-checking every single tube on the chassis. Sometimes I would go back and re-check a few measurements. If I got a different number, I would re-measure and re-check every dimension that could have affected that specific value.

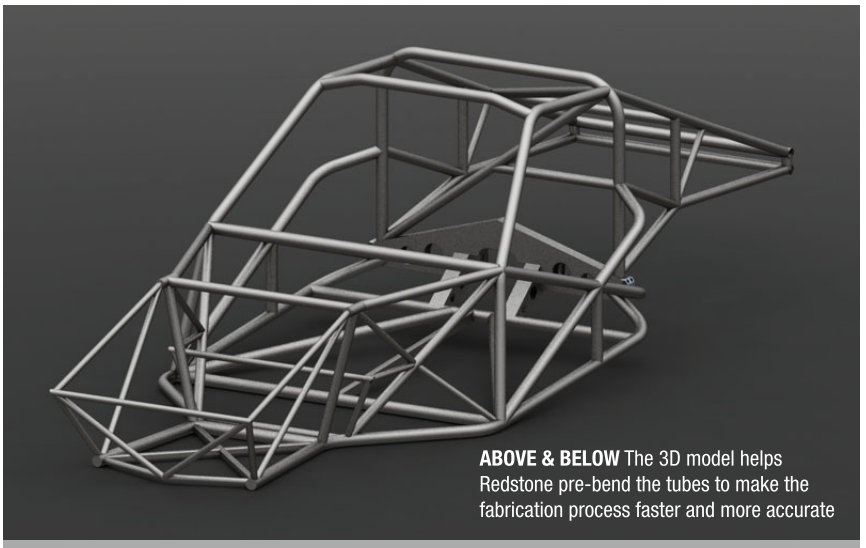
"When I was confident that my numbers were right, I started drawing the 3D model, another big task. It took me about 40 hours from drawing the first line to the point I felt I was done, this process taking so long mainly as I had to double-check every line I made. If point A was

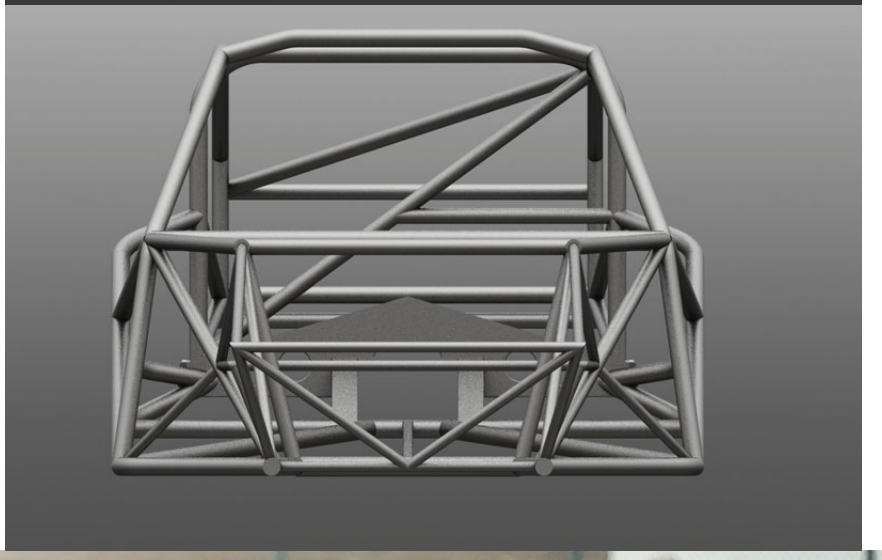
X distance from point B, then point F should be Y distance from point A. If the numbers did not match, it was back to the drawings. It went back and forth like that until everything matched perfectly, both on my notes and on the model, but what a great feeling it was when everything was just right."

Ramos says that the whole process took two weeks and about 90 hours. "It could have taken a little less time, but even when everything seemed right, I went back and checked again," he notes. "Something that I have learned from Garnet is to check even when everything seems right. This advice has always been helpful."

The time came and the tubes were bent. A few months later, when Garnet completed the chassis, it looked absolutely beautiful, says Ramos: "When the original panels were attached to it, they fitted perfectly. This was the ultimate confirmation that all my work was worth it.

"Reverse engineering the chassis was a long and arduous process but one that I thoroughly enjoyed. Right now, the chassis is on its way to Germany. I just hope the new owner enjoys it very much; I know I did!" HRT





ABOVE & BELOW The 3D model helps Redstone pre-bend the tubes to make the fabrication process faster and more accurate



ABOVE Of all the Porsches Redstone offers, the 935 remains Ramos's favourite

The Goodwood pilgrims' progress

Alan Stoddart reflects on figures which suggest the rate of development of historic racecars is now outpacing their modern counterparts

PROGRESS can be a difficult thing to assess.

Take Formula 1 for example. Accepted as the very pinnacle of motorsport, a series which sees hundreds of thousands of man-hours spent every year pursuing technological advantages. An exercise in which continual development of even the most minor components and endless optimisations are carried out so the vehicles at the centre of it all can complete laps around tracks in less time than before.

By this metric alone, however, things aren't looking too good, with the fastest laps for some tracks, including Monza, Melbourne and Circuit Gilles Villeneuve, having been set 15 years ago in 2004. For all the energy expended and the billions of dollars spent, F1 teams have, on the face of it, failed to make progress.

Of course, there are far too many caveats to draw conclusions from such comparisons, with tyre rules, efficiency rules and fundamental architecture changes, all playing their part. But it is interesting that even more simplistic measurements, such as power to weight ratios, don't come out in the modern car's favour: Michael Schumacher's Ferrari F2004 offered 1,570 bhp/tonne, while Lewis Hamilton's ridiculously-named Mercedes AMG F1 W09 EQ Power+, in which he won the 2018 championship, delivers around 1,360 bhp/tonne.

Perhaps there are better places to see progress in action. The hill climb at Goodwood's Festival of Speed is unique in allowing an enormous range of historic and contemporary cars to complete directly comparable runs on the same bit of asphalt. Road cars, race cars, four-wheel drive cars, two-wheel drive cars, aeroplane-engined cars, cars that are 100 years old and electric autonomous cars of the future are all able to be benchmarked against one another on as equal a footing as they are going to get.

The results make for interesting reading. In Shootout qualifying this year, the Bentley 'Barnato Hassan Special' took 72.68 seconds to navigate the course, eight seconds less than the 22-year older Fiat S76 from 1910, which made 80.28 seconds, but significantly slower than the 1927 Bugatti Type 35B which raced up in 61.98 seconds. The Can-Am March 717 from 1970 stormed up in 52.66 seconds, slightly edging out a current Chevrolet SS NASCAR, but still seven seconds slower than the Penske PC22 from 1993.

What can be made of the differences between these cars is debatable, but for the historics, it should be obvious that the gaps between them should remain the same; you wouldn't expect to see relative progression. That assumption fails to hold true when you look at the numbers. In last year's Glover Trophy at the Goodwood Revival, the fastest lap was a 1:22:590, set by a Ferrari 1512 from 1965. In 2004, when the Ferrari F2004 was breaking records, the fastest time was a Brabham-Climax BT4's 1:26.295 – an improvement of nearly four seconds.

It's a similar story in the Chichester Cup, where a 1:23.969 set in a Brabham-Ford BT2 eclipses the 1:32.198 set by the Caravelle Ford MkIII in 2004. The fastest lap in the Sussex Trophy in 2004 was the 1959 Tojeiro-Jaguar which circulated the course in 1:29.384, nearly five seconds off 2018's Lister-Jaguar 'Knobbly' which managed 1:24.430. Even the exact same car had made nearly two seconds up in the intervening 14 years. As far as preservation goes, that seems like a lot of progress.

What's more, looking solely at a racecar's ability to drive in a circle quickly, the development of historic racers is now ironically outpacing that of motorsport's cutting edge. A fact that should be of concern to those in both camps. HRT

Photos: Newspress





ABOVE & BELOW Italy's finest has come on a bit over the last hundred years (Schumacher's record-breaking F2004 is seen above, the Beast of Turin below). But faced with the same ribbon of Tarmac at Goodwood, the stopwatch doesn't always stop where you would imagine

VBOX MOTORSPORT

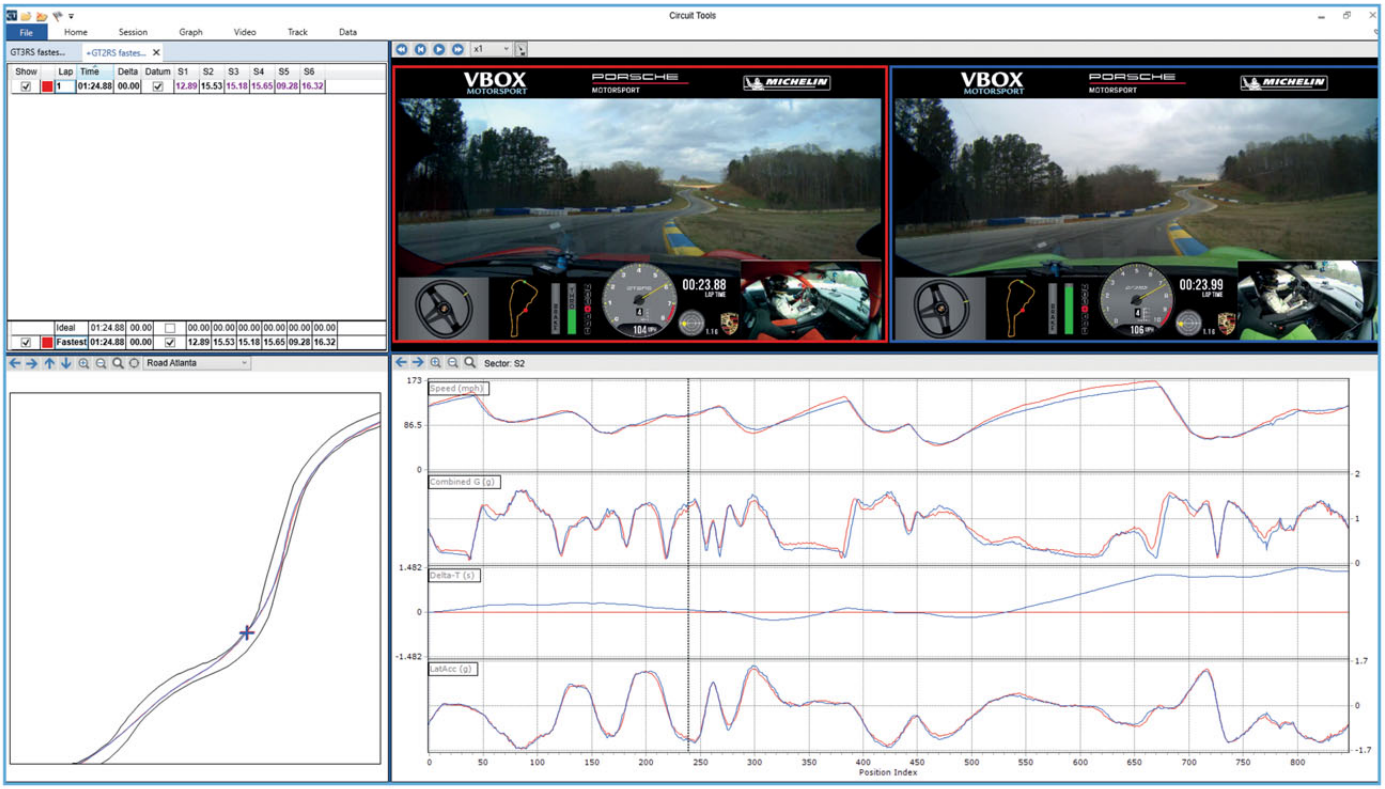
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